We're at as Much Risk as We Are Led to Believe: Effects of Message Cues on Judgments of Health Risk

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One of the greatest challenges in advertising health-related information is overcoming the target audiences' self-positivity bias (i.e., the tendency for people to believe that they are invulnerable to disease). In this article, we show that the self-positivity bias hinders message processing, and we demonstrate that message cues can reduce this bias and engage people in more precautionary thinking and behavior. We identify the process by which risk-behavior cues provided in the message affect people's estimates of their vulnerability (self-risk estimates), depth of message processing, attitudes, and behavioral intentions. We test and find support for our theory in three studies that specify the types of risk behaviors that make the contraction of a disease seem easy versus difficult (study 1), that examine their interactive effects with the number of risk behaviors that are enumerated (study 2), and that delineate the underlying process by which these effects manifest (study 3). We demonstrate that the self-positivity bias acts as an a priori hypothesis on the basis of which people process and test incoming risk-behavior information, as would be predicted by confirmatory hypothesis testing theory. Our findings affect the theoretical understanding of how memory- and message-based factors work in opposing ways and suggest a more comprehensive framework for understanding memory- versus message-based judgments. Our results also have implications for media strategy and public health policy by differentiating between commonly used risk-behavior messages that are beneficial to the communicator's goals (e.g., increase compliance) and those that are detrimental to the communicator's goals (e.g., decrease compliance).

If I use an antiperspirant on a regular basis will I get breast cancer? If I get a manicure at Senorita's do I run the risk of getting hepatitis C? How much can I smoke before my asthma gets worse? People are faced with a wide variety of uncertain situations, the resolution of which depends on their assessment of the likelihood or risk of the event occurring. Numerous articles suggest that consumers use information retrieved from memory (memory-based) and information presented in the context (e.g., message-based) to help make such judgments (e.g., Alba and Chattopadhyay 1985; Biehal and Chakravarti 1982; Burke and Srull 1988; Meyers-Levy and Tybout 1997). Extensive research also demonstrates that risk assessments may be biased by two simplifying heuristics: the availability heuristic and the representativeness heuristic (Tversky and Kahneman 1974); both may lead to under- or overweighted risk estimates. In particular, memory-based risk judgments are influenced by the availability in memory of instances of the event. Raghubir and Menon (1998), for example, studied the effects of accessibility of memory-based information on judgments of one's risk of contracting a disease and of subsequent health-compliance behavioral intentions. They had participants search their memory and retrieve behaviors that could

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cause AIDS, and they showed that the ease with which such information could be retrieved affects one's judgment of the risk of getting AIDS. Their study demonstrates the role of the availability heuristic—when information about ways of contracting AIDS is highly accessible in memory, self-risk estimates increase, as do intentions to behave cautiously in the future.

This study extends the literature on risk estimates by examining the effects of message-based information on judgments of one's risk of contracting a disease. Previous research suggests that message-based judgments are influenced by the representativeness heuristic, rather than the availability bias (Tversky and Kahneman 1974). In this case, people try to assess the similarity of the information in the message to some internalized representation or prototype. Thus, the more similar or representative that the information is to their mental model, the higher the judged likelihood of the event's occurrence. Explicitly studying the role of the representativeness heuristic on judgments of health risk is important, because the effects of message-based information are not always the same as those for memory-based information. In fact, as we demonstrate here, memory- and message-based information work in opposing ways on judgments of health risk. The importance of examining the effects of the representativeness heuristic is underscored by the prevalence of real health messages that list risky behaviors to promote health-related issues for public service and commercial profit. For example, the following information, which appeared as part of a full-page color advertisement in the *New York Times* (October 20, 1998), is typical of many health messages (see also *New York Times* [April 22, 1998] for risk of a first heart attack, and *New York Times* [February 10, 1998] for risk of sugar sensitivity):

> Hepatitis C is a potentially deadly, contagious disease caused by a blood-borne virus that invades your liver and may lead to cirrhosis (scarring of the liver), liver cancer, and liver failure. In fact, four times more people have hepatitis C than AIDS. And to get it, all you have to do is come in contact with an infected person's blood . . . just once.
>
> You are at-risk if you:
>
> - Had a blood transfusion before 1992
> - Had your ears or any other part of your body pierced
> - Shared a razor, toothbrush, or any item that could carry blood
> - Snorted cocaine (from a straw or bill) or tried IV drugs
> - Have a tattoo
> - Had a hands-on health-care job or been exposed to blood in the military.
>
> Call for more information or a doctor referral—1-800-HEP-8273.

Our article explores the representativeness heuristic on judgments of health risk using message-based risk behaviors similar to the ones described in the *New York Times* advertisement. We first examine how people assume that risk behaviors presented in a message are representative of the population of risk behaviors, and how this translates into a biased risk estimate as the comparison between oneself and the average person (mental prototype or stereotype) is made. The self-positivity bias, a finding that the self is more invulnerable than others, poses a threat to health-care marketers in particular, as people tune out health messages if they think they are special and impervious to the threats of disease. We demonstrate that the type of message cues (study 1) and the number of message cues (study 2) interact to affect the self-positivity bias and, consequently, people's attitudes, intentions, and behavior. We follow up with a study that delineates the process by which these effects manifest (study 3). We show that people hold an a priori hypothesis that they are invulnerable to diseases; with this as a base, they then process and test incoming risk-behavior information in a manner consistent with confirmatory hypothesis testing theory. We elaborate on the theoretical understanding of the representative heuristic in risk judgments and on how memory and message factors work in opposing ways. We identify the process by which different message cues affect judgments of risk, reports of intentions to behave in a health-compliant way in the future, and the depth of information processing.

From a practical standpoint, we provide tangible methods that can be used by health-care marketers to grab the attention of the audience. Because we demonstrate that the effectiveness of the message depends on the interactive effect of the number of risk behaviors and the specific risk behaviors chosen, we underscore the importance of the actual risk behaviors used in the advertisement. The use of the "wrong" risk behaviors may do more damage than good.

We chose hepatitis C as the context in this article for several reasons. First, it is a widely prevalent disease—nearly 4,000,000 Americans are believed to have hepatitis C and about 10,000 people die from it every year (*New York Times* [November 19, 1998]). Second, hepatitis C is transmitted through blood and semen and can be contracted through activities commonly found in a college environment—including sexual contact, body piercing, sharing razors and toothbrushes, and getting tattoos—which makes it an important domain to examine. Third, because the focus of this article was to examine the effects of message-based factors on self-risk estimates, we wanted to minimize the effects of memory-based factors. In this regard, it helps that hepatitis C is a disease that people do not know much about. We now present three studies that examine these issues.

STUDY 1—QUALITY MATTERS: EFFECTS OF WHAT RISK BEHAVIOR IS SPECIFIED

Literature has extensively demonstrated that people perceive themselves in a positive light. Some researchers have documented this by examining the judgments that people make about themselves vis-à-vis other people (Alicke et al. 1995). For example, people perceive themselves to be better than average on trait ratings (Dunning, Meyerowitz, and

Hotzberg 1989), as well as on behavior ratings (Allison, Messick, and Goethals 1989). This perception has been attributed to one's tendency to selectively recruit information that favors oneself (Perloff and Fetzer 1986). Similarly, Weinstein (1980) found that people estimated the likelihood of something pleasant happening (e.g., having a gifted child) as greater for themselves than for their peers, while they estimated the likelihood of something negative happening (e.g., having trouble finding a job) as lower for themselves than for their peers. Similar effects have been demonstrated for predictions of other negative events such as becoming ill (Perloff and Fetzer 1986), having an accident (Robertson 1977), and contracting AIDS (Raghubir and Menon 1998). Moreover, this "self-positivity bias" occurs irrespective of age, occupational status, gender, or level of education (Weinstein 1980).

In this study, one of the focal questions that we examined was whether the self-positivity bias could be decreased by the information provided in a message. One potential way to decrease the self-positivity bias is to provide information about the ways in which a disease could be contracted. If the message were to provide an example of a risk behavior that could lead to the contraction of hepatitis C, people may use this information as a representative behavior of the population of hepatitis C risk behaviors. This would be suggested by the representativeness heuristic (Tversky and Kahneman 1982). Therefore, if the message uses risk behaviors that make hepatitis C seem more likely (vs. less likely) to be contracted, inferences about one's risk estimates should vary. We should note that when making judgments of health risk for the average person, people are more likely to use their stereotypical expectations of the extent to which such an individual would engage in the behavior (Mischel 1973). The type of cues contained in a message is unlikely to affect perceptions of risk for the average person. However, when making a judgment of health risk for themselves, people are more likely to use the individuating information contained in the context. Thus, assessments of risk are likely to be sensitive to the type of cues in the message. Further, theories of health behavior suggest that the greater an individual's perceived risk, the greater their intention to alter behavior (Block and Williams, forthcoming; Luce and Kahn 1999).

In our study, we expect that using risk behaviors that make hepatitis C seem more easily contractible should also increase precautionary thinking and behavioral intent. We expect message cues to affect behavioral attitudes and intentions through perceptions of self-risk. Thus:

H1: When a risk behavior that makes the contraction of hepatitis C seem easier (vs. difficult) to contract is specified in the message:

(*a*) self-positivity bias will be reduced, and
(*b*) concern about hepatitis C, intentions to learn more about hepatitis C, and intentions to get tested for hepatitis C will be greater.

H2: The effects of message cues on attitudes and intentions toward hepatitis C are mediated through perceptions of self-risk.

Method

Choice of Risk Behaviors. Hepatitis C can be contracted through a variety of risk behaviors, particularly behaviors in which a student population would engage. Our first task was to manipulate the perception that the contraction of hepatitis C is more or less likely by choosing behaviors that conveyed this information. One variable that accomplishes this goal is the frequency of engaging in the risk behavior. The more (vs. less) frequently people engage in a risk behavior, the more (vs. less) likely it should be that they contract hepatitis C. Based on results of a pretest that queried 137 participants from the student population (in which the main studies were conducted) about the frequency with which they performed various behaviors ("How many times have you ever . . . ?"), we chose the most frequently rated risk behavior, "not bandaging a cut" ($M = 25.5$), and the least frequently rated risk behavior, "getting a tattoo" ($M = 0.09$), from 21 activities, of which 16 were blood-transmitting ones (e.g., getting a manicure, sharing a razor), for study 1.

Procedure and Stimuli. One hundred ten undergraduate students participated in the study for partial course credit. On entering the experimentation room, all participants were told that they would be asked some health-related questions and that their responses would be kept completely confidential and anonymous. Participants were randomly handed one of three versions (frequent risk behavior/infrequent risk behavior/control) of an information sheet on hepatitis C. All three versions began with the following paragraph:

> Most Americans are familiar with hepatitis A and hepatitis B, two diseases that disrupt liver function. However, hepatitis C is a relatively newer virus that people do not know about, but is already present in 3.5 million Americans. It is expected to spread at a very rapid rate and is expected to lead to more deaths than hepatitis A and B combined. The eventual effects of chronic infection from hepatitis C make it a growing and costly problem for public health as well as the individual. Sometimes hepatitis C goes undetected for years since it produces no discernible symptoms. Hepatitis C is mainly transmitted through the blood.

The above information completes the control condition. The frequent (infrequent) risk-behavior condition continued as follows: "For example, do you know that hepatitis C is often contracted simply by leaving a cut unbandaged (getting a tattoo)?" After completing the questionnaire, participants were debriefed and provided with detailed information regarding risk behaviors and consequences of hepatitis C.

Measures. We elicited three types of measures:

a) For risk estimates, after participants finished reading the paragraph, they answered a series of hepatitis C risk questions pertaining to themselves, their best friend, and the average undergraduate (cf. Raghubir and Menon [1998], to assess a self-positivity bias). We used two separate scales, a 100-point probability scale and a seven-point likelihood scale, anchored at "not at all likely" and "very likely."

b) For attitude and intention measures, participants next rated how concerned they are about hepatitis C and how interested they are in learning more about the hepatitis C virus, using seven-point semantic-differential scales (anchored at "not at all" and "very"). They then indicated their intention to get tested for hepatitis C on a seven-point scale (anchored at "will definitely not" and "will definitely"). Because these three scales have a high reliability (Cronbach's $\alpha = .83$), we computed an average that we refer to as the "attitude and intention index."

c) For manipulation check information, participants, to check the similarity manipulation, rated how similar they thought they were to their best friend and to the average undergraduate at this school, using seven-point semantic-differential scales anchored at "not at all similar" and "very similar" (Menon, Raghubir, and Schwarz 1995; Raghubir and Menon 1998).

Results

Manipulation Check. We conducted a 3 (message cue: frequent risk behavior/infrequent risk behavior/control) × 2 (target person: best friend/average undergraduate) mixed-design MANOVA on person similarity ratings. The results confirm a main effect of target person such that participants perceive their best friend to be more similar to them ($M = 5.07$) than the average undergraduate at their school is ($M = 3.47$; $F(1, 107) = 89.10$, $p < .001$). As desired, no other effect was significant.

Manifestation of the Self-Positivity Bias. We first replicated the existence of a self-positivity bias in the context of hepatitis C. In order to do this, we needed to examine risk estimates in the absence of any intervention. We used only the control condition in testing it. We used the risk estimates for the three target people as the dependent measures and expected judgments of risk to be lower for oneself than others, and lower for a best friend than for an average undergraduate. Because both dependent measures, the 100-point probability scale and the seven-point likelihood scale, yield the same support for our hypothesis, we discuss the results of only the 100-point scale here. Means and standard deviations for the risk estimates in the control condition are presented in the right column of table 1.

A one-way three-level repeated-measures ANOVA (target person: self/best friend/average undergraduate) yielded a significant main effect on the 100-point probability scale ($F(2, 72) = 24.12$, $p < .001$). Risk estimates are lower for oneself than those for a more-similar person (M's = 22.46 vs. 32.89, contrast $t = 5.67$, $p < .001$), which in turn are lower than that for a less-similar person (M's = 32.89 vs. 41.81, contrast $t = 3.54$, $p < .001$). The data, therefore, indicate that perceived risk increases as perceived similarity decreases, replicating the findings of Raghubir and Menon (1998).

TABLE 1

STUDIES 1 AND 2: EFFECTS OF MESSAGE CUES ON RISK ESTIMATES

Study 1:[a] target person	Message cue: Frequent behavior ($n = 36$)	Infrequent behavior ($n = 37$)	Control ($n = 37$)
Probability (0–100):			
Self	35.72 (24.88)	22.95 (25.58)	22.46 (24.52)
Best friend	32.28 (22.22)	24.43 (22.92)	32.89 (26.22)
Average undergraduate	46.94 (23.09)	48.54 (25.84)	41.81 (24.01)
Likelihood (1–7):			
Self	2.97 (1.23)	2.11 (1.29)	2.57 (1.54)
Best friend	3.00 (1.29)	2.41 (1.50)	3.16 (1.71)
Average undergraduate	4.00 (1.20)	3.87 (1.51)	4.00 (1.62)

Study 2:[b] number of risk-behaviors	Message cue: Frequent behavior ($n = 64$)	Infrequent behavior ($n = 65$)	Control ($n = 31$)
Probability (0–100), prearticle:			
Two	32.79 (25.23)	24.55 (15.07)	25.13 (19.00)
Eight	45.13 (28.57)	16.88 (22.18)	
Likelihood (1–7), prearticle:			
Two	2.91 (1.51)	2.52 (1.00)	2.52 (1.09)
Eight	3.66 (1.66)	2.00 (1.48)	
Probability (0–100), postarticle:			
Two	26.12 (19.66)	26.15 (16.22)	18.90 (15.92)
Eight	37.77 (24.68)	11.94 (17.36)	

NOTE.—Standard deviations are in parentheses.
[a]Dependent measures: risk estimates.
[b]Dependent measures: self-risk estimates.

Hypothesis 1—Effects of Message Cues. Hypothesis 1a posits that the message cue affects risk estimates for oneself, thereby moderating the self-positivity bias. We conducted a 3 (message cue: frequent risk behavior/infrequent risk behavior/control) × 3 (target person: self/best friend/average undergraduate) mixed-design MANOVA, treating the message cue as the between-subject variable and the target person as the within-subject variable. Consistent with our theorizing, a significant interaction between the two factors supports hypothesis 1a, that the self-positivity bias is affected by the type of cues used in the message ($F(4, 214) = 5.10$, $p < .001$; see table 1). In other words, the difference between risk estimates for oneself and for another person is lower when a frequent rather than infrequent risk behavior is presented in the message. In addition, a significant main effect of target person indicates that risk estimates increase as perceived similarity decreases ($F(2, 214) = 58.32$, $p < .001$). No other effects were significant.

The contrasts between means indicate results as predicted. For example, contrasts on the difference between self-risk estimates and risk estimates for the average undergraduate when a frequent risk behavior is used versus when an infrequent risk behavior is presented are significant (mean differences: 11.22 vs. 25.60, contrast $t = 2.84$, $p < .01$). We should note that the comparable difference in the control condition (19.35) falls between the differences in the frequent and infrequent message-cue conditions. While the contrasts between the differences in the frequent behavior and the control conditions are significant ($t = 1.61$, $p < .10$), those between the control and the infrequent behavior conditions are not ($p > .10$). The data support hypothesis 1a.

Hypothesis 1b predicted that the message cue should affect people's attitudes and intentions. As expected, the attitude and intention index is greatest for the frequent risk behavior ($M = 4.74$), followed by the control condition ($M = 4.23$) and the infrequent risk behavior ($M = 3.74$; $F(2, 107) = 3.67$, $p < .05$). The contrasts between each of the three pairs of means were significant (frequent vs. infrequent behavior: contrast $t = 2.71$, $p < .01$; frequent behavior vs. control: contrast $t = 1.37$, $p < .10$; and infrequent behavior vs. control: contrast $t = 1.35$, $p < .10$). Therefore, as predicted, participants' concern about hepatitis C, their need to learn more about it, and their intentions to get tested are affected by the behaviors acting as cues in the advertisement.

Hypothesis 2—Mediation of the Effects on Attitudes and Intentions through Self-Risk Perceptions. To test hypothesis 2, we ran a path analysis using SPSS Amos 4, a structural equation modeling software.[1] We ran two models to test our hypothesis of mediation, "direct effect" and "mediational," using the guidelines developed by Judd and Kenny (1981) and Brown (1997; see also Baron and Kenny 1986). In the first model, we tested the direct effect of type of message cue (frequent vs. infrequent behaviors) on attitudes and intentions. The direct effect model showed a significant effect of message cues on attitudes and intentions (already documented in testing hypothesis 1b). There was a significant positive effect of message cues such that the frequent behavior produced higher scores on the attitude and intention index ($\beta = .323$, $p < .01$). The mediational model was run with self-risk estimates included as the mediating variable.

Following the recommendations of Baron and Kenny (1986), Judd and Kenny (1981), and Brown (1997), three conditions would need to be satisfied for mediation. First, the paths from the message cue to the self-risk estimate and from the self-risk estimate to the attitude and intention index must be significant. Second, the direct effect from the message cue to the attitude and intention index in the presence of the mediator must be significantly reduced in comparison to the direct effect model. Third, the indirect effect of the message cue on the attitudes and intentions must be significant in the presence of the mediator. This is indeed what was found. The message cue had a significant positive effect on self-risk probability estimates ($\beta = .26$, $p < .05$), which in turn had a significant positive impact on attitudes and intentions ($\beta = .27$, $p < .05$). Additionally, the direct effect of message cues on attitudes and intentions was only marginally significant in the presence of the mediator ($\beta = .25$, $p = .07$), indicating partial mediation (Baron and Kenny 1986). Finally, the indirect effect of message cues on attitudes and intentions is significant ($\beta = .10$, $p < .05$).

When we use risk likelihood as the dependent measure in our analyses, we obtain perfect mediation such that the direct effect of message cues is not significant in the presence of the mediator. Therefore, we find support for hypothesis 2.

Discussion

Our results provide a theoretical contribution by demonstrating that the self-positivity bias can be affected by the cues used in a message. Using a cue that makes the contraction of a disease seem more likely increases people's perceptions of their own risk, thereby reducing the self-positivity bias. Previous studies have documented that the self-positivity bias exists (Perloff and Fetzer 1986), is influenced by memory accessibility, and applies to people considered to be similar to oneself (Raghubir and Menon 1998). Our study extends this literature to show that these optimistic biases can vary depending on the information provided by the message. We manipulated the message by specifying risk behaviors that make the risk of contracting hepatitis C seem either higher or lower. We showed that the self-positivity bias is lower when participants are presented with behaviors in which they more frequently engage. We also demonstrated that the message cue affects attitudes toward hepatitis C and their intentions to get tested in the near future, and that these effects are mediated through self-risk perceptions.

Our findings present interesting implications for designing health messages. We designed our study to include a control condition in which participants did not receive any risk-behavior information. Our results reveal that risk estimates for oneself, concern over the disease, and behavioral inten-

[1]Amos 4 enables the specification of multiple models and displays parameter estimates (standardized β) graphically on the path diagram. By estimating all parameters simultaneously, the approach eliminates the bias inherent in ordinary least squares regressions for models that may have correlated errors. Because of space constraints, we have presented only the bare bones of our analyses. Please contact the authors for more details.

tions to learn more and get tested for hepatitis C increase from the infrequent behavioral to the frequent behavioral cues condition. Therefore, using a message that makes the contraction of hepatitis C seem easy works to the advantage of a health-care practitioner by breaking through the invulnerability wall.

Our data suggest that using an infrequent risk behavior is worse than not using a risk behavior at all—cuing an infrequent risk behavior resulted in lower risk estimates and decreased intentions than not enumerating any behaviors at all did. Although this effect was not significant for risk estimates, it was for attitude and intentions. That our results are directionally supportive with only one behavior enumerated cautions health educators against using risk behaviors in advertisements that may make the chances of contracting a disease seem even more remote, because it may create a backfire effect that defeats the purpose of advertising.

When a behavior makes hepatitis C seem easy to contract, self-risk estimates go up. We should note that these effects are obtained by changing just one example of a behavior that leads to the contraction of hepatitis C. Does this mean then that the greater the number of behaviors enumerated, the higher the perceived self-risk? Could listing more behaviors that make hepatitis C seem difficult to contract reverse these effects? Such enumeration of multiple risk behaviors in a message is the focus of our next study.

STUDY 2—QUANTITY MATTERS TOO: EFFECTS OF HOW MANY RISK BEHAVIORS ARE ENUMERATED

The finding that people make inferences from the message and use these to compute various kinds of judgments and probabilities has been demonstrated time and again in various domains (e.g., person perception literature: Gilovich, Savitsky, and Medvec 1998; probability and frequency judgments: Kahneman and Tversky 1973; Tversky and Kahneman 1973, 1974; and missing information inferences: Simmons and Lynch 1991). If people make inferences from the message as the literature seems to suggest, then we can assume that the length of the list of risk behaviors that cause hepatitis C should signify some information to its audience about the number of ways of contracting hepatitis C. Exposure to a longer list should lead people to infer that there are more risk behaviors that lead to the contraction of hepatitis C than would a shorter list. Thus, if we show people a list of eight ways to contract hepatitis C, they may conclude that there are more ways of contracting the disease than if they were shown only two ways.

Previous work on memory-based judgments of risk demonstrated that when AIDS-related behaviors were more accessible in memory (i.e., easier to retrieve), people reported a higher risk of AIDS than when it was less accessible in memory (Raghubir and Menon 1998). The authors asked people to retrieve three behaviors that cause AIDS (the higher accessibility condition) or to retrieve five behaviors (the lower accessibility condition). They theorized that the more difficult a recall task, the smaller, one thinks, is the overall population from which it was drawn. Presumably, retrieving five behaviors that cause AIDS is a more difficult task than retrieving three. We should note that the content of the behaviors recalled was not an input in the judgment, because people reported higher AIDS risk when they recalled three behaviors versus five. If the content was an input, they should have reported higher levels of risk as they retrieved more behaviors.

However, when information is presented in the message, we would expect the opposite effect. We predict a two-way interaction between the number of risk behaviors and the type of risk behavior on self-risk estimates, based on Tversky and Kahneman's work (1974, 1982) on heuristic processing. Specifically, as an inference is made about the number of ways in which hepatitis C can be contracted, a person's estimate of their own risk will depend on the kind of risk behaviors that make up the list. If the representativeness heuristic holds, then people will assume that the risk behaviors presented in the list are representative of the population of risk behaviors. Additionally, a longer list should corroborate the representativeness of a set of risk behaviors more than a shorter list if the risk behaviors are relatively homogeneous in the content. Therefore, exposure to a greater (vs. fewer) number of risk behaviors that make hepatitis C seem more likely to contract should lead people to believe that they are more at-risk. However, exposure to a greater (vs. fewer) number of risk behaviors that make hepatitis C seem relatively less likely to contract should lead people to infer that they are less at-risk, because the risk behaviors seem removed from them. Specifically, we predict a two-way interaction between the number of risk behaviors enumerated and the type of risk behavior. Furthermore, we expect this interactive effect to carry over to message effectiveness. Previous studies have shown that the greater an individual's perceived risk, the greater their intention to alter behavior (Block and Williams, forthcoming; Raghubir and Menon 1998). If we define message effectiveness as the ability of messages to affect (1) attitudes, (2) behavioral intentions, and (3) actual behavior, then we would expect that the number and type of risk behaviors enumerated have an interactive effect on these measures and that this results from the fact that respondents' self-risk perceptions are affected by the type and number of behaviors listed. As a consequence,

H3: The type and number of message cues enumerated in the message will interact such that:

(*a*) When risk behaviors are used that make the contraction of hepatitis C seem easy and the number of behaviors enumerated increases:

(i) self-risk estimates will be higher, and
(ii) message effectiveness will be higher.

(*b*) When risk behaviors are used that make the contraction of hepatitis C seem more difficult and the number of behaviors enumerated decreases:

(i) self-risk estimates will be higher, and
(ii) message effectiveness will be higher.

H4: The effects of message cues on message effectiveness are mediated through self-risk estimates.

Method

Procedure and Stimuli. One hundred sixty undergraduate students participated in the study in exchange for partial course credit. Participants were told they would be asked a few health-related questions that would be helpful in designing an advertising campaign for certain kinds of infections that might affect students like them. Participants were assured that all responses would be kept confidential.

Participants were given one of five versions of the survey corresponding to a 2 (type of message cue: frequent/infrequent) × 2 (number of message cues: short/long list) design with a control. All participants read a modified version of the information on hepatitis C used in study 1, and they were shown either two or eight frequent or infrequent risk behaviors that cause hepatitis C. The control condition did not feature this statement or the list. We refer to this as the "manipulation paragraph."

Based on the pretest ($n = 137$) reported earlier in study 1, we chose the following eight most frequent risk behaviors: not bandaging a cut, kissing, sharing a toothbrush, sharing a razor, having sexual intercourse without a condom, engaging in oral sex, sharing bottles of water or soda, and getting a manicure. Only the first two were used in the short-list condition. We chose the following eight infrequent risk behaviors: getting a tattoo; using needles on yourself; piercing body parts such as nipples, nose, tongue, or belly button; accidentally being jabbed by a needle; donating blood; having multiple sex partners during the same time period; the use of nonsterilized equipment in your doctor's office; and getting blood transfusions. The first two represent the short list.

After completing a series of questions on risk estimates, inferences and inhibitory recall, and behavioral intentions, participants read an article with more detailed information on hepatitis C, adapted from an article that had appeared in the *New York Times* (December 10, 1997). We edited some of the information on ways to contract hepatitis C, because we used these in our manipulation. Participants in all five conditions then answered another risk-estimate question, article processing measures, and postarticle behavioral intention measures.

Measures. We used the following measures:

a) For risk estimates, after participants read the initial manipulation paragraph, they answered the self-risk assessment questions that we used in study 1: (i) a 100-point probability measure and (ii) a seven-point likelihood measure. In addition, we elicited risk estimates on the 100-point probability scale after participants read the hepatitis C article. We refer to this as the "postarticle probability."

b) For attitude and behavioral intention measures, two of the questions used in study 1 were used here before and after reading the article on hepatitis C: (i) concern about contracting the hepatitis C virus and (ii) intention to get tested for the hepatitis C virus.

c) For article processing measures, we used five measures.

i) For reading time, article reading time was measured. Participants were instructed to write down the current time immediately prior to reading the article and again after they were finished. A large clock was placed in the room so that all students had access to the time. To mask this measure and ensure that participants did not spend more time reading than they otherwise would because of any social desirability bias, we had participants periodically write down the time in the questionnaire booklet. We did this under the guise of monitoring the subject pool experience and trying to make it more enjoyable in the future.

ii) For attention, in addition to the reading time, we also measured self-reported attention to the article. Participants were directly asked how much attention they paid to reading the article on a seven-point scale anchored at "not very much attention" and "a lot of attention."

iii) For accuracy quiz, participants, to check depth of processing, answered 15 true-false questions about hepatitis C (e.g., hepatitis C is a bacterial [vs. viral] infection). One point was assigned for each correct response; the analysis was conducted on the summed correct score.

iv) For attitude toward the article, participants rated their attitude on seven semantic differential seven-point items: not informative/very informative, not credible/very credible, not interesting/very interesting, not useful to me/very useful to me, boring/exciting, not scary/very scary, and not well-written/very well-written. The average of these seven items is used as the attitude index (Cronbach's $\alpha = .84$).

v) For persuasion, two questions measured participants' reports of persuasiveness of the article. Participants rated how much they learned from the article ("1 = Didn't learn anything" and "7 = Learned a lot") and whether the article will affect their future behavior ("1 = Will definitely not affect my future behavior" and "7 = Will definitely affect my future behavior"). We analyze these two items separately because their correlation was low (.31).

d) Finally, for manipulation check, participants rated how frequently they engage in each of the eight frequent risk and eight infrequent risk behaviors used in the study. All 16 behaviors were rated on a seven-point scale from "1 = never" to "7 = very frequently." We computed a "frequency index" by averaging the scores on the two/eight frequent items and again for the two and eight infrequent items.

We also included six questions that queried respondents' inferences about the number of ways that hepatitis C can be contracted. For the first three, participants were told to think back to the different ways of contracting hepatitis that were mentioned, and for the next three questions they were asked for other ways in which hepatitis C could be contracted. The questions for each of these tasks were (i) on a scale from 1 to 7, where "1 = few" and "7 = many," indicate how many (other) ways there are to contract hepatitis C; (ii) to quantify the response, indicate how many (other) ways are there in which a person could contract hepatitis C; and (iii) list these ways in the space below.

Results

Manipulation Checks and Controls. We conducted two 2 (type of risk behavior: frequent/infrequent) × 2 (number of risk behaviors: short/long list) ANOVAs on the frequency index across (i) the two risk behaviors used in the short list and (ii) the eight risk behaviors used in the long list. This analysis confirms that the frequency indices are significantly higher for the frequent risk than the infrequent risk behaviors (two: M's = 4.28 vs. 1.35, $F(1, 128) = 713.12$, $p < .001$; eight: M's = 3.09 vs. 1.15, $F(1, 128) = 470.08$, $p < .001$). No other effects were significant.

Our manipulation of the number of behaviors was intended to make people infer the number of causes of hepatitis C. We tested this using a 2 (type of message cue) × 2 (number of message cues) ANOVA. When two message cues were enumerated, participants inferred significantly fewer causes of hepatitis C than when eight risk behaviors were enumerated across measures: on the seven-point scale measure (M's = : 3.15 vs. 6.11; $F(1, 121) = 130.59$, $p < .001$; control = 2.23), on the open-ended measure (M's = 3.98 vs. 7.93; $F(1, 121) = 18.88$, $p < .001$; control = 2.57), and when asked to list the number of ways (M's = 2.50 vs. 5.03; $F(1, 121) = 117.93$, $p < .001$; control = 2.23). No other effects were significant ($p > .10$).

Further, there was support for an inhibitory effect of recall (Alba and Chattopadhyay 1985; Lynch and Srull 1982), as was evidenced by an equal number of recalled items of other causes of hepatitis C across experimental conditions. There were no significant differences in the number of other ways to contract hepatitis on the seven-point scale (aggregate $M = 3.80$; control = 2.81), the open-ended scale (aggregate $M = 6.10$; control = 2.00), or the list writing measure (aggregate $M = 1.69$; control = 1.52) across the number of risk behavior (two vs. eight) conditions. Neither were there any main effects of type of risk behavior or its interaction with the number of risk behaviors ($F < 1$).

Hypothesis 3(i): Interactive Effects of Type and Number of Message Cues on Self-Risk Estimates. We predicted that the type and number of message cues would interactively affect people's estimates of judgments of self-risk as well as message effectiveness. All cell means and standard deviations are presented in the bottom half of table 1. In testing hypotheses in which the control condition is not pertinent, we provide the means in table 1 but do not discuss them in the text.

We ran a 2 (type of message cue: frequent/infrequent) × 2 (number of message cues: short/long list) MANOVA using the three self-risk estimates (prearticle probability and likelihood estimate, and postarticle probability) as the repeated measures dependent variables. The expected two-way interaction was significant (multivariate $F(3, 124) = 4.38$, $p < .01$). Self-risk estimates are higher when a longer list of frequent risk behaviors are enumerated rather than a shorter list (multivariate $F(3, 124) = 1.95$, $p < .06$; e.g., $M_{\text{prearticle probability}} = 45.13$ vs. 32.79) and when a shorter list of infrequent risk behaviors are enumerated rather than a longer list (multivariate $F(3, 124) = 2.98$, $p < .01$; e.g., $M_{\text{prearticle probability}} = 24.55$ vs. 16.88). In addition, the type of risk behavior enumerated had a main effect (multivariate $F(3, 124) = 6.00$, $p < .001$); enumerating frequent (vs. infrequent) risk behaviors increases risk estimates. As expected, there was no main effect of the number of risk behaviors. The interaction effect and the main effect of frequency are both significant for each of the three dependent measures ($p < .01$). For readability, we have reported the multivariate F across all three measures.

Hypothesis 3(ii): Interactive Effects of Type and Number of Message Cues on Message Effectiveness. We postulated an interaction between type and number of risk behaviors such that when frequent (infrequent) risk behaviors are enumerated, the effectiveness of the message will be higher (lower) when more risk behaviors are enumerated. Operationally, we expected greater message effectiveness to be reflected through higher levels of concern (i.e., attitudes), behavioral intentions, and article processing (i.e., behavior). Cell means and standard deviations are presented in table 2.

For attitudes, we measured concern level before and after test subjects read the article. We treated this as a within-subjects measure and tested hypothesis 4 using a 2 (type of risk behavior: frequent/infrequent) × 2 (number of risk behaviors: short/long list) × 2 (level of concern: pre-/post-article) mixed-design MANOVA. Note that we use prearticle attitudes and intentions as examples in reporting the results—these are not presented in the table.

Results support our hypothesis of a significant type x number of risk behaviors interaction ($F(1, 125) = 16.66$, $p < .001$). As predicted, when frequent risk behaviors were enumerated, participants reported lower levels of concern when they were exposed to the shorter list than to the longer list (e.g., $M\text{'s}_{\text{prearticle}} = 4.09$ vs. 5.10; $F(1, 125) = 11.41$, $p < .001$). However, when infrequent risk behaviors were enumerated, participants reported higher levels of concern when exposed to the shorter list than to the longer list (e.g., $M\text{'s}_{\text{prearticle}} = 3.58$ vs. 2.88; $F(1, 125) = 6.92$, $p < .01$). In

TABLE 2

STUDY 2: THE EFFECTS OF MESSAGE CUES ON ATTITUDES, INTENTIONS, AND PROCESSING

Measures and number of behaviors presented in the message	Type of behavior presented in the message		
	Frequent	Infrequent	Control
Attitudes and intentions (postarticle):			
How concerned are you about contracting hepatitis C? (1–7 scale):			
Two	4.34 (1.06)	4.21 (1.58)	3.74 (1.39)
Eight	5.16 (1.13)	3.00 (1.79)	
Do you intend to get tested for hepatitis C in the next six months? (1–7 scale):			
Two	4.50 (1.14)	4.12 (1.43)	3.97 (1.56)
Eight	5.03 (1.14)	3.18 (1.78)	
Article processing measures:			
Article reading time (in minutes):			
Two	6.09 (1.51)	5.70 (2.34)	4.68 (2.72)
Eight	7.17 (1.46)	4.03 (1.54)	
Accuracy in quiz (no. correct out of 15):			
Two	9.85 (3.72)	9.55 (2.39)	8.61 (3.33)
Eight	11.19 (2.33)	6.88 (3.26)	
Attitudes toward the article (index of seven 1–7 scaled items; $\alpha = .84$):			
Two	5.61 (.68)	5.31 (.89)	5.21 (.67)
Eight	6.06 (.76)	4.72 (1.14)	
How much attention paid to the article? (1–7 scale):			
Two	5.73 (.91)	5.19 (1.58)	5.23 (1.31)
Eight	5.90 (1.16)	4.06 (1.71)	
How much learned from the article? (1–7 scale):			
Two	5.94 (.83)	5.49 (1.33)	5.65 (.92)
Eight	6.48 (.72)	4.94 (1.32)	
How much will article affect future behavior? (1–7 scale):			
Two	5.06 (1.64)	4.55 (1.35)	4.27 (1.55)
Eight	5.65 (1.50)	3.85 (1.66)	

NOTE.—Standard deviations are in parentheses.

addition, concern over hepatitis C increased significantly after reading the article on hepatitis C ($F(1, 125) = 4.93$, $p < .05$), possibly because the threat of hepatitis C became real. Further, levels of concern were higher when frequent risk rather than infrequent risk behaviors were enumerated ($F(1, 125) = 30.29$, $p < .01$), supporting hypothesis 1b and the results of study 1. No other main effects or interactions were significant ($p > .10$).

For intentions, we measured behavioral intentions by asking participants to indicate the likelihood of their getting tested for hepatitis C before and again after they read the article. As before, we used a 2 × 2 × 2 mixed-design MANOVA, which resulted in a significant type by number of message-cues interaction ($F(1, 125) = 8.17$, $p < .01$). Again, when cued with frequent risk behaviors, participants reported lower intentions to get tested when exposed to the shorter list than to the longer list (e.g., M's$_{\text{prearticle}} = 4.19$ vs. 4.94; $F(1, 125) = 7.36$, $p < .01$). When cued with infrequent risk behaviors, participants reported higher intentions to get tested when they were exposed to the shorter list than to the longer list (e.g., M's$_{\text{prearticle}} = 3.73$ vs. 3.24; $F(1, 125) = 3.36$, $p < .07$). In addition, as with concern levels reported above, behavioral intentions increased significantly after reading the article on hepatitis C ($F(1, 125) = 3.87$, $p < .05$). Further, there was a main effect of type of behavior (corroborating hypothesis 1b), such that the use of frequent behaviors increased the intention to get tested for hepatitis C compared with infrequent behaviors ($F(1, 125) = 21.44$, $p < .01$). No other main effects or interactions were significant ($p > .10$).

For behavior, we operationalized behavior as the extent to which the audience processed the information about hepatitis C that they were provided after exposure to the article: attention paid in objective terms (reading time) and subjective (self-reported attention) terms, accuracy in a surprise quiz, attitude toward the article, amount learned from the article, and how the article affects future behavior. Again, we used a 2 (number of message cues: short/long list) × 2 (type of message cue: frequent/infrequent) MANOVA across all these different dependent measures. The multivariate F across these measures for the predicted two-way interaction term is significant ($F(6, 113) = 5.83$, $p < .001$). The data suggest that, as predicted, when frequent risk behaviors are used, article processing is greater when more versus fewer risk behaviors are enumerated ($F(1, 113) = 5.19$, $p < .001$; e.g., M's$_{\text{reading time}} = 7.17$ vs. 6.09; see table 2).

When infrequent risk behaviors are used, article processing is greater when fewer versus more risk behaviors are enumerated ($F(1, 113) = 2.48$, $p < .01$; e.g., M's$_{\text{reading time}} = 5.70$ vs. 4.03). Finally, the effect of the type of behavior was significant (multivariate $F(6, 133) = 11.84$, $p < .01$), with enumerating frequent (vs. infrequent) behaviors leading to higher levels of article processing. The data are, therefore, completely consistent with our hypothesis.

Hypothesis 4: Mediation of the Effects of Message Cues on Message Effectiveness through Self-Risk Estimates. As in study 1, we used path analysis to test for mediation, treating type and number of message cues and their interaction term as independent variables, self-risk estimates as the mediating variable, and attitudes, intentions, and behavior as the outcome variables. In these analyses we allowed the error variances of the mediator and the dependent variables to be correlated, enabling us to account for biases arising out of shared method variance. Because the results are similar across all the measures, we discuss the results using one measure—attitudes toward the article on hepatitis C.

The direct effect model shows a significant positive effect of type of behavior on attitudes toward the message such that frequent behaviors lead to more positive attitudes ($\beta = .45$, $p < .01$) and a significantly positive interaction between type of behavior and number of behaviors ($\beta = .23$, $p < .05$). However, the direct effect of both the type of behavior and the interaction term are reduced to nonsignificance in the mediational model, with the inclusion of self-risk probability as a mediator ($\beta_{type} = -.45$, NS, $\beta_{interaction} = -.46$, NS). The path between the type of message cue and self-risk probability estimates ($\beta = .32$, $p < .01$) and that between the interaction term and self-risk estimates ($\beta = .19$, $p < .05$) are significant and positive. Similarly the path between the self-risk estimate and attitudes toward the article is significant and positive ($\beta = 4.49$, $p < .01$). A reverse causality model with message measures such as the attitude toward message as a mediator and the self-risk estimates as the dependent variable was found to be untenable, ruling this out as a potential alternative explanation. Finally, the indirect effect of the type of message cue ($\beta = 1.35$, $p < .01$) and the interaction term ($\beta = 0.69$, $p < .05$) are significant. Together, these again provide evidence of mediation, as we hypothesized.

Overall Effectiveness of Message Cues. Our applied research motivation was to provide specific advice to health-care media strategists who routinely use enumerated risk categories in their messages. An analysis of the advertisements described at the beginning of this article (e.g., hepatitis C, heart attack risk) shows, on average, 8.7 risk categories enumerated in the advertisements. An interesting question is whether, in general, providing a list of behaviors is a more effective strategy than not providing such a list. To answer this question, we need to compare the mean in the experimental condition with that in the control condition. Compared to the condition in which frequent risk behaviors are used to make hepatitis C seem easily contractible, the longer list increases postarticle levels of concern ($M = 5.16$) over the control condition ($M = 3.74$, contrast $t = 2.58$, $p < .01$). Therefore, a message enumerating different risk behaviors that are frequently engaged in by the target population will increase the concern level. Interestingly, enumerating more risk behaviors that make hepatitis C seem more difficult to contract has an opposite backfire effect ($M = 3.00$, contrast $t = 1.89$, $p < .05$; one-way ANOVA across these three levels $F(1, 92) = 10.24$, $p < .01$). ANOVAs across these three levels of message cues indicate that this pattern of results is consistently replicated over prearticle concern levels (M's $= 5.10 > 3.32 > 2.88$, $F(2, 92) = 7.21$, $p < .01$), intentions to get tested ($M\text{'s}_{prearticle} = 4.94 > 3.94 > 3.24$, $F(2, 92) = 3.92$, $p < .05$; $M\text{'s}_{postarticle} = 5.03 > 3.97 > 3.18$, $F(2, 92) = 6.17$, $p < .01$), and article processing measures (reading time: $7.17 > 4.68 > 4.03$; quiz accuracy: $11.19 > 8.61 > 6.88$; attitudes toward the article: $6.06 > 5.21 > 4.72$; attention paid to the article: $5.90 > 5.23 > 4.06$; amount learned from article: $6.48 > 5.65 > 4.94$; effects on future behavior: $5.65 > 4.27 > 3.85$; multivariate $F(12, 164) = 2.95$, $p < .01$).

These data strongly point out that the health educator needs to be wary about enumerating various risk behaviors in an advertisement. While enumerating behaviors that make the contraction of the disease seem easy increases message effectiveness, enumerating behaviors that make the contraction of the disease seem difficult actually has the opposite effect and could be detrimental to message effectiveness.

Discussion

The results of study 2 provide strong evidence that risk behaviors used as cues in a message enhance or reduce estimates of self-risk in a predictable manner. Specifically, we find that a greater number of frequent risk behavioral message cues reduces the self-positivity bias. More interestingly, a greater number of infrequent risk behavioral message cues increase this bias and cause a backfire effect relative to the control condition, corroborating and providing stronger evidence for the findings of study 1. Identification of these moderators of the self-positivity bias (type and number) makes a theoretical contribution to previous research by demonstrating that memory and message factors work in opposing ways (see Raghubir and Menon [1998] for memory factors). In addition, we find this translates to message effectiveness. Our finding that self-risk estimates and message effectiveness measures polarize with an increase in the number of risk factors motivates study 3. Our objectives for study 3 are (*a*) to understand the underlying process by which a list of behaviors affects perceptions of self-risk, and (*b*) to study the change in people's perceptions of self-risk as a function of our manipulations.

STUDY 3: WHAT'S GOING ON?

What is the process by which the effects found in studies 1 and 2 occur? It could be that people engage in selective information processing whereby they look for evidence that confirms their a priori opinion. Confirmatory hypothesis testing is an iterative process that occurs when people hold a priori judgments and then interpret evidence and make inferences in line with their original hypothesis, or a priori opinion (Sanbonmatsu et al. 1998). According to the confirmatory hypothesis testing explanation, the presence of confirming evidence would be assimilated with little or low cognitive effort, and with little discounting or counterarguing (Gilbert 1991). The resulting judgment would be held with great confidence and would likely result in a polarized opinion (Koehler 1991). The presence of disconfirming evidence initiates a comparison with the focal hypothesis that is effortful, is characterized by discounted or ignored evidence, and results in a judgment held with less confidence (Gilbert 1991).

Because the a priori hypothesis that people have regarding risk judgments is that they are not at-risk, presenting disconfirming evidence in the form of frequent behaviors should increase self-risk estimates (as observed in studies 1 and 2) and should be accompanied by increased cognitive effort and decreased confidence in one's judgment. However, presenting confirming evidence in the form of infrequent behaviors should have the opposite effects on these measures. These effects should be stronger with an increase in the number of behaviors presented, indicating an interactive effect between type and number of message cues used. In sum, we could detect confirmatory hypothesis testing as the process underlying the results obtained in study 2 if we replicate the design, testing for cognitive effort, and confidence measures.

H5a: When infrequent (vs. frequent) behaviors are presented:

(i) cognitive effort will be lower, and
(ii) confidence will be higher.

H5b: Type of message cues will interact with the number of message cues such that:

(i) as the number of frequent behaviors increases, cognitive effort increases and confidence decreases, and
(ii) as the number of infrequent behaviors decreases, cognitive effort increases and confidence decreases.

We also predict that there will be a discounting process that people go through when they encounter information that is inconsistent with a priori beliefs. When they encounter frequent behaviors that go against their a priori hypothesis, people are likely to disbelieve that the behaviors presented actually cause hepatitis C. However, encountering infrequent behaviors will bolster their belief that they are not susceptible to the disease, and they should report higher believability of such behaviors causing hepatitis C. And with additional pieces of information (i.e., when eight behaviors are presented vs. two), believability that the behaviors cause hepatitis C (whether frequent or infrequent) should increase (Petty and Cacioppo 1984). Thus, we predict two main effects.

H6a: Infrequent behaviors will be perceived as more believable causes of hepatitis C than frequent behaviors.

H6b: The behaviors will be perceived as more believable as the number presented increases.

However, the more interesting and stronger test of the process obtains if we provide a set of heterogeneous (i.e., frequent and infrequent) behaviors to people. If processing was unbiased and each risk factor was evaluated on its own merit, then the order of presentation would be irrelevant. On the other hand, if the process is one of confirmatory hypothesis testing, then people should be testing their a priori hypothesis that they are not at-risk as they encounter each piece of information, and when they encounter sufficient information they should form a judgment that either confirms or disconfirms their expectations. In this case, the order in which confirming and disconfirming behaviors are presented is critical.

Let us consider the case when only infrequent behaviors are presented. These behaviors act as confirming evidence of one's not-at-risk status. The more behaviors on the list, the more confirming evidence, and the more polarized one's initial judgment becomes. What happens when these infrequent behaviors are followed by frequent ones? People would then start out by confirming their a priori hypothesis and would adjust risk estimates downward, but the presence of subsequent frequent behaviors should prevent the risk estimates from being adjusted as much as if they were exposed only to infrequent behaviors.

In contrast, a list of frequent behaviors opposes the a priori hypothesis that one is not at-risk. When all available evidence opposes one's initial hypothesis (as in the case of presenting only frequent behaviors), selective hypothesis testing diminishes the likelihood of confirmation, and the alternative hypothesis (i.e., one is at-risk) is accepted (Sanbonmatsu et al. 1998). The greater the number of frequent behaviors presented, the greater the change from one's a priori risk estimates. When these frequent behaviors are followed by infrequent ones, however, people should adjust their risk estimates upward, but not as much as if they were only exposed to frequent behaviors, because of the presence of confirming evidence subsequently. In sum, when heterogeneous behaviors are presented, the risk estimates should be less polarized than when only frequent or infrequent (i.e., homogeneous) behaviors, given the presence of both confirming and disconfirming evidence. Formally,

H7a: The number and order of message cues will interact and affect the polarization of self-risk estimates when homogeneous or heterogeneous behaviors are presented such that:

(i) when more behaviors are presented (i.e., eight), risk estimates are higher when frequent behaviors precede infrequent behaviors; and
(ii) when only two behaviors are presented, there should be no difference in risk estimates as a function of order.

H7b: This self-risk polarization will be greater when homogeneous (vs. heterogeneous) behaviors are presented.

What happens to cognitive effort and confidence when heterogeneous behaviors are presented? If confirmatory hypothesis testing is the underlying process, then order should result in different levels of effort and confidence. If people are exposed to infrequent behaviors first, they begin processing by confirming their a priori hypothesis, using little cognitive effort and holding high confidence. These judgments and subsequent self-risk estimates are then upwardly modified when they encounter the latter frequent behaviors. By contrast, if people are exposed to disconfirming frequent behaviors first, they immediately begin effortful processing and having diminishing confidence. Their judgments are then downwardly modified when they encounter the latter infrequent behaviors. Overall, though, these effects are likely to manifest more when people are exposed to a larger number of behaviors (i.e., eight vs. two behaviors). In sum:

H8: For heterogeneous behaviors, the number and order interact such that:

(*a*) When frequent behaviors precede infrequent behaviors (vs. frequent),

(i) cognitive effort will be higher, and
(ii) confidence will be lower.

(*b*) These effects should be stronger as the number of behaviors increase.

Additionally, the cognitive effort expended in assimilating additional information and the associated confidence with risk judgments should depend on the number of disconfirming pieces of evidence encountered, especially with exposure to longer lists. Across conditions, a greater number of disconfirming pieces of evidence (i.e., frequent behaviors) should result in a greater cognitive effort associated with the task and a lower confidence associated with the judgment.

H9: As the number of message cues conforming with the a priori self-positivity bias increases:

(*a*) cognitive effort will decrease, and
(*b*) confidence in risk estimates will increase.

Method

Procedure and Stimuli. One hundred fifty-two undergraduate students participated in this study for partial course credit. The experiment was conducted in two stages. During the first stage, participants were presented with the same opening paragraph as in study 2. We then elicited self-risk estimates that formed the basis for their priors. After completing an intervening unrelated filler task, participants were handed a second questionnaire featuring a message simulating the *New York Times* advertisement presented at the beginning of this article. Eight versions of this message were used, corresponding to a 2 (number of message cues: 2 vs. 8) × 2 (type of message cue: homogeneous vs. heterogeneous) × 2 (order, nested within heterogeneous message cues: frequent first vs. infrequent first) design. In the homogeneous conditions, participants were shown two or eight frequent or infrequent behaviors. In the heterogeneous conditions, participants were shown one frequent and one infrequent behavior in the two message-cues condition, or four frequent and four infrequent behaviors in the eight message-cues condition. The order in which these behaviors were presented in the heterogeneous condition was rotated. This nests order within heterogeneous message cues in our design.

Measures. Participants then completed the following set of measures:

a) For pre- and post-self-risk estimates, participants provided an estimate of their perceived risk of contracting hepatitis C in both stages of the study using the 100-point probability scale from studies 1 and 2. We computed the difference between the risk estimate obtained after and before exposure to the message manipulation as a measure of self-risk polarization. A negative score indicates that the risk estimate went down after exposure to the message (i.e., an increase in self-positivity), and a positive score indicates an increase in the estimate after message exposure (i.e., a decrease in self-positivity).

b) For confidence and accuracy, a seven-point scale anchored at "not at all confident" and "very confident" provided a measure of how confident participants were about the probability estimate that they had reported. We also asked participants how accurate they thought the risk estimate was on a seven-point scale anchored at "not at all accurate" and "very accurate." Because $\alpha = .85$ for these two scales, they were combined to form a "confidence index."

c) For cognitive effort, participants then completed four items on seven-point scales (Menon 1997; Menon et al. 1995). They rated how difficult and effortful it was to come up with the risk estimate, how much thought they had to put into the task, and how much time it took. Because Cronbach's $\alpha = .83$ for these four items, the scores on the four items were averaged to form a composite "cognitive effort index."

d) For believability, participants rated, on a seven-point scale anchored at "not at all believable" and "very believable," the believability that each of the behaviors to which they were exposed caused hepatitis C. Therefore, the list of behaviors rated varied by type (frequency and order) and number of behaviors, depending on the experimental condition. To compare across conditions, the score for each behavior was averaged across frequent and infrequent behaviors, yielding a "believability index" for frequent and infrequent behaviors. Therefore, in the heterogeneous condition, the index reflects the believability of the frequent behaviors versus the infrequent behaviors as a function of the order in which they were presented. For the homogeneous condition, the index reflects the average across all the behaviors that were presented as a function of frequency only.

Because of the length of the questionnaire in this study, we did not collect manipulation check information on the frequency of the behaviors used as message cues in this study. Instead, we rely on the manipulation checks conducted in study 2.

Results

Cell means and standard deviations are presented in table 3.

Hypothesis 5: Confirmatory Hypothesis Testing in the Homogeneous Condition. First, as predicted, confidence and cognitive effort were inversely related ($r = -.45$, $p < .01$).

We conducted a 2 (type of message cue) × 2 (number of message cues) ANOVA on the cognitive effort index and the confidence index. As per hypothesis 5a, we obtain a significant main effect of type of message cue such that frequent (vs. infrequent) behaviors makes the task more effortful and the judgment held with lower confidence (cognitive effort index: $M_{frequent} = 4.67$ vs. $M_{infrequent} = 3.64$, $F(1, 79) = 17.73$, $p < .01$; confidence index: $M_{frequent} = 3.54$ vs. $M_{infrequent} = 5.24$; $F(1, 79) = 29.02$, $p < .01$). As predicted by hypothesis 5b, we obtain an interaction between number and type of message cues on measures of cognitive effort and confidence (cognitive effort index: $F(1, 79) = 4.45$, $p < .05$; confidence index: $F(1, 79) = 3.42$, $p < .10$). Cognitive effort increases and confidence decreases for frequent behaviors as the number of behaviors encountered increases, indicating that encountering more information inconsistent with priors requires greater processing and that the judgment is held with less confidence (cognitive effort index: $M_2 = 4.33$ vs. $M_8 = 5.17$, contrast $p < .01$; confidence index: $M_2 = 3.98$ vs. $M_8 = 2.92$, contrast $p < .01$). For infrequent behaviors (i.e., behaviors confirming one's priors), the number of behaviors presented did not make a difference (cognitive effort index: $M_2 = 3.76$ vs. $M_8 = 3.47$, contrast $p = .12$; confidence index: $M_2 = 5.17$ vs. $M_8 = 5.35$, NS).

Hypothesis 6: Discounting of Information in the Homogeneous Condition. A 2 (type of message cue) × 2 (number of message cues) ANOVA on the believability index revealed a significant main effect of the type of message cue, indicating that the perceived believability of infrequent behaviors was higher than that of frequent behaviors ($F(1, 77) = 11.21$, $p < .01$; $M_{frequent} = 4.38$ vs. $M_{infrequent} = 5.54$). Further, as per hypothesis 6b, we obtained a main effect of number of message cues such that both the

TABLE 3

STUDY 3: MEASURES DETECTING PROCESS

Measures and number of behaviors presented in the message	Type of behavior presented in the message: "Homogeneous" behaviors: Frequent	Infrequent	"Heterogeneous" behaviors: Order: frequent-infrequent	Order: infrequent-frequent
Postprior difference in self-risk estimates (100-point scale):				
Two	1.78 (18.99)	−5.92 (12.51)	−4.55 (17.51)	−3.00 (18.79)
Eight	12.75 (16.36)	−9.06 (11.08)	8.23 (12.86)	−6.15 (21.38)
Cognitive effort index (7-point 4-item scale; $\alpha = .83$):				
Two	4.33 (1.21)	3.76 (1.42)	3.60 (1.42)	3.29 (1.27)
Eight	5.17 (1.21)	3.47 (1.29)	4.81 (1.28)	4.05 (1.22)
Confidence index (7-point 2-item scale; $\alpha = .85$):				
Two	3.98 (1.80)	5.17 (1.67)	4.47 (1.39)	5.06 (1.70)
Eight	2.92 (.84)	5.35 (1.13)	3.03 (1.34)	3.87 (1.33)
Believability that behaviors cause hepatitis C (7-point scale for each behavior):				
Two	4.14 (1.54)	5.27 (1.48)	4.39 (1.44) Freq = 3.53 Infreq = 5.12	4.68 (1.29) Freq = 3.70 Infreq = 5.02
Eight	4.72 (.94)	5.74 (1.95)	5.12 (.84) Freq = 4.67 Infreq = 5.52	4.70 (1.47) Freq = 4.37 Infreq = 5.35

NOTE.—Standard deviations are in parentheses.

frequent and infrequent behaviors were perceived to be more believable as the number increased ($F(1, 77) = 2.96$, $p < .10$; frequent behaviors: $M_2 = 4.14$ vs. $M_8 = 4.72$, contrast $p < .01$; infrequent behaviors: $M_2 = 5.27$ vs. $M_8 = 5.74$, contrast $p < .10$).

Hypothesis 7: Polarization of Self-Risk Estimates. We conducted a 2 × 2 ANOVA within each of the homogeneous and heterogeneous behavior conditions using the difference between post- and a priori risk estimates as the dependent measure. As expected, the interaction for the homogeneous condition was significant at $p < .01$ ($F(1, 79) = 4.18$, $p < .01$), whereas the interaction for the heterogeneous condition was only significant at $p < .10$ ($F(1, 71) = 3.49$, $p = .06$). No other effects are significant.

To test the nature of the interactions, we conducted planned contrasts. These analyses indicate that when frequent behaviors precede infrequent behaviors in the heterogeneous condition, the risk estimates go up as the number increases ($M_2 = -4.55$ vs. $M_8 = 8.23$, contrast $p < .10$). However, when infrequent behaviors precede frequent behaviors, the risk estimates goes down directionally ($M_2 = -3.00$ vs. $M_8 = -6.15$, NS). In the case of homogeneous behaviors, when frequent behaviors alone are presented, the risk estimates go up as the number increases ($M_2 = 1.78$ vs. $M_8 = 12.75$, contrast $p < .05$), while risk estimates go down when infrequent behaviors are presented ($M_2 = -5.92$ vs. $M_8 = -9.06$, contrast $p < .10$). Note that in both, the heterogeneous and homogeneous, conditions risk estimates increase postexposure to the message only when 8 frequent behaviors are used (contrast against zero significant, $p < .05$). Therefore, these results support our hypothesis for a significant interaction in the heterogeneous condition, albeit a more compressed one than in the homogeneous condition.

Hypothesis 8: Confirmatory Hypothesis Testing in the Heterogeneous Condition. Hypothesis 8 predicts main effects of order and number on the cognitive effort and confidence indices. As predicted, we obtain significant main effects of number ($F(1, 71) = 10.26$, $p < .01$; $M_2 = 3.45$ vs. $M_8 = 4.40$, contrast $p < .01$) and order ($F(1, 71) = 2.99$, $p < .10$; $M_{\text{freq-inf}} = 4.18$ vs. $M_{\text{inf-freq}} = 3.70$, contrast $p < .10$) on the cognitive effort index. While exposure to frequent behaviors increases cognitive effort, the increase in the number of behaviors also increases cognitive effort.

Further, as predicted, our analyses on the confidence index indicate significant main effects of number ($F(1, 71) = 14.87$, $p < .01$; $M_2 = 4.76$ vs. $M_8 = 3.49$, contrast $p < .01$) and order ($F(1, 71) = 4.42$, $p < .05$; $M_{\text{freq-inf}} = 3.77$ vs. $M_{\text{inf-freq}} = 4.42$, contrast $p < .05$). Therefore, while exposure to frequent behaviors decreases confidence, the increase in the number of behaviors, in general, also decreases confidence.

Finally, we investigated the effects of our factors on the believability score and found that no effect was significant at the aggregate level ($p > .10$). We computed the believability score separately for frequent and infrequent behaviors for each of the 2 (two vs. eight) × 2 (frequent-infrequent vs. infrequent-frequent) cells. First we ran a 2 (number) × 2 (order) (frequent vs. infrequent as within subjects) mixed ANOVA. The results indicate a significant main effect of frequency of the behavior ($F(1, 66) = 32.43$, $p < .01$), with infrequent behaviors being perceived as much more believable than frequent ones ($M_{\text{frequent}} = 4.07$ vs. $M_{\text{infrequent}} = 5.25$), which supports hypothesis 6a. Further, the main effect of the number of message cues was significant ($F(1, 66) = 4.08$, $p < .05$), providing additional support for hypothesis 6b that believability in disconfirming evidence increases as the number of such pieces of evidence increases.

Hypothesis 9: Linear Trends. Finally, we tested our hypothesis for linear trends on the cognitive effort and confidence indices in the conditions in which participants were exposed to eight risk behaviors. We predicted that the cognitive effort should increase linearly and should be lowest in the condition where it conforms to the self-positivity bias and highest in the condition where it conforms least. We predicted the opposite pattern of results for confidence. Note that when eight message cues are used, the number of pieces of disconfirming evidence is eight in the frequent-only condition, none in the infrequent-only condition, and four in each of the heterogeneous conditions.

We find that cognitive effort is highest when participants are presented only frequent behaviors ($M = 5.17$), followed by frequent-infrequent ($M = 4.81$), infrequent-frequent ($M = 4.05$), and then infrequent only ($M = 3.47$; linear trend significant, $F(1, 69) = 9.79$, $p < .01$). Analogously, we find that this trend is reversed when we examine the confidence index, with the index being lowest when participants are exposed to only frequent behaviors ($M = 2.92$), followed by frequent-infrequent ($M = 3.03$), infrequent-frequent ($M = 3.87$), and then infrequent only ($M = 5.35$; linear trend significant, $F(1, 69) = 10.59$, $p < .01$). These data completely support hypothesis 9.

Discussion

The results of this study provide evidence for a confirmatory hypothesis testing process by which audiences process advertising information. In essence, people believe what they want to believe. However, these beliefs can be molded by message-cue information. We find evidence that encountering information inconsistent with priors increases cognitive effort to arrive at judgments. In addition, confidence in judgments is higher when people encounter infrequent behaviors and decreases as the amount of information inconsistent with priors increases. Most illustrative of the biases was the reported believability that different types of behaviors cause hepatitis C. Infrequent behaviors are believed to cause hepatitis C more than frequent ones are. However, believability that the frequent behaviors could cause hepatitis C increases with number (i.e., when people are presented with more disconfirming evidence against priors).

GENERAL DISCUSSION

In this article, we examined the effects of enumerating risk behaviors on people's judgments of the risk of contracting a disease and on increasing behavioral compliance. We show that the type and number of cues contained in a message act as signals of representativeness. Given the a priori hypothesis of invulnerability that people have about themselves, we show that listing a greater number of frequent behaviors breaks the invulnerability barrier and increases people's perceptions of self-risk, which in turn translate into changed attitudes, intentions, and behavior. This process, though, leads to greater cognitive effort on the part of the audience and to lower confidence levels in the risk estimates, potentially because the presented list of frequent behaviors acts to change what the audience believes is representative of risky behaviors. On the other hand, listing a greater number of infrequent behaviors can actually have a backfire effect on perceptions of vulnerability. Additionally, these lead to an even greater confidence in one's beliefs about being at-risk and a reduced cognitive effort at processing the information. Viewed together, a greater ease of processing and a greater belief that the listed infrequent behaviors are representative of the population of behaviors that cause the disease are likely to cause a reduced level of involvement in both the message and the issue. Thus, the inherent low involvement caused by people's self-positivity bias is accentuated by using a list of behaviors that they maybe incorrectly interpret as being representative of the total risk. We also show that if a more representative list of behaviors targeting various audiences needs to be provided, using a heterogeneous list with frequent behaviors preceding infrequent ones may be the best option in terms of increasing involvement and ensuring compliance.

Previous studies on involvement (Petty and Cacioppo 1984) have investigated the effects of inducing high and low levels of involvement external to the message and its consequent effects on message processing as a function of two message variables (which are similar to our message cues). They found that when issue involvement was low, nine arguments were more persuasive than three arguments, regardless of message strength. However, when issue involvement was high, an interaction between quality and quantity of message arguments showed that a greater (vs. lesser) number of strong (vs. weak) arguments were more persuasive. However, the process by which the effects manifest is different in the two articles. In the Petty and Cacioppo (1984) study, issue involvement was independent of manipulated message variables. In our scenario of health-risk perceptions, issue involvement is completely dependent on the type and number of behaviors used as message cues in our manipulations. In other words, we know that the audiences' general tendency toward invulnerability, or the self-positivity bias, results in low message involvement as measured by low message processing and low persuasion. Presenting a greater number of frequent behaviors or a lesser number of infrequent behaviors increases self-risk estimates, which increases message processing and persuasion. One might analogize that these conditions represent high involvement conditions. However, presenting a smaller number of frequent behaviors or a greater number of infrequent behaviors further reduces message processing and persuasion from the original level represented by the control condition. Thus, these conditions result in even lower involvement. Therefore, we extend the interesting results obtained in the earlier Petty and Cacioppo (1984) study by integrating issue involvement with the actual context of the advertisement, and by studying the cognitive processes by which the effects of type and number manifest.

This research extends our knowledge of defensive-biased processing of health-related information. Block and Williams (forthcoming) demonstrate the defensive processing strategy that occurs after one's self-risk is estimated among consumers exposed to information about the harmful effects of too much caffeine and Olestra consumption. These researchers find that consumers who perceive a high self-risk estimate "seize" on information supporting past knowledge and "freeze" on it, becoming impervious to subsequent information. Seizing and freezing is conceptually similar to confirmatory hypothesis testing in that consumers actively seek and overweight confirming evidence, ignoring or underweighting disconfirming evidence. In the current study, we demonstrate the similar defensive strategy that leads to self-risk estimates. Together, the studies reported in the current article and the Block and Williams study present a more complete understanding of the defensive process and how it might be reduced in order to increase health compliance.

The finding that the cues in a message are diagnostic in one's estimations of personal vulnerability is important in communication strategy. Our results imply that including an infrequent risk behavioral cue in a message results in lower self-risk estimates, compared with not providing any information regarding behavioral risk. Moreover, the significant interaction between type and number of cues further specifies the most effective communication strategy. Self-risk estimates are higher when a greater number of frequent risk behaviors are presented. If the objective of the message is to increase perceived vulnerability, a message containing a longer (vs. shorter) list of risk behaviors is more effective, providing the target audience frequently engages in these risk behaviors. However, there are many instances where a message needs to communicate risk behaviors that are not frequently engaged in. For example, in the actual hepatitis C advertisement discussed earlier in the introduction to this article, readers learn that they are at-risk if they had a blood transfusion prior to 1992. Our results suggest that a shorter (vs. longer) list of risk behaviors is more effective, providing the target audience infrequently engages in these risk behaviors.

One implication of these results is that there are trade-offs in the communication of risk information to consumers. Generally speaking, there are two different goals involved in health-related communication—getting people more information and getting people to change their behavior. Our research suggests that these goals can work at cross-purposes.

Specifically, as the breadth of information (frequent and infrequent) behaviors increases, consumers' risk assessments go down, which in turn may have important implications for their behavior. However, they may be less informed if only frequent behaviors were listed, but they would be more likely to get tested. There are also trade-offs involved across segments of consumers. Moorman and Price (1989) point to the potential of information targeted toward one segment harming the interests of another segment. Given a heterogeneous distribution of frequency of engaging in specific risk behaviors, it is likely that listing some behaviors (e.g., tattooing) that may be frequently engaged in by certain subgroups may backfire in the context of the overall population. Listing all risk behaviors without targeting will thus elicit a minimal response. However, given the limited resources available to communicate public health messages, targeting specific segments within the population implicitly leads to a loss in efficacy in reaching other segments. Our research suggests that using a heterogeneous listing of behaviors can help mitigate the problem to some extent.

An avenue for future research lies in the modality of the message. Past work has indicated that the use of aural presentation focuses people on the most recent pieces of information (Hippler and Schwarz 1987). Therefore, the aural mode may detract from the actual content of the risk behaviors enumerated, such that only the type of behavior enumerated last matters and affects risk estimates, attitudes, intentions, and behavior. It may be likely that visual (written or pictorial) cues are processed in totality, allowing for a greater level of conjunctive judgments. However, given the propensity of people to focus only on the most recent aural cues, only these will be deemed representative of the population of behaviors. Thus, the order effects obtained for heterogeneous behaviors could well be reversed as a function of modality.

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