

ORIGINAL RESEARCH REPORT

Do People Devalue Sources of Threatening Health Feedback Particularly When Its Criteria Are Ambiguous and Its Consequences Enduring?

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We tested the pre-registered hypotheses that receiving threatening health feedback would lead participants to disparage the health-assessment tool used to generate it and that quality of the assessment would moderate this effect. In Studies 1–3, undergraduate students completed a questionnaire including both unambiguous and ambiguous health-assessment items and were randomly assigned to receive either negative health feedback or no feedback. In Study 4, participants were randomly assigned to a control condition or to one of two experimental conditions that entailed receiving negative feedback about enduring or fleeting consequences of their health behaviors. Across all studies, contrary to our predictions, there were no significant effects of feedback on participants' ratings of the accuracy of the assessment procedures. These findings have implications for understanding the specific conditions under which people disparage sources of threatening feedback in the domain of health.

Keywords: health-information processing; health messages; health feedback; ambiguity

Persuading people to engage in healthy behaviors is notoriously difficult (Hofmann, Friese, & Wiers, 2008; Marteau, Hollands, & Fletcher, 2012). One method of motivating people to change their health behaviors is to expose them to threatening messages, such as by providing negative feedback related to task performance (e.g., Collange, Fiske, & Sanitioso, 2009) or to physiological output (e.g., Ehlers, Margraf, Roth, Taylor, & Birbaumer, 1988). Although some research suggests that threat can be motivating (Floyd, Prentice-Dunn, & Rogers, 2000; Milne, Sheeran, & Orbell, 2000), people often do not respond well to threatening feedback. For example, if feedback or information is antithetical to one's beliefs and/or actions, or if the information is incongruent with one's perceptions of self, then negative feedback may engender less acceptance and more criticism of the message (Ditto & Boardman, 1995; Ditto & Lopez, 1992). To minimize the threat of the feedback's implications, a person may attempt to discount the quality of the feedback (Liberman & Chaiken, 1992).

Disparaging Information Following Negative Feedback

The consequences of receiving negative feedback have been studied in many different domains. Researchers have examined how receiving negative evaluative feedback

(e.g., poor performance on an academic task; Cianci, Klein, & Seijts, 2010) impacts psychological and physiological outcomes (e.g., anger, emotion regulation; Niemann, Wisse, Rus, Van Yperen, & Sassenberg, 2014; Schmeichel & Demaree, 2010). In response to negative feedback, people may become fearful and motivated to change their behaviors (see Tannenbaum et al., 2015 for a meta-analysis). Alternatively, people may disagree with the feedback, leading them to disparage it or its source. Given that research supports both responses to threatening feedback, it is important to understand the conditions under which people are inclined to accept versus reject threatening feedback or its source.

Studies examining the effects of negative feedback on evaluations of the assessment process have found support for the notion that people will disparage the source of negative feedback; these results have been obtained using a variety of different dependent measures of disparagement or devaluation of the evaluative process. For example, in response to negative self-relevant feedback, people will disparage an intelligence test (Wyer & Frey, 1983) or prefer to read research articles that appear to disparage the test (Frey & Stahlberg, 1986). People also have been shown to devalue a source (e.g., a psychologist or fellow student) whom they believe to have scored or interpreted their test responses in a way that resulted in negative feedback (e.g., Freeman, 1973; Steiner, 1968), and to dislike a source (e.g., a nurse) who is simply an innocent deliverer of negative feedback (e.g., positive cancer biopsy results, Study 2A; John, Blunden, Liu, 2019). Research also shows that people will degrade

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the accuracy of a bogus diagnosis that they believe to be based on their responses to a psychological assessment as analyzed by a computer program (Ditto & Boardman, 1995). These findings suggest that people may disparage a test itself or a feedback-generating source to the extent that they yield undesirable results.

In the domain of health, when feedback is self-relevant and threatening, compared to either non-self-relevant or non-threatening, people tend to be more critical of the information (Ditto & Lopez, 1992), more likely to downplay the personal relevance of the information (Harris & Napper, 2005), and more inclined to judge the information as less accurate (Kunda, 1987). Relatedly, people who engage in unhealthy behaviors (e.g., smoking) often are quick to defend those behaviors, even when confronted with contradictory evidence (Dijkstra, 2009), and people are more likely to criticize information that links negative consequences to their health behaviors (e.g., caffeine consumption; Liberman & Chaiken, 1992). In general, when people are threatened by health-related feedback or information, they may react defensively by avoiding, denying, or counterarguing against the information or its source (see van't Riet & Ruiters, 2013, for a review).

Although the research literature on reactions to feedback suggests that people attempt to minimize or dismiss undesirable, self-relevant negative feedback, research is needed that elucidates the conditions under which such effects are most likely to be observed. Toward this end, we investigated whether one factor that may facilitate discounting undesirable feedback is the extent to which the feedback is ambiguous. This question is important particularly in the domain of health, given the often ambiguous and inconsistent nature of health information (Deering & Harris, 1996; Mendes, Abreu, Vilar-Correia, & Borlido-Santos, 2017), and given that ambiguity can facilitate the use of motivated reasoning (Kunda, 1990). Research has shown that people are more likely to disparage information that is ambiguous than information that is explicitly clear (Dunning, Meyerowitz, & Holzberg, 1989), and research suggests also that people are more likely to use motivated reasoning about ambiguous information (Kunda, 1990) and to use to their advantage definitions that are vague or unclear (Dunning et al., 1989). Accordingly, defensive strategies against negative feedback, such as disparaging the test used to generate that feedback, may be facilitated by ambiguous information. Because people capitalize on information that is vague or ambiguous, an important distinction may exist between disparaging broadly a source of negative feedback or disparaging particularly ambiguous elements of the feedback source.

Overview of The Present Studies

In the present work, we investigated whether people would disparage the health-assessment process generally following threatening feedback or whether they would selectively disparage ambiguous (i.e., lacking clear implications for health) information.¹ To investigate the

possibility that people capitalize on ambiguity in their defensive strategies following negative feedback, we examined item-specific ambiguity as a potential moderator of the effect of receiving threatening health feedback on disparaging the test used to generate that feedback. Additionally, studies on negative health feedback typically provide false information about a specific health issue; in the present work, however, we examined the effect of feedback related to several aspects of health, based on an assessment tool that measured a wide range of lifestyle and health behaviors.

Across three studies, we examined whether participants given threatening health feedback would evaluate the health-assessment process as lower in quality than would participants who received no feedback, but who instead received general information about the health assessment. Half of the assessment items were designed to lack clear implications for health (i.e., ambiguous items) and half the assessment items were designed to have clear implications for health (i.e., unambiguous items). These studies were 2 (feedback) \times 2 (item ambiguity) mixed between-within designs. In a fourth study, we examined using a 3 (feedback) \times 2 (item ambiguity) mixed between-within design whether the extent to which participants believed the health consequences communicated by the feedback to be enduring/chronic, versus fleeting/acute, moderated the effect of feedback on ratings of the health-assessment tool.

Studies 1–3

In Studies 1–3, we predicted a main effect of feedback, such that participants who received threatening feedback about their health would rate the health-assessment items as less accurate measures of health than would participants who received no feedback. Moreover, we hypothesized a significant interaction between feedback condition and item ambiguity, such that receiving threatening feedback would lead to disparaging the quality of ambiguous health-assessment items to a greater extent than unambiguous items.

The hypotheses, method, and data-analysis plan for Study 1 were pre-registered via the Open Science Framework (osf.io/nt2dr). The method for Study 2 was pre-registered (osf.io/xjp47). Study 3 also was pre-registered (osf.io/3w2ua) and was an exact replication of Study 1, with the procedure, feedback manipulation, measures, and data-analysis strategy identical to those in Study 1.

Method and Results (Study 1)

Described below are details for the general method used, which was similar across all studies. The only deviation from the method described below was in Study 2, as part of which two versions of the health-assessment questionnaire were given to participants: one measuring participants' reported agreement with engaging in the 28 assessed health behaviors and one measuring the extent to which participants agreed that a doctor would recommend each of those same behaviors for optimal health.²

Participants

A power analysis was conducted to determine the appropriate sample size for this study. To attain a power level ($1-\beta$) of .95 when $\alpha = .05$ with an estimated effect size of $d = .30$, 148 participants were required. A total of 158 English-speaking undergraduate students participated in this study; they were recruited via the psychology subject pool at a northeastern university in the United States and received one unit of subject pool credit for their involvement. Seven consenting participants were excluded from final data analyses; three participants were excluded due to equipment failure, one participant was excluded for leaving in the middle of the study, one participant was excluded due to personal distress not having to do with the study, and two participants were excluded after they indicated that they did not believe the feedback presented in the study. The final sample consisted of 151 (81 Female; 70 Male) participants ranging from 18 to 43 years of age ($M = 20.75$, $SD = 2.64$); 35.3% European/White, 26.7% Asian American, 17.3% Other, 12.0% Hispanic/Latino American, 7.3% Black or African American, .7% Native Hawaiian or Other Pacific Islander, and .7% More than one race – Black/White.

Procedure

After providing informed consent, participants completed a questionnaire regarding their lifestyle and health behaviors. The questionnaire consisted of 14 unambiguous health-assessment items and 14 ambiguous health-assessment items, randomly interspersed. Participants were then randomly assigned to receive either negative feedback regarding their general health (experimental condition; $n = 79$) or neutral information about the health assessment (no feedback/control condition; $n = 72$). After the delivery of the feedback, participants again were presented with the same 28 health items to which they had initially responded, and they were asked to indicate their thoughts on four characteristics related to each item. Participants next provided demographic information. Lastly, participants were fully debriefed.

Measures and Manipulation

Health Assessment

To measure participants' agreement with engaging in various health behaviors, we used a 28-item measure of health behaviors that included 14 unambiguous items measuring behaviors with clear implications for health, and 14 ambiguous items measuring behaviors that lacked clear implications for health. The unambiguous items were selected from the Lifestyle and Habits Questionnaire-Brief Version (LHQ-B; Dinzeo, Thayasivam, & Sledjeski, 2014), which is a 42-item survey designed to assess health-related attitudes and behaviors in a variety of lifestyle domains (e.g., health and exercise, social concern, nutrition). We operationalized unambiguous as having clear implications for health, considering that guidelines and recommendations abound regarding alcohol, fruit, or water consumption, and other behaviors such as exercise and substance use. These items met our

operationalization of unambiguous because they were drawn from an established health measure and assessed behaviors with clear implications for health (e.g., "I have good physical endurance" or "I eat five or more servings of fruits and vegetables daily."). The unambiguous items selected from the LHQ-B were chosen on the bases of face validity, length, interest in the measured behavior, and relevance to college students. The ambiguous items were created by the experimenters with the aim of constructing items that could be open to interpretation by participants due to a lack of clear implications of the behaviors for health (e.g., some participants could interpret avoiding snacking as healthy, whereas others could interpret that same behavior as unhealthy). The final set of 14 items was decided upon through pilot-testing, as part of which participants indicated the extent to which each of the items were accurate measures of their own health and of most people's health. Some examples of ambiguous items include "I tend to participate in physical exercise more than in the morning than in the evening" and "I sometimes take afternoon naps." Participants indicated on a scale from 1(*strongly disagree*) to 5(*strongly agree*) their agreement with each of the items (for a full list of the 28 health-assessment items, please see Appendix S1).

Health Feedback

After completing the health-assessment questionnaire, participants were randomly assigned to receive either false negative health feedback generated by "calculating [their] score" following completion of the health assessment (experimental condition) or general information about the health assessment itself (control condition). The health feedback in the present study was delivered in auditory fashion via a female voice recorded using an online text to speech generator (see <https://text-to-speech-demo.mybluemix.net/>). Participants in the negative feedback condition received the following feedback:

According to the answers you provided to the questions at the beginning of the study, you scored in the bottom 40 percent of participants with regard to your general health. Based on your responses, you may be at heightened risk for overall poor health, safety, and death. Your lifestyle activities indicate you also may be in danger of developing physical health problems, including cardiovascular disease, common illnesses such as the cold, flu, sore throat, or stomach flu, obesity and diseases related to it such as Type II diabetes or gallbladder disease, and substance abuse such as excessive drinking and drug use. Additionally, you may be at increased risk for psychological disturbances, such as stress, anxiety, and depression. Finally, with regard to forming social and interpersonal connections, which are also shown to dramatically impact general health, your responses did not allow us to form a conclusion. In summary, considering your final score in the bottom 40 percent, relative to other participants, you may be in poor health.

Participants in the control condition were informed that, although they would not be receiving their own results based on answers to the items to which they just responded, the questionnaire could be used to assess general health to determine whether an individual may be at risk for several physical, psychological, and social health consequences, which were the same domains referred to in the feedback condition.

Health-Assessment Ratings

Four rating items were used to assess participants' thoughts and opinions about each of the health-assessment items. The four items used were as follows: (1) "To what extent do you feel this item is a good measure of your health?" (2) "To what extent do you feel this item is a good measure of most people's health?" (3) "To what extent is this item personally relevant to you?" and (4) "To what extent does this item remind you of items you have seen before?" Participants rated each item on a scale from 1(*not at all*) to 5(*extremely*). Items 1 and 2 were averaged and used as our dependent measure of the extent to which participants viewed the assessment items as accurate measures of health.

Feedback Manipulation Check

To assess whether the feedback manipulation was experienced as threatening, we used two items as a manipulation check. Participants rated on a scale from 1(*not at all*) to 5(*extremely*) the extent to which they felt threatened by the feedback and the extent to which they felt worried by the feedback. Participants' scores on the threatened and worried items were averaged to create an overall measure of threat.

Design and Data Analysis

This study was a two-factor mixed between-within design and analysis of variance (ANOVA) was used to test our statistical hypotheses, using SAS 9.4 statistical software. The independent variables were feedback (negative versus no feedback, manipulated between subjects) and ambiguity of the health-assessment items (ambiguous versus unambiguous, manipulated within subjects). The dependent variable was participants' ratings of the extent to which each health-assessment item was an accurate measure of one's own health and of most people's health, averaged. All significance tests were conducted at $p < .05$.

Results

Descriptive statistics for the study measures are presented in **Table 1**. Means and standard deviations for ratings of the health-assessment items are presented by condition in **Table 2**. Neither the main effects of feedback nor the predicted feedback by ambiguity interactions were statistically significant. Contrary to our pre-registered hypotheses, the main effect of feedback on ratings of the assessment items as accurate measures of health, $F(1, 149) = .46, p = .500$, and the interaction effect between feedback and ambiguity on item ratings, $F(1, 149) = 1.45, p = .230$, were not statistically significant (see **Figure 1**). Consistent with the results of our pilot study, there was a statistically significant main effect of item ambiguity on item ratings, $F(1, 149) = 535.05, p < .0001$, such that participants rated the unambiguous items ($M = 3.70, SD = .46$) as significantly more accurate measures of health than the ambiguous items ($M = 2.70, SD = .57$).

Table 1: Descriptive statistics for study measures.

| | Health Assessment | | | Assessment Ratings | | | Threat | | | N |
|---------|-------------------|-----|----------|--------------------|-----|----------|--------|------|----------|-----|
| | M | SD | α | M | SD | α | M | SD | α | |
| Study 1 | 3.18 | .42 | .77 | 3.20 | .44 | .90 | 2.03 | 1.15 | .81 | 151 |
| Study 2 | 3.24 | .37 | .73 | 3.29 | .48 | .93 | 2.27 | 1.27 | .79 | 104 |
| Study 3 | 3.12 | .34 | .67 | 3.26 | .47 | .92 | 2.45 | 1.20 | .82 | 153 |
| Study 4 | 3.18 | .37 | .70 | 3.29 | .44 | .91 | 2.62 | 1.19 | .79 | 413 |

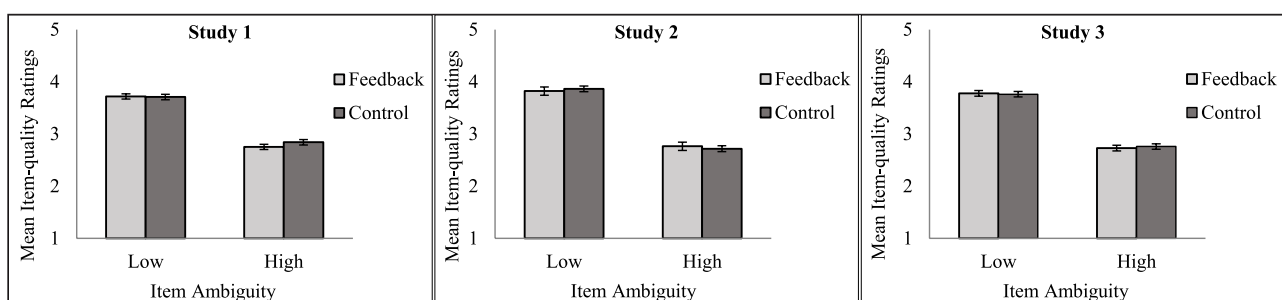


Figure 1: Across Studies 1–3, there was no significant main effect of feedback condition and no significant interaction effect between feedback condition and ambiguity of the health-assessment items on participants' ratings of the items as accurate measures of health. Error bars represent the standard errors of the means for the between-person feedback conditions.

Feedback Manipulation Check

We used an independent samples *t*-test to examine the difference between the negative feedback and no feedback conditions on feelings of threat and worry (averaged; $r = .68$) related to the information they received about the test. Participants in the negative feedback condition ($M = 2.52$, $SD = 1.14$) rated the feedback as significantly more threatening, $t(149) = 6.17$, $p < .0001$, $d = 1.01$, representing a large effect, compared to participants in the control condition ($M = 1.49$, $SD = .88$).

Method and Results (Study 2)

Participants

To attain a power level ($1-\beta$) of .95 when $\alpha = .05$ with an estimated effect size of $d = .30$, 98 participants were required. English-speaking undergraduate students ($N = 109$) received one unit of credit for their participation. Five consenting participants were excluded from data analyses for indicating that they were suspicious of or did not believe the feedback. The final sample consisted of 104 (78 Female; 26 Male) participants ranging from 17 to 29 years of age ($M = 19.06$, $SD = 2.18$); 39.4% Asian American, 24.0% European/White, 13.5% Other, 12.5% Black or African American, 5.8% Hispanic/Latino American, 2.9% More than one race – Black/White, and 1.9% Native Hawaiian or Other Pacific Islander.

Procedure

Participants received two versions of the health-assessment questionnaire: one that assessed the extent to which they agreed that they engaged in each behavior and one that assessed the extent to which they agreed that a doctor would recommend engaging in a behavior. The items were exactly the same across both versions, with the 28 self-relevant items presented in a self-referential manner (e.g., "I limit the amount of salt and sugar I consume.") and the 28 doctor-recommended items presented as though the behavior were one that a doctor might promote (e.g., "For optimal health, doctors recommend limiting the amount of salt and sugar one consumes."). The remainder of the study was identical to Studies 1 and 3, with participants randomly assigned to receive negative feedback ($n = 55$) or no feedback ($n = 49$).

Additional Measures

Doctor-Recommended Items

In Study 2 only, participants rated on a scale from 1(*strongly disagree*) to 5(*strongly agree*) the extent to which they agreed that 28 lifestyle and health behaviors would be recommended for optimal health by doctors (e.g., "For optimal health, doctors recommend limiting the amount of salt and sugar one consumes"); $M = 3.83$, $SD = .36$, $\alpha = .81$.

Results

Descriptive statistics for study measures are presented in **Table 1**. Means and standard deviations for ratings of the assessment items as accurate measures of health are presented by condition in **Table 2**. The feedback manipulation check again indicated that participants

who received negative feedback ($M = 3.01$, $SD = 1.31$) felt significantly more threatened than did participants who received no feedback ($M = 1.61$, $SD = .79$), $t(102) = 6.71$, $p < .0001$, $d = 1.29$; again, this difference was large.

Consistent with the findings of Study 1, there was a statistically significant main effect of ambiguity on ratings of the items as accurate measures of health, $F(1, 102) = 463.43$, $p < .0001$, such that participants rated the unambiguous items ($M = 3.84$, $SD = .50$) as significantly more accurate measures of health than the ambiguous items ($M = 2.74$, $SD = .60$). Also consistent with the results of Study 1, and contrary to our predictions, there was not a statistically significant main effect of feedback on item ratings, $F(1, 102) = .00$, $p = .977$, and there was no statistically significant interaction effect between feedback and item ambiguity on item ratings, $F(1, 102) = .75$, $p = .389$ (see **Figure 1**).

Method and Results (Study 3)

Participants

In line with Study 1, 157 undergraduate students completed the study in exchange for course credit. Four consenting participants were excluded from final data analyses for indicating that they were suspicious of or did not believe the feedback. The final sample consisted of 153 (101 Female; 52 Male) participants ages 17 to 24 years old ($M = 18.97$; $SD = 1.38$), with 80.4% Not Hispanic or Latino, 16.3% Hispanic or Latino, and 3.3% Unknown; specifically, 43.8% Asian American, 19.0% European/White, 13.7% Other, 11.1% Black or African American, 10.5% Hispanic/Latino American, and 1.3% More than one race – Black/White.

Results

Descriptive statistics for the study measures are presented in **Table 1**. Means and standard deviations by condition for ratings of the assessment items are presented in **Table 2**. Participants who received negative feedback ($n = 78$; $M = 2.95$, $SD = 1.09$) reported feeling significantly more threatened than did participants who received no feedback ($n = 75$; $M = 1.94$, $SD = 1.08$), $t(151) = 5.74$, $p < .0001$, $d = .93$, a large effect. There was a statistically significant main effect of item ambiguity on ratings of the items as accurate measures of health, $F(1, 151) = 604.05$, $p < .0001$, such that participants rated the unambiguous items as significantly more accurate ($M = 3.77$, $SD = .49$) and the ambiguous items as less accurate ($M = 2.74$, $SD = .58$). Consistent with the results of Studies 1 and 2, and contrary to our predictions, there was not a statistically significant main effect of feedback on item ratings, $F(1, 151) = .01$, $p = .941$, and there was no statistically significant interaction effect between feedback and item ambiguity on ratings of the items as accurate measures of health, $F(1, 151) = .31$, $p = .580$ (see **Figure 1**).

Integrative Data Analysis of Studies 1–3

To evaluate the strength of the evidence in favor of the observed null findings, we examined via Bayesian repeated-measures ANOVA the main effect of feedback on

item ratings and the interaction effect between feedback and item ambiguity on item ratings, using integrative data analysis, which is the statistical analysis of one data set that encompasses two or more separate data sets merged into a single file (Curran & Hussong, 2009). Data from Studies 1–3 were pooled and analyzed in JASP statistical software. Via model comparison using the combined data set ($N = 408$), the hypotheses were tested that participants who received negative feedback would rate the health-assessment items as less accurate measures of health, compared to participants who received no feedback, and that ratings of ambiguous health-assessment items would be lower for participants who received negative health feedback, whereas there would be no difference between the feedback conditions on ratings of the unambiguous assessment items. The feedback main-effect model and the feedback by ambiguity model were compared against a null model that included item ambiguity, in order to compare directly our two models of interest, excluding the ambiguity main effect. The resulting Bayes Factors (BF_{01}) suggested moderate evidence ($BF_{01} = 6.45$) in favor of the null model (including ambiguity) against the main-effect model of feedback only on ratings of the items as accurate measures of health. Results also indicated strong evidence ($BF_{01} = 45.45$) in favor of the null model (including ambiguity) against the model including the interaction effect of feedback and item ambiguity on item ratings.

Study 4

In Studies 1–3, we observed no main effect of threatening health feedback on participants' ratings of the quality of the health-assessment tool that they believed was used to generate that feedback. We also observed no significant interaction effect between feedback (negative versus no feedback) and item ambiguity (unambiguous versus ambiguous) of the health-assessment items in predicting disparagement of the health-assessment tool. In an attempt to further understand these observed null effects, we tested as a moderator the enduringness of the consequences of participants' health behaviors, based on a longstanding literature suggesting that people respond differently to feedback depending on the perceived malleability of the trait or situation upon which that feedback is based (e.g., Yeager et al., 2019).

Previous findings indicate that, to the extent that attributes are perceived as difficult to change, people tend to respond defensively in a variety of biased or self-serving ways. For example, previous work suggests that people are more likely to engage in cognitive distortions that shed a positive light on a bad decision that they are unable to change, compared to a malleable decision (e.g., Gilbert & Ebert, 2002), and to respond in self-serving ways (e.g., retroactive pessimism) when they do not have control over the consequences of a situation (e.g., Tykocinski & Steinberg, 2005). Previous work in the health domain shows that people are less likely to seek negative health-relevant feedback (e.g., diagnostic tests) about diseases they believe are untreatable, versus treatable (e.g., Dawon, Savitsky, & Dunning, 2006). When people do seek and/or receive negative feedback, immutable feedback tends to

be more threatening than mutable feedback, and people's perceptions of the mutability of particular circumstances or situations can influence their responses to that threatening feedback (e.g., Roese & Olsen, 2007). For example, concern about the short-term consequences of smoking is negatively associated with smoking intention and behavior, whereas concern about long-term smoking consequences is not (Chang, 2009).

Together, these findings suggest that, when a person values a particular attribute or action, viewing it as immutable may motivate them to defend its adequacy, whereas viewing it as modifiable may foster further development of the attribute/action. Thus, people who believe their attributes or circumstances are fleeting may be more inclined to accept threatening feedback in an effort to further develop or persist toward a related goal (e.g., changing their health behaviors to reduce malleable risks), whereas threatening feedback may lead those who believe their attribute or situation to be relatively enduring to defend themselves against that unchangeable risk. Given this theorizing, we examined whether providing participants with feedback indicating that the potential consequences of their health behaviors were enduring, versus fleeting, would moderate the influence of receiving threatening feedback on participants' evaluations of the health-assessment tool.

In Study 4, we tested the prediction that participants who received feedback that the consequences of their health behaviors may be enduring, compared to fleeting and compared to a no feedback (control) condition, would be significantly more likely to disparage the quality of the assessment tool. We also predicted that feedback condition and item ambiguity would interact, such that there would be little to no difference between the three feedback conditions in their ratings of the unambiguous items, but that participants in the enduring feedback condition would rate the ambiguous items as lowest in quality, compared to participants in the fleeting consequences and control conditions.

Method

The study hypotheses, method, and data analysis plan were pre-registered (osf.io/4vrct) prior to data collection. The method was identical to the methods of Study 1 and Study 3, with one exception: the feedback manipulation included three conditions in Study 4, as described below.

Participants

A power analysis was conducted to determine the appropriate sample size to attain a power level ($1-\beta$) of .95 when $\alpha = .05$ with an estimated effect size of $d = .20$; this power analysis yielded $N = 390$. A total of 430 English-speaking undergraduate students were recruited for this study and they received one unit of subject-pool credit for their involvement. Seventeen consenting participants were excluded from final data analyses; 15 participants were excluded for indicating that they did not believe the feedback presented in the study and two participants were excluded for repetitive responding. Excluding participants for repetitive responding was not part of our pre-registered plan for these studies, but one participant indicated in the

comments section that they became “bored and started selecting the number closest to the ‘Next’ button” for the last 36 study questions. Based on this information, we conducted an analysis to compare for the last 40 study items the within-person standard deviations of all participants to the participant who indicated boredom; this analysis revealed one other participant with a smaller within-person standard deviation ($SD = 0$) on the last 40 items, suggesting this participant also selected identical responses across the last 40 items, thus we removed this participant as well for repetitive responding.³

The final sample consisted of 413 (241 Female; 172 Male) participants ranging from 17 to 30 years of age ($M = 19.13$, $SD = 1.73$); 25.9% European/White, 36.6% Asian American, 16.5% Other, 10.8% Hispanic/Latino American, 9.0% Black or African American, 1.2% Native Hawaiian or Other Pacific Islander, and .7% More than one race – Black/White.

Measures and Manipulation

The 28-item health assessment, the assessment-item ratings, and the feedback manipulation check were as described above. The key change in Study 4 was the manipulation of the extent to which the false negative feedback communicated either enduring or fleeting consequences of participants’ health behaviors; specifically, participants were randomly assigned to either the no feedback condition (similar to Studies 1–3) or to one of the two threatening feedback conditions. All other aspects of this study were as described above.

Health Feedback

After completing the health-assessment questionnaire, randomly assigned participants received auditory delivery of no feedback (control condition) or of one of two versions of the negative health feedback, indicating their risk for potential consequences of their health behaviors may be either long-term (enduring negative feedback condition) or short-term (fleeting negative feedback condition). Participants in the two negative feedback conditions received the following feedback (differences are bolded in square brackets):

According to the answers you provided, you are at greater risk than most college students for developing [chronic, long-term; temporary, short-term], and [enduring; changeable] health problems. Because you scored in the bottom 35 percent of participants for risks for [chronic; temporary] health problems, you are at heightened risk for [long-term; short-term] periods of poor health, poor safety-related outcomes, and poor psychological outcomes. Specifically, our algorithms estimate that you will develop a 12% reduction in cardiovascular strength; a 4% reduction in bone mass; a 9% reduction in muscle mass; and a 17% increase in body weight, with these changes coming at a relatively early age [and being very difficult to reverse; but being not very difficult to reverse]. Your answers also suggest you are at increased risk for developing [long-term; short-term] psychological problems related to

anxiety and depression. Finally, with regard to forming social and interpersonal connections, which also impact general health, your responses did not allow us to form a conclusion. In summary, considering your final score in the bottom 35 percent, relative to other participants, you appear to be at risk for developing [chronic; temporary] and [enduring; changeable] health problems.

Participants in the control condition were informed that the health-assessment questionnaire could be used to assess general health to determine whether an individual may be at risk for the various physical, psychological, and social health consequences presented to experimental participants, but that they would not receive any scores or health feedback.

Design and Data Analysis

This study was a 3 (feedback: enduring negative consequences versus fleeting negative consequences versus no feedback, manipulated between subjects) \times 2 (ambiguity of the health-assessment items: ambiguous versus unambiguous, manipulated within subjects) mixed between-within design and ANOVA was used to test our statistical hypotheses. The dependent variable was participants’ ratings of the extent to which each health-assessment item was an accurate measure of one’s own health and of most people’s health, averaged. All significance tests were conducted at $p < .05$.

Results

Descriptive statistics for the overall measures are presented in **Table 1**. Condition means and standard deviations for ratings of the accuracy of the assessment items for measuring health are presented in **Table 2**.

Manipulation Checks

Analyses related to our manipulations revealed that participants reported feeling significantly more threatened by the feedback communicating enduring ($n = 133$; $M = 3.17$, $SD = 1.07$) and fleeting ($n = 132$; $M = 3.09$, $SD = .98$) health consequences, compared to participants who received no feedback ($n = 148$; $M = 1.71$, $SD = .88$), $F(2, 410) = 101.29$, $p < .0001$, $\omega^2 = .33$, representing a large effect; subsequent post-hoc tests (Tukey-Kramer Honestly Significant Difference tests) revealed significantly large differences between the means of threat for the enduring consequences and control conditions ($p < .0001$, $d = 1.49$), and for the fleeting consequences and control conditions ($p < .0001$, $d = 1.48$); the mean threat difference (.08) between the two feedback conditions was not statistically significant ($p = .772$). Regarding our manipulation of enduringness of the health consequences communicated by the feedback, participants in the enduring feedback condition ($M = 3.77$, $SD = 1.06$) reported significantly longer-term consequences of their health behaviors ($F(1, 263) = 119.80$, $p < .0001$; $d = 1.34$, a large effect), compared to participants in the fleeting feedback condition ($M = 2.24$, $SD = 1.21$). Conversely, participants who received fleeting feedback ($M = 3.80$, $SD = 1.04$) reported significantly shorter-term consequences of their

health behaviors ($F(1, 263) = 97.07, p < .0001; d = 1.21$, a large effect) than did participants who received enduring feedback ($M = 2.56, SD = 1.00$).

Hypotheses Tests

Our feedback and feedback by ambiguity interaction hypotheses were not supported; the pattern of results in Study 4 was identical to the patterns observed in Studies 1–3. There was a statistically significant main effect of item ambiguity on ratings of the items as accurate measures of health, $F(1, 410) = 1493.54, p < .0001$, such that participants rated the unambiguous items ($M = 3.77, SD = .47$) as higher than the ambiguous items ($M = 2.81, SD = .54$) in accuracy for measuring health. Again, we did not observe a statistically significant main effect of feedback on item ratings, $F(2, 410) = 2.27, p = .104$, nor was there a statistically significant interaction effect between feedback and item ambiguity on ratings of the items as accurate measures of health, $F(2, 410) = 1.52, p = .220$ (see **Figure 2**).

Lastly, we assessed the degree of support for a null model of the above results using Bayesian repeated-measures ANOVA in JASP. We found moderate evidence ($BF_{01} = 3.32$) in favor of the null model (including ambiguity) over the feedback main-effect model, and very strong evidence ($BF_{01} = 30.17$) in favor of the null model (including ambiguity) over the model including the feedback by ambiguity interaction.

General Discussion

The primary goal of the present work was to build upon research indicating that receiving threatening feedback can lead to defensive responses (e.g., denial, discounting).

To extend this literature in the domain of health, we aimed to discern whether individuals broadly disparage an assessment tool used to generate threatening feedback or whether they discount the quality of ambiguous assessment items particularly strongly. Although participants were able to distinguish between assessment items that were designed to have clear implications for health and items that were designed to lack clear implications for health, and although participants who received threatening health feedback reported feeling more threatened by the feedback than did participants who received general information about the test, our hypotheses were not supported. In all four studies, contrary to the study hypotheses, there was no effect of receiving threatening feedback on ratings of the assessment items as accurate measures of health, and there was no interaction between feedback and ambiguity of the health-assessment items on item ratings. Importantly, whether the consequences of one's health behaviors were understood to be enduring or fleeting did not moderate these effects. Participants who received feedback that the negative consequences of their health behaviors were enduring were no more likely than those who received fleeting feedback or no feedback to disparage the health-assessment tool, although this would be predicted by evidence suggesting that people may view fleeting (i.e., malleable) consequences as opportunities for growth and thereby be more accepting of the information than those at risk for enduring consequences, who may be most likely to react defensively by disparaging the tool that generated the feedback.

Disparagement of threatening feedback and/or its source is often thought to stem from people's motivations to engage in self-enhancement, or view themselves in a

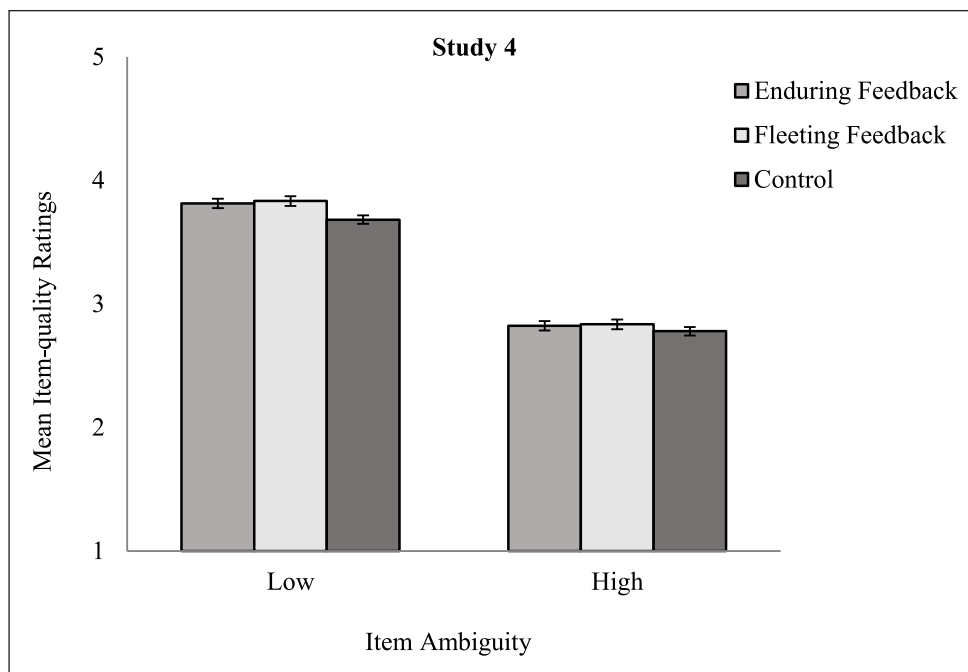


Figure 2: In Study 4, there was no significant main effect of feedback condition and no significant interaction effect between feedback condition and ambiguity of the health-assessment items on participants' reports of the items as accurate measures of health. Error bars represent the standard errors of the means for the between-person feedback conditions.

favorable light (e.g., Kwan, John, Kenny, Bond, & Robins, 2004; Sedikides & Strube, 1997), and ambiguity is theorized to facilitate this process by affording to people an opportunity to draw their own conclusions about information that is vague or unclear (e.g., Dunning et al., 1989). The present findings suggest that perhaps there are varying extents to which self-enhancement may explain processing of threatening feedback. A strong self-enhancement model would be indicated by activation of self-enhancement motives in response to negative feedback across all domains, in which case threatening feedback would automatically and always lead to engaging in self-enhancement. A weaker self-enhancement model would be indicated by selective self-enhancement motives, such that people would not automatically disparage all threatening feedback in all cases, but instead would take into consideration additional contextual factors. This latter model would be in line with research on learning, which provides evidence that people can and do learn from negative feedback and subsequently use it as motivation for goal attainment (e.g., Carver & Scheier, 2000, pp. 43) or for self-improvement (e.g., Breines & Chen, 2012; Kurman, 2006). The present findings point to the possibility of a less ubiquitous, weaker self-enhancement model, whereby there may be contextual factors that are important for understanding the conditions that lead to more, relative to less, disparagement of threatening feedback or its source. Here, we tested ambiguity of the health-assessment tool and enduringness of the health consequences of one's behaviors as assessed by the tool as potentially important conditions under which people disparage the source of threatening feedback, but neither resulted in disparagement of a health-assessment tool following receipt of threatening feedback.

One possible explanation for the present findings is that discounting the source of self-relevant and threatening information is less likely in the domain of health, perhaps compared to other domains (e.g., intelligence). In support of this interpretation, there is some evidence that fear-inducing messages can have a positive impact on health behavior, in particular (Tannenbaum et al., 2015). In the current studies, it may be that participants were more worried by the feedback, given its relation to several aspects of their personal health, than they were defensive. This possibility is consistent with findings from other work showing that college students do not devalue a recommendation based on bogus feedback about their risk for developing a repetitive strain injury from frequent use of a computer mouse, even though they feel vulnerable to the health threat (e.g., de Hoog, Stroebe, & de Wit, 2005). Thus, it may be that people are more likely to be motivated by threatening feedback that is health-related, more so than feedback related to other domains, than to engage in a defensive strategy to disparage its source; this may be particularly true when feedback either clearly is personally relevant or poses obvious risks to their health status. Relatedly, given frequent media attention to the many health risks people's behaviors pose, participants in the present studies may have been aware that they can or need to do more to maintain or achieve

their health goals; accordingly, highlighting this need via threatening feedback could have encouraged motivation for action, rather than dismissal of the feedback source. Research on self-regulation, for example, suggests that people are motivated by discrepancies between current state and desired states (e.g., Ballard, Yeo, Vancouver, & Neal, 2017; Vancouver, Weinhardt, & Vigo, 2014). Accordingly, threatening feedback in the present studies may have acted as an indicator of necessary improvement in the health domain, thereby increasing awareness and subsequent motivation to improve one's health or health behaviors, more so than might be observed in other domains in which there may be less awareness or acceptance of a general need for at least some self-improvement. One approach that may benefit future work, then, could be to contrast potentially motivated responses to threatening feedback in different domains (e.g., health versus academics).

It also may be that defensiveness following threatening feedback is bounded by characteristics of the information itself. Many studies have shown that participants tend to disparage a test providing false feedback about specific health issues; for example, participants who are told that they are deficient in a particular enzyme judge the deficiency test as less accurate than control participants (e.g., Croyle & Sande, 1988; Ditto & Lopez, 1992). In these studies, participants were told that the "deficiency was said to cause individuals who have it to be 'relatively susceptible to a variety of pancreatic disorders' later in life" (Ditto & Lopez, 1992, p. 575). One difference between some of this earlier work and the present set of studies, however, is our use of threatening feedback that described risk for a variety of health-related issues, some of which are common and relevant to young people (e.g., common illnesses such as the flu, obesity), as well as the suggestion of risk for social and interpersonal consequences related to health. Risk for pancreatic disorders later in life may be less salient to college students than risk for obesity or for interpersonal problems. As such, it may be that the level of fear and/or personal relevance communicated by the message plays a role in the effect of threatening feedback on devaluation of the assessment process within the health domain, with broader, more self-relevant threatening feedback resulting in less disparagement and more acceptance, compared with more specific threats that may be more readily discounted.

Study 4 highlights further the notion that there may be different conditions under which people may or may not disparage threatening feedback. In Study 4, we presumed that people who expected that the consequences of their health behaviors were enduring (i.e., fixed) would be more motivated to disparage the tool used to generate that feedback than would people who received feedback that the consequences of their health behaviors were fleeting (i.e., malleable), given differences between the feedback's implications for participants' opportunities for change. The conceptual rationale for Study 4 was based on research showing that people may respond differently to feedback depending on the extent to which the basis of that feedback is malleable (e.g.,

Yeager et al., 2019), with people generally more open to negative feedback regarding changeable attributes or skills (e.g., Zingoni & Byron, 2017). Although this theory is reasonable conceptually and although a number of studies support it, our finding in Study 4 that there were no differences between the two experimental groups in disparagement of the health-assessment tool suggests that malleability of an attribute does not necessarily influence the degree to which people disparage the source of threatening feedback pertaining to that attribute. This possibility is in line with some recent replication studies that do not always find evidence that differentially perceiving malleability in human attributes predicts differential responding to challenge or failure (e.g., Li & Bates, 2019).

Finally, the present findings point to the possibility that individual differences may play an important role in the disparagement of threatening health feedback. Research suggests that how people learn from feedback may depend on how they approach the demands of the learning-related task and on their prior experience with components of the task. For example, participants high in ability or experience, compared to those lower in ability or with less experience, may learn more when they receive less informative feedback because it allows them to be more engaged in cognitive processing related to the task, subsequently leading to more learning (e.g., Kelley & McLaughlin, 2012). Because participants in the present studies likely all were familiar with some form of health information and likely all had prior experience receiving health feedback in one capacity or another, the less informative feedback (i.e., information about their behavioral health consequences without recommendations for improvement) provided to them may have led them to process the information more carefully, resulting in more acceptance than disparagement. Personal or psychological characteristics also may contribute to differences in who disparages threatening health feedback; for example, feedback oriented toward improvement induces self-improvement motivation among persons high in attributes such as self-esteem or perceived control (e.g., see Sedikides & Hepper, 2009 for a review). Future research should assess individual differences in learning related to health information or in psychological attributes (e.g., self-esteem) in order to determine whether people's prior knowledge of health information or their characteristics may predict who is more or less likely to disparage a source of threatening feedback.

Limitations and Future Directions

One limitation of the current studies is that the feedback manipulations and study measures were different from earlier studies examining the extent to which people disparage the source of threatening feedback. For example, previous studies have examined one aspect of health, rather than a wide range of health behaviors as was examined here; previous studies also have used established assessments (e.g., formal IQ tests; Frey & Stahlberg, 1986). Although these differences between earlier-reported and presently reported methods may help explain differences

between our results and earlier-reported ones, it also is important to note that the present methods showed adequate measurement reliability. Additionally, the consistent finding that participants who received the threatening health feedback felt significantly more threatened than participants who received no feedback indicates that, although the feedback created for these studies was broader than feedback provided in previous work, the feedback was experienced as threatening. This conclusion is strengthened further by the finding in Study 4 that participants in both the enduring and fleeting health consequences conditions were similarly threatened by the feedback, whereas control participants were significantly less threatened than participants in both feedback conditions. A second potential limitation is that we did not assess possible indicators of action tendencies (e.g., intentions) that could have provided additional clarity about the present null effects (e.g., Das, de Wit, & Stroebe, 2003). It could be useful to know whether participants who received threatening feedback reported increased intention to change those health behaviors assessed in the present studies.

Other limitations also exist related to our manipulations of feedback and ambiguity. First, the general health-assessment information received by control participants (i.e., no assessment-based results) in the present studies could have prevented control participants from evaluating fully the assessment tool, which could explain why there would be no differences between the feedback and control conditions in ratings of the items; specifically, it may be that participants in the control condition were unwilling to provide higher ratings of the items because they felt ill-equipped to do so, whereas participants in the feedback condition were unwilling to provide higher ratings as a way to disparage the health-assessment tool. Although plausible, Study 4 addresses this possibility somewhat with the inclusion of a second experimental group, allowing for comparison of the two experimental groups, neither of which were more nor less likely than the other to disparage the tool. Second, we manipulated item ambiguity within-subjects, which raises the question of whether experimental participants simply thought that the ambiguous items did not contribute to generating their health-assessment scores; if so, these participants would be no more likely to disparage the items than control participants. Because we observed no main effect of feedback, however, it is difficult to interpret the lack of condition differences in ratings of the ambiguous items. Nevertheless, future research could replicate the present studies using different control groups, for example, that are given neutral feedback or positive feedback, or by manipulating item ambiguity between-subjects.

Implications and Conclusions

Understanding how to improve health is a critical problem of our time, and the present findings have implications for information-processing biases related to self-relevant health information. Research suggests that threatening messages may not be optimal for eliciting health-behavior change (Ruiter, Kessels, Gjalnt-Jorn, & Kok, 2014); on the

other hand, however, the present findings indicate that receiving threatening messages also may not lead people to defensively dismiss the information. Rather than dismiss threatening negative feedback by disparaging the assessment tool that generated it, participants in the present research appeared to view the quality of the assessment tool similarly, regardless of whether or not they received threatening feedback. Importantly, people may be more circumspect when receiving evaluative health information, not necessarily devaluing unfavorable feedback about their health. Given that people do appear to learn from feedback and that the present results do not support two conditions (i.e., ambiguity and malleability) that would theoretically predict differences in receptiveness of such feedback, future work is needed to examine further the potential conditions under which people discount health-assessment tools in response to threatening feedback.

Data Accessibility Statements

Along with the pre-registrations of study hypotheses, materials, and data analysis plans, analysis scripts, data codebooks, and data for each study can be found at the following Open Science Framework links: Study 1 (osf.io/nt2dr); Study 2 (osf.io/xjp47); Study 3 (osf.io/3w2ua); and Study 4 (osf.io/4vrct).

Notes

¹ Our original intention with this work was to first establish an effect of negative feedback on ratings of the quality of the test items and then to develop an intervention intended to attenuate that effect. Given a large literature supporting the notion that people tend to devalue negative feedback and/or its source, we expected to find support for the prediction that participants would disparage the test items after receiving negative health feedback based on the test. After confirming this prediction, we intended to examine whether we could reduce this effect using a distraction manipulation. After finding no support for our hypothesis in Study 1, we conducted the subsequent studies to further evaluate the null effect observed in Study 1 and to attempt to understand conditions under which disparaging the source of threatening feedback may occur. Accordingly, we did not move forward with our initial aim to test the use of distraction to reduce disparagement of the test items following receipt of negative feedback.

² As part of Study 2, several hypotheses were tested that are unrelated to those described in this article. For more information about hypotheses related to the doctor-recommended items, please see the online pre-registration for Study 2 (osf.io/xjp47).

³ We conducted our analyses of Study 4 including data from the two participants whose standard deviations indicated repetitive responding, and the pattern of results was unchanged for the ambiguity main effect ($F(1, 412) = 1489.67, p < .0001$), the feedback main effect ($F(2, 412) = 2.06, p = .1288$), and their interaction ($F(2, 412) = 1.41, p = .2453$). Because excluding these

participants did not change the pattern of results in Study 4 and Studies 1–3 were almost identical methodologically, with Study 4 being the first time a participant indicated repetitive responding via free-response comments, we did not revisit our analyses for Studies 1–3 following analyses of the data from Study 4.

Additional File

The additional file for this article can be found as follows:

- **Appendix S1.** Included as supplemental material with this article is one appendix providing the full list of health-assessment questionnaire items used in these studies (please see Appendix S1). Our manipulation of item ambiguity was built into this questionnaire and these items were rated by participants as accurate measures of health, our dependent variable of interest. DOI: <https://doi.org/10.1525/collabra.259.s1>

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Competing Interests

The authors have no competing interests related to this manuscript. Antonio Freitas serves as an editor for *Collabra: Psychology*. He was not involved in the review of this manuscript.

Author Contributions

Ashley Araiza and Antonio Freitas contributed equally to the conceptualization, design, data collection, and data analyses related to these studies. Ashley Araiza drafted the first version of this manuscript, and Ashley Araiza and Antonio Freitas contributed equally to revisions and to final approval of this manuscript.

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