# The Effect of Message Frames and CVD Risk Factors on Behavioral Outcomes

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***Objectives*: To examine the interactive effects of message frames and CVD risk factors on women's knowledge, beliefs, efficacy, and behavioral intentions. *Methods*: In a randomized experiment, women (n = 395) read either a loss- or gain-framed heart disease prevention message to test differential effects by risk factor status. *Results*: Messages significantly increased knowledge, self-efficacy and intervention efficacy beliefs, and behavioral intentions. Frames had significantly different effects on self-efficacy and behavioral intent to engage in detection behaviors by parental risk factor status. *Conclusions*: Further study is warranted to assess effects of frames on behavioral outcomes among women at elevated CVD risk.**

***Key words*: information processing, message framing, women and heart disease prevention, health communication**

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Cardiovascular disease (CVD), including heart disease (HD) and stroke, is the leading cause of death and premature permanent disability among women in the United States.[1] There is strong evidence of modifiable risk factors attributable to HD (eg, cigarette/tobacco smoke, high blood pressure and cholesterol, diabetes mellitus, overweight/obesity, and physical inactivity), and there are well-established methods to lower risk.[2,3] Yet prior research has shown a high prevalence of HD risk factors and low levels of awareness, knowledge, and accurate perceptions of risk among women age ≥ 25 years.[4-6] In response, the American Heart Association, the National Heart Lung Blood Institute, and their partners have launched several national campaigns to raise heart health awareness among women ≥ 25 years of age (eg, the Red Dress "Heart Disease Doesn't Care What You Wear—It's the #1 Killer of Women" campaign targeting women ages 40-60 years as part of *The Heart Truth*, www.nhlbi.nih.gov/health/hearttruth).

Although the risk of HD increases with age, the fact that risk factors for HD are progressive throughout the life course[7,8] necessitates the design and evaluation of health communication and health behavior interventions targeting adult women at an earlier age (18-24 years). Further, studies show that the major behavioral and physiological HD risk factors

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tend to aggregate in families,[9,10] meaning that offspring of people with HD are more likely to develop it themselves. Offspring are a high-risk population who may benefit from early educational and behavioral interventions targeting prevention and early detection of major risk factors. Ensuring that people who are at elevated risk are exposed to effective informational messages is an important public health goal.[11-13]

Prior national surveys by the American Heart Association indicate that younger women (ages 25-44) are less aware than older women (≥ 45) that HD is the leading cause of death.[4,5,14] In addition, results from the 2003 National Youth Risk Behavior Survey[15] demonstrated that the majority of HD risk behaviors are initiated during adolescence, with the prevalence of several behaviors at levels of concern among females at or near 18 years of age. Results from the National College Health Risk Behavior Survey[16] found that the percentages of college women receiving information from their current school on topics related to HD prevention (eg, tobacco use prevention, dietary behaviors and nutrition, and physical activity and fitness) ranged between ~30% and 39%. These women also reported cigarette smoking (28%) and low levels of physical activity (62.4%). Cigarette smoking nationwide among college students significantly increased between 1993 and 1997 (the most recent data available to date), with greater increases in public colleges (22.0% to 29.3%) and no differences across student subgroups (sex, race/ethnicity, and year in school).[17]

Because the prevalence of HD risk factors such as smoking and physical inactivity among female college students is a cause for national concern and because these risk factors are among the leading preventable causes of death and disability, it is necessary to assess the educational and motivational needs of this population.[18]

**Purpose**

Given the need to design and evaluate messages targeting young women, particularly those with elevated risk of HD, and to motivate behaviors associated with HD risk reduction, the purpose of this research was to (a) assess the HD awareness, knowledge, risk and efficacy perceptions, and related behavioral intentions of young women ages 18-24 years and (b) develop and evaluate persuasive messages designed to increase awareness and instill favorable thoughts that motivate preventive behaviors.

In the current study we examined the interaction between the type of message (either highlighting the probable benefits/gains of engaging in healthy behaviors *or* the probable costs/losses of not doing so in either the short-term or long-term future) and characteristics of the message recipient (personal/family history of HD risk factors).

**Framing of Health Messages**

The use of different wording strategies to elicit preferences between decision alternatives is known as *framing* a message.[19,20] Prior work on gain- vs loss-framed health messages are based on prospect theory,[21] which argues that individuals are likely to tolerate risk when considering potential losses and to avoid risk when considering potential gains. Therefore, people may respond differently to a health message framed as a loss or as a gain, and the likelihood of choosing a risky option will depend on the message frame. The application of prospect theory to health behavior suggests that when a person considers a risky situation (eg, the possibility of detecting a risk factor for HD such as high blood pressure), a message that focuses on the losses associated with not performing a behavior may be more effective than one on the gains associated with doing so. However, when a person considers a situation not perceived as risky, a message that focuses on the salient gains associated with performing a behavior may be more effective.[22] Detection behaviors such as screening for high blood cholesterol are generally regarded as risky because a person may learn of the presence of a risk factor or disease. In contrast, prevention behaviors such as not smoking, engaging in regular exercise, and following a healthy diet are generally regarded with little risk.

The majority of gain- vs loss-framing studies largely address cancer-related prevention and detection behaviors.[23,24] The preponderance of evidence demonstrates that indeed loss-framed messages are more effective in promoting detection behaviors[19,23,24] and gain-framed messages are more effective in promoting prevention behaviors.[20,25]

The likely effectiveness of gain- vs loss-framed messages to address risk perceptions and related behaviors among young women might not be as straightforward as prior applications of prospect theory suggest. Motivating behavior change among young women using HD prevention messages (a topic perceived as less worrisome and potentially less risky compared to cancer among women[4]) may be problematic due to tendencies of young adults to underestimate their risk (especially for conditions perceived as preventable) and to fail to recognize the relationship between personal actions and susceptibility to harm.[26-30] Designing preventive health and early detection messages for young women also may be challenged by the nature of HD prevention itself—that the associated adverse health-related events are relatively uncertain and may (or may not) occur in the very distant future. Young adults may weigh the probability of undesirable health consequences in the distant future against the probability of unfavorable consequences at present, underscoring the need to understand salient health and nonhealth beliefs[31] associated with the behavior being advocated and to incorporate that knowledge into messages. It is for this reason that we included a time orientation when we designed and evaluated framed messages, in a 2 (gain vs loss) x 2 (present vs future) factorial design.

The effect of gain vs loss message frames on mediators theorized to motivate health behavior change particularly related to HD prevention is largely unexplored. Framing techniques may influence health beliefs such as perceived susceptibility to HD, which may motivate behavior change;[32] beliefs that one can perform a specific detection or prevention behavior (self-efficacy) and that the behavior will achieve a desired outcome (intervention efficacy[33,34]); or intent to take action (behavioral intent[35]).

We predicted that young women would have low awareness and knowledge and inaccurate perceptions of HD risk and that the experimental messages would significantly and differentially affect psychosocial outcomes that are linked to behavior change (eg, a message frame by women's risk factor status interaction).

## METHODS

### Overview

Four experimental message conditions were developed using a 2 (gain or loss) x 2 (present or future time orientation) factorial design based on an iterative data collection and analysis process organized into 2 phases: Phase 1 involved qualitative interviews and focus group discussions to develop and pilot test messages; Phase 2 involved exposure and evaluation of messages among a sample of 395 college women (ages 18-24 years) recruited from 4 universities located in Maryland and the District of Columbia. (Institutional Review Boards at all participating universities approved the study protocol and informed consent procedures.)

### Phase 1: Message Development

Eleven in-depth 90-minute qualitative semistructured interviews[36] with female college students were conducted to gain a better understanding of participants' salient HD-related perceptions and beliefs. The information gained from these interviews guided the development of print message themes and pre- and postexposure study-specific instruments. Message arguments were based on identified themes. Factual information about CVD risk factors was included and reviewed for accuracy by content-area experts.

Messages and instruments were pilot tested and discussed with small groups of women in a focus group format (n = 24 participants) and revised as needed. Messages, printed in black ink on white paper, were 2 pages in length and were organized using an identical format; every message had the same number of arguments and factual content. The main components were facts about women and heart disease, main behavioral risk factors associated with heart disease, likely immediate or long-term benefits (or consequences) of healthy (or unhealthy) activities**,** and suggested actions. The wording of information in each message was equivalent concerning the known modifiable HD risk factors and actions that a person could take to detect risk factors and lower risk. Message arguments for the benefits of engaging in heart-healthy behaviors vs the consequences of not doing so in the present or future were varied to highlight the framing condition being tested. Pivotal message statements illustrating wording variations across conditions are in Table 1.

**Table 1**
**Pivotal Message Statements**

| Message Condition | Sample Statements |
|---|---|
| **Gain x Present** | The GOOD NEWS about heart disease TODAY |
| **Gain x Future** | The GOOD NEWS about heart disease and your FUTURE |
| **Loss x Present** | The BAD NEWS about heart disease TODAY |
| **Loss x Future** | The BAD NEWS about heart disease and your FUTURE |
| **Gain x Present** | The likely benefits today of healthy activities:<br>Boost your energy; help your ability to cope with school stress |
| **Gain x Future** | The likely future benefits of healthy activities:<br>Achieve your goals for yourself as an active older adult;<br>Have the strength to go for long walks, garden, or play with future children or grandchildren; maintain a healthy weight; be less dependent on others to do things |
| **Loss x Present** | The likely consequences today of unhealthy activities:<br>Lower your energy; hurt your ability to cope with school stress |
| **Loss x Future** | The likely future consequences of unhealthy activities:<br>Fail to achieve your goals for yourself as an active older adult;<br>Lack the strength to go for long walks, garden, or play with future children or grandchildren; have difficulty maintaining a healthy weight; be more dependent on others to do things |

**Phase 2: Message Testing Protocol**

**Sample size.** Calculation of an acceptable sample size was based on 3 decision points: (a) the desired significance level (alpha) and power (1-*B*), (b) the type of data collected and statistical tests performed, and (c) the anticipated effect size. Standard alpha and power levels were employed, set at .05 and .80, respectively. The main statistical test was analysis of variance (ANOVA) to assess differences in main effects and interactions between experimental factors. A conservative effect size (mid range between small and medium) of .20, with 1 degree of freedom, required approximately 99 participants in each of 4 conditions.[37] Therefore, the sample size of 98 to 100 women per condition with a total of 395 participants was adequate.

**Recruitment.** Recruitment of female college students involved the following groups who had not participated in an earlier phase of this research: (a) those enrolled in an undergraduate psychology course that had a research participation requirement or extra credit option; (b) members of campus activity groups such as sororities, university choirs, and black student organizations; and (c) the general student body, using flyers placed in public spaces (eg, library billboards, school newspaper). Recruitment materials invited women to participate in a one-time data collection session for which they were asked to complete a questionnaire and read health information. All data sessions were conducted in a classroom and facilitated by either the lead author or a part-time research assistant. There were a total of 32 one-hour data collection sessions (ranging from 2 to 37 participants per session).

**Procedures.** Participants completed a questionnaire immediately before and after a timed 3-minute reading task in which they were randomly assigned to read one of the 4 experimental messages. Participants were asked to pull a folded piece of paper from a bag that had up to 400 pieces, each with a number that ranged from 1 to 400, and these numbers corresponded with message conditions to determine message assignment.

Messages were inserted within the questionnaire and appeared immediately

after the final pretest page. Participants were instructed when to start each section of the questionnaire. Upon completing the questionnaire, each participant received $5 and an informative brochure from the American Heart Association about women and HD.

**Measures.** Sociodemographic information was measured using items from the National College Health Risk Behavior Survey.[16] Personal and family HD risk factor history were measured by asking participants to mark an "X" for all that applied: "Have you, either of your biological parents or grandparents, now or in the past: had high blood pressure (hypertension), high cholesterol, a heart attack, a stroke (brain attack), or diabetes; been overweight (20 or more pounds); or smoked cigarettes (socially or regularly)?" For analysis purposes, overall personal risk factor status was computed as a dichotomous variable such that a "personal history of at least one risk factor = 1" and "no personal risk factors = 0." Family history variables were recoded to create dichotomous variables that would indicate "at least one parent with a specified risk factor or event = 1" and "no parent = 0." These variables were used to assess potential main and interactive effects of risk factors status (personal and family history).

Measures of awareness and knowledge at pre- and postexposure used items from the American Heart Association's national survey of women's HD and stroke awareness.[38] Women were asked to list (with no prompts) "Based on what you know, what are the major causes of heart disease?" Responses were coded for accuracy, and correct responses were summed. Ten additional "true/false/don't know" response options were used to assess changes in knowledge and the number of correct responses summed.

Measures of susceptibility perceptions included a series of 5-point items that asked, "How worried do you feel about developing...heart disease?" (compared to a list of other illnesses[38]), where 1 = not at all worried, 2 = slightly worried, 3 = moderately worried, 4 = very worried, 5 = extremely worried.[28]

Self-efficacy to prevent HD involved 2 items that asked participants to indicate "the strength of my belief that I can prevent myself from developing HD at this time in my life (in the future)," whereby respondents were instructed to indicate the strength of their belief by marking an "X" on a line that was labeled (0% "can not prevent") at the far left end to 100% ("certain can prevent") at the far right end. The line was increasingly labeled from left to right at 10% intervals that were located equidistant.[34] Measures of the perceived efficacy of behavioral interventions used a similar response format to assess the strength of the belief that a specific behavior "can prevent me from developing heart disease."

Behavioral intent measures assessed the perceived likelihood that participants would engage in specific detection and prevention behaviors within the next 30 days using a similar response scale ranging from 0% (not at all likely) to 100% (completely likely).

For the purpose of data reduction, sets of perceptions-change variables were combined into summary indices based on the results of principal component exploratory factor analysis.[39] The goal of this procedure was to reduce a large set of related variables into a smaller set of general summary scores, decreasing the number of dependent variables that were used to assess message X personal/family heath history effects on perception outcomes. Table 2 provides the final factor loadings, Eigen values, percents of variance explained**,** and reliability results for each perception scale.

**Analysis plan.** Phase 2 data analysis involved several steps. First, we executed basic univariate descriptive statistics to explore the sociodemographic and health status characteristics of the sample, and bivariate analyses (including Pearson correlations, t-tests, chi-square) to assess possible associations between these variables and message conditions. Second, we assessed pre- and postexposure HD-related knowledge, awareness, beliefs and behavioral intentions. Third, we performed multivariate analyses (ANCOVA) to evaluate main and interactive effects of message variables and receiver characteristics (personal or family HD history) on outcomes.

## RESULTS

### Sociodemographic Characteristics

Most participants (65.1%) were 18 years old and self-identified "white" (65.7%). Sociodemographic characteristics are provided in Table 3.

Pearson correlations revealed statisti-

**Table 2**
**Factor Analysis Results, Sample Sizes (n), Means (M), and Alpha Coefficients for Change in Perception Scales**

| Change in Perception Variables | 1 Component: Factor Loadings | Eigen Value | % of Variance Explained | n | M | Alpha |
|---|---|---|---|---|---|---|
| **Change in Perceived Heart Disease Susceptibility** (5=Extremely, 3=moderately, 1=not at all worried) How worried do you feel about developing…? | | 2.33 | 77.81 | 393 | .64 | .85 |
| Heart disease | .76 | | | | | |
| Heart attack | .83 | | | | | |
| Stroke | .73 | | | | | |
| **Self-efficacy to Prevent Heart Disease** The strength of my belief that I can prevent myself from developing heart disease… | | 1.72 | 86.16 | 394 | 8.78 | .83 |
| at this time in my life | .92 | | | | | |
| in the future | .92 | | | | | |
| **Efficacy of Behavioral Interventions** The strength of my belief that… can prevent me from developing heart disease: | | 1.98 | 66.25 | 386 | 4.42 | .69 |
| not smoking | .69 | | | | | |
| a low-fat diet | .86 | | | | | |
| regular exercise | .87 | | | | | |
| **Behavioral Intentions** The likelihood that I will… in the next 30 days: | | | | | | |
| ***Screening Intentions*** | | 1.65 | 82.96 | 389 | 18.72 | .79 |
| have my blood pressure checked | .91 | | | | | |
| have my cholesterol checked | .91 | | | | | |
| ***Dietary Behavior Intentions*** | | 1.56 | 78.38 | 386 | 10.52 | .72 |
| eat low amounts of salt | .88 | | | | | |
| eat low amounts of dietary cholesterol | .88 | | | | | |
| ***Physical Fitness Intentions*** | | 1.43 | 71.80 | 389 | 12.42 | .60 |
| increase my daily physical activity | .84 | | | | | |
| try to lose excess body fat | .84 | | | | | |
| ***Smoking Intentions*** | | 1.33 | 66.55 | 161 | 9.19 | .48 |
| resist any smoking | .81 | | | | | |
| decrease my cigarette smoking | .81 | | | | | |

**Table 3**
**Frequencies of Sociodemographic Variables**

| Variables | f (%[a]) |
|---|---|
| **Age (N = 395)** | |
| 18 | 257 (65.1) |
| 19 | 67 (17.0) |
| 20 | 39 (9.9) |
| 21 | 20 (5.1) |
| 22 | 9 (2.3) |
| 23 | 3 (0.8) |
| **Race/Ethnicity (n = 394)** | |
| White | 259 (65.7) |
| Black | 68 (17.3) |
| Hispanic/Latino | 18 (4.6) |
| Asian/Pacific Islander | 34 (8.6) |
| American Indian/Alaskan | 1 (0.3) |
| Other | 14 (3.6) |
| **Family Income (n = 373)** | |
| Less than $25 000 | 9 (2.4) |
| $25 000 - $49 000 | 47 (12.6) |
| $50 000 - $74 000 | 84 (22.5) |
| $75 000 - $99 000 | 70 (18.8) |
| $100 000 - $124 000 | 60 (16.1) |
| $125 000 + | 103 (27.6) |
| **Mother's education (N = 395)** | |
| Did not finish high school | 6 (1.5) |
| High school graduate or GED | 54 (13.7) |
| Some post-high school education | 68 (17.2) |
| College graduate | 144 (36.5) |
| Some graduate school | 42 (10.6) |
| Completed postgraduate degree | 79 (20.0) |
| Not sure | 2 (.5) |
| **Father's education (n = 394)** | |
| Did not finish high school | 10 (2.5) |
| High school graduate or GED | 35 (8.9) |
| Some post-high school education | 73 (18.5) |
| College graduate | 95 (24.1) |
| Some graduate school | 41 (10.4) |
| Completed postgraduate degree | 131 (33.2) |
| Not sure | 9 (2.3) |

**Note.**
**a Valid percents were used when fewer than 395 women responded to a particular item.**

cally significant correlations between sociodemographic covariates including race (white vs nonwhite), parent education, and family income ($P \leq .05$); these variables were used in further analyses as a cluster of sociodemographic variables as an indicator of family socioeconomic status. Chi-square tests also revealed relationships between sociodemographic variables (family income and parent's education) and family history of HD risk factors. Because it is important to understand the impact of message and CVD risk-factor status on study outcomes without regard to sociodemographic variables, we controlled for the effects of race, parent education, and family income by using these variables as covariates in multivariate tests.

### Personal and Family History of Risk Factors

Approximately 39% of women reported one or more personal risk factors for HD, with the most frequently reported personal and family risk factors being smoking, overweight, and high blood pressure and cholesterol. The frequencies are presented in Table 4.

### Evaluation of Messages and Verification of Random Assignment

Feedback from focus group participants who pilot tested and discussed each of the messages indicated that the facts and persuasive arguments featured in each message were acceptable, comprehensible, and personally relevant. Participants indicated that they could discern which messages were intended to present each frame.

Analyses to verify random assignment found that there were no statistically significant associations between any sociodemographic variables (including race, parent education, and family income) or health variables (eg, personal and parental risk factor status variables) with message variables. In addition, t-tests revealed no significant differences across messages in pretest knowledge.

Messages significantly increased knowledge from pre- to post-message exposure ($P=.0001$), indicating that the messages effectively provided information about HD. In addition, messages significantly changed attitudes such that t-tests indicated a statistically significant increase in state positive affect (PA) and state negative affect (NA) scores[40] before and after message exposure ($P=.0001$). However, no significant differences were found across message manipulations for

**Table 4**
**Frequency and Percents of Overall Personal and Family Risk Factor Status Variables**

| Risk Factor | Status n (%) |
|---|---|
| **Overall Personal Risk Factor Status** | |
| Personal history of one or more risk factors | 154 (39.1) |
| high blood pressure (hypertension) | 17 (4.3) |
| high cholesterol | 34 (8.6) |
| diabetes | 1 (.3) |
| overweight (20 or more pounds) | 50 (12.7) |
| smoke cigarettes (socially or regularly) | 90 (22.8) |
| **Overall Family Risk Factor Status** | |
| One or more parent(s) with a history of… | |
| high blood pressure or high cholesterol | 237 (60.0) |
| overweight | 192 (48.7) |
| cigarette smoking | 199 (50.4) |
| One or more parent(s) or grandparent(s) with a history of… | |
| heart attack(s), stroke(s), or diabetes | 266 (67.5) |

mean change in either PA or NA scores.

**Heart Disease Knowledge, Awareness, and Perceptions Pre- and Postexposure**

Knowledge and awareness. Table 5 provides preexposure, postexposure, and significant changes in frequencies and percents for correctly identified causes of HD. At pretest, the most reported causes for HD were nutrition/diet (n = 300, 76%), physical inactivity (n = 240, 61%), and heredity (n =170, 43%). At posttest, smoking became one of the 3 most frequently reported causes (n = 318, 80.5%).

**Table 5**
**Knowledge: Frequency and Percentages for Correctly Identified Causes of Heart Disease**

| Causes | Correctly Identified Causes: Pretest n (%) | Correctly Identified Causes: Posttest n (%) | % Change |
|---|---|---|---|
| **Smoking** | 156 (39.5) | 318 (80.5) | 41.0 |
| **Overweight** | 84 (21.2) | 178 (45.0) | 23.8 |
| **Physical Inactivity** | 240 (60.7) | 362 (91.6) | 30.9 |
| **Nutrition/Diet** | 300 (75.9) | 378 (95.7) | 19.8 |
| **High Blood Pressure** | 73 (18.4) | 297 (75.2) | 56.8 |
| **High Cholesterol** | 117 (29.6) | 303 (76.7) | 47.1 |
| **Hereditya** | 170 (43.0) | 36 (9.1) | -33.9 |

**Note.**
**a Heredity was not mentioned in messages as a risk factor for heart disease; rather, the messages highlighted the known modifiable risk factors. This may explain the low frequency of responses postexposure that list heredity as a cause of heart disease.**

**Table 6**
**Frequency and Percentages for Correctly Answered Heart Disease Knowledge Items**

| Questions | Correctly Identified Pretest n (%) | Correctly Identified Posttest n (%) | % change |
|---|---|---|---|
| **Heart disease is the leading cause of death in women.** | 90 (22.8) | 388 (98.5) | 75.7 |
| **Black women are more likely than white women to die from a heart attack or stroke.** | 98 (24.8) | 358 (90.6) | 65.8 |
| **Some forms of heart disease may result in a stroke.** | 337 (85.5) | 376 (95.2) | 9.7 |
| **Women are more likely to delay seeking care for heart attack symptoms than men.** | 117 (44.9) | 349 (88.4) | 43.5 |
| **Women are less likely to get heart disease after menopause than before.** | 116 (29.4) | 284 (71.9) | 42.5 |
| **A blood pressure of 140/90 is currently the cutoff for high pressure.** | 57 (14.5) | 248 (62.8) | 48.3 |
| **A total cholesterol level of 200 is currently the cutoff for high cholesterol.** | 111 (28.2) | 264 (67.0) | 38.8 |
| **When people have a heart attack, they are likely to die quickly.** | 236 (60.1) | 312 (79.0) | 18.9 |
| **Young adults, ages 18-24 years, are still too young to have high blood pressure.** | 360 (91.4) | 382 (96.7) | 5.3 |
| **High blood pressure usually has no symptoms.** | 73 (18.5) | 319 (80.8) | 62.3 |

Table 6 provides the frequencies and percentages for correctly identified HD knowledge items that were measured using "true/false/don't know" items before and after message exposure. The mean number of correct knowledge items at pretest was 4.19 (n = 392, SD = 1.59, range 0-9), and at posttest the mean number was 8.30 (n = 393, SD = 1.42, range 4-10).

At pretest, the majority of responders (65.9% of 382) indicated that breast cancer/cancer is "the greatest health problem facing women today." Only 11 women responded that HD is women's greatest health problem. Similarly, 75% of 370 responders believed that breast cancer/cancer was the leading cause of death for women, and only 17% correctly identified HD or heart attacks.

**Perceptions.** Mean scores at pre- and post-message exposure are listed in Table 7 and statistically significant changes are denoted.

Paired sample t-tests revealed significant increases in perceived illness susceptibility for HD including heart attack and stroke (P<.0001) and cancer (P = .05). Participants were "moderately worried" about HD and related illnesses but more worried about cancer. Analyses regarding self-efficacy to prevent HD using paired samples t-tests found that the strength of this perception increased significantly "at this time in my life" (t[393] = -8.75, P = .0001, mean difference = -8.39) and "in the future" (t[393] = -10.74, P = .0001, mean difference = -9.27). Means, standard deviations, and the range of scores are provided in Table 7 and indicate strong beliefs about self-efficacy to prevent the development of HD.

**Table 7**
**Means, Standard Deviations, and Ranges for Perception Variables**

| Perception | Pretest M | Pretest SD | Pretest Range | Posttest M | Posttest SD | Posttest Range |
|---|---|---|---|---|---|---|
| **Illness Susceptibility** (5=Extremely, 3=moderately, 1=not at all worried) How worried do you feel about developing…? | | | | | | |
| Cancer * | 3.12 | 1.11 | 1-5 | 3.20 | 1.10 | 1-5 |
| Breast Cancer | 3.18 | 1.13 | 1-5 | 3.17 | 1.11 | 1-5 |
| Heart disease **** | 2.57 | 1.20 | 1-5 | 3.33 | 1.10 | 1-5 |
| Heart attack **** | 2.48 | 1.26 | 1-5 | 3.10 | 1.18 | 1-5 |
| Stroke **** | 2.27 | 1.22 | 1-5 | 2.83 | 1.22 | 1-5 |
| Osteoporosis | 2.66 | 1.19 | 1-5 | 2.73 | 1.20 | 1-5 |
| Alzheimer's | 2.48 | 1.23 | 1-5 | 2.45 | 1.23 | 1-5 |
| Diabetes | 2.30 | 1.26 | 1-5 | 2.35 | 1.28 | 1-5 |
| HIV/AIDS *** | 2.54 | 1.36 | 1-5 | 2.45 | 1.33 | 1-5 |
| **Self-efficacy to Prevent Heart Disease** The strength of my belief that I can prevent myself from developing heart disease… | | | | | | |
| at this time in my life**** | 72.22 | 19.38 | 5-100 | 80.61 | 16.81 | 4-100 |
| in the future **** | 70.78 | 19.05 | 5-100 | 79.97 | 16.88 | 10-100 |
| **Efficacy of Behavioral Interventions** The strength of my belief that…can prevent me from developing heart disease: | | | | | | |
| not smoking **** | 79.23 | 20.78 | 1-100 | 87.38 | 15.87 | 0-100 |
| a low-fat diet **** | 80.23 | 17.96 | 5-100 | 85.42 | 14.33 | 20-100 |
| regular exercise **** | 83.30 | 14.23 | 15-100 | 86.08 | 13.88 | 5-100 |
| **Behavioral Intentions** The likelihood that I will… in the next 30 days: | | | | | | |
| have my blood pressure checked **** | 31.94 | 32.80 | 0-100 | 43.55 | 33.99 | 0-100 |
| have my cholesterol checked **** | 21.60 | 26.60 | 0-100 | 35.65 | 30.65 | 0-100 |
| eat low amounts of salt **** | 53.62 | 29.24 | 0-100 | 60.43 | 27.98 | 0-100 |
| eat low amounts of dietary cholesterol **** | 53.46 | 26.84 | 0-100 | 61.56 | 26.51 | 0-100 |
| increase my daily physical activity **** | 60.12 | 25.93 | 0-100 | 69.36 | 24.09 | 0-100 |
| try to lose excess body fat **** | 60.55 | 29.93 | 0-100 | 66.71 | 29.26 | 0-100 |
| resist any smoking **** | 73.89 | 36.29 | 0-100 | 79.38 | 31.62 | 0-100 |
| decrease my cigarette smoking | 67.98 | 37.37 | 0-100 | 70.22 | 35.68 | 0-100 |

**Note.**
* **Statistically significant change in mean from pre- to post-message exposure, P ≤ .05.**
*** **Statistically significant change in mean from pre- to post-message exposure, P ≤ .001.**
**** **Statistically significant change in mean from pre- to post-message exposure, P ≤ .0001.**

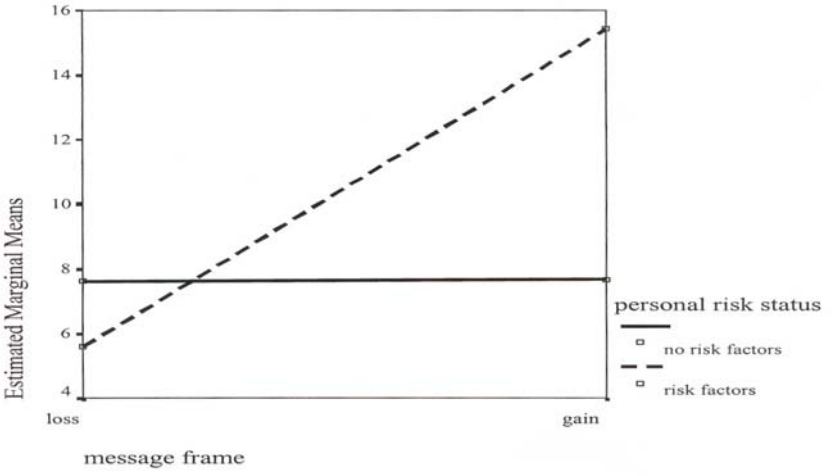
Mean scores to measure the perceived efficacy of behavioral interventions to prevent HD significantly increased for 3 behaviors (not smoking, having a low-fat diet, and exercising regularly) at P = .0001 (see Table 7 for means, standard deviations, and ranges). Posttest mean scores suggested that students had strong be-

## Table 8
## Significant ANCOVA Results Comparing Mean Change in Outcome Variables by Health History and Message Variables (Gain and Loss Framed) Controlling for Socioeconomic Covariates

| Outcome Variable | Model Variables | F | df | P | Effect Size | $R^2$ |
|---|---|---|---|---|---|---|
| **Change in Susceptibility** | Health History: **Personal Risk Factor Status** | 2.82 | 1 | .09 | | |
| | Message Frame: Gain or Loss | 4.11 | 1 | .04* | .01 | |
| | Interaction: Health History x Message Frame | 0.01 | 1 | .90 | | .03 |
| | Health History: **Parent History of Over Weight** | 1.21 | 1 | .27 | | |
| | Message Frame: Gain or Loss | 4.26 | 1 | .04* | .01 | |
| | Interaction: Health History x Message Frame | 0.32 | 1 | .57 | | .03 |
| | Health History: **Parent History of Smoking** | 0.51 | 1 | .47 | | |
| | Message Frame: Gain or Loss | 4.05 | 1 | .04* | .01 | |
| | Interaction: Health History x Message Frame | 0.13 | 1 | .71 | | .03 |
| **Change in Self-efficacy** | Health History: **Personal Risk Factor Status** | 2.81 | 1 | .09 | | |
| | Message Frame: Gain or Loss | 8.39 | 1 | .004** | .02 | |
| | Interaction: Health History x Message Frame | 8.21 | 1 | .004** | .02 | .06 |
| | Health History: **Parent History of High Blood Pressure or Cholesterol** | 2.18 | 1 | .14 | | |
| | Message Frame: Gain or Loss | 4.59 | 1 | .03* | .01 | |
| | Interaction: Health History x Message Frame | 0.45 | 1 | .50 | | .04 |
| | Health History: **Parent History of Over Weight** | 0.00 | 1 | .97 | | |
| | Message Frame: Gain or Loss | 5.55 | 1 | .01** | .01 | |
| | Interaction: Health History x Message Frame | 1.76 | 1 | .18 | | .04 |
| | Health History: **Parent History of Smoking** | 0.71 | 1 | .40 | | |
| | Message Frame: Gain or Loss | 5.07 | 1 | .02* | .01 | |
| | Interaction: Health History x Message Frame | 2.16 | 1 | .14 | | .04 |
| | Health History: **Family History of Heart Attack, Stroke, or Diabetes** | 2.48 | 1 | .11 | | |
| | Message Frame: Gain or Loss | 3.72 | 1 | .05* | .01 | |
| | Interaction: Health History x Message Frame | 2.16 | 1 | .14 | | .04 |
| **Change in Intent to Check Blood Pressure or Cholesterol** | Health History: **Parent History of High Blood Pressure or Cholesterol** | 0.08 | 1 | .76 | | |
| | Message Frame: Gain or Loss | 5.20 | 1 | .64 | | |
| | Interaction: Health History x Message Frame | 5.13 | 1 | .02* | .01 | .02 |

**Note.**
**Covariates included in each model: Race/ethnicity, mom education, dad education, and family income.**
* **P ≤.05**
** **P ≤.01**
*** **P ≤.001**

**Figure 1**
**Mean Change in Perceived Self-efficacy Pre- to Post-message Exposure: Statistically Significant Interaction between Message Variables (gain and loss framed) and Personal Risk Factor Status**




liefs about the efficacy of the behavioral interventions (pre- and posttest means were between approximately 80 and 87 on a scale ranging from 0-100).

Behavioral intentions for 7 of 8 behaviors significantly increased (P=.0001): check blood pressure, check cholesterol, eat low amounts of salt, eat low amounts of dietary cholesterol, increase daily physical activity, try to lose excess body fat, and resist any smoking in the next 30 days. Although 90 participants (22.7%) indicated a personal smoking history, 98.2% (n = 388) indicated at pretest their intent to "resist any smoking," and all 395 affirmed the same intent at posttest. In addition, 54.6% (n = 216) indicated intent to "decrease cigarette smoking" at pretest and 53% (n = 210) at posttest. The reliability of smoking intentions, therefore, is compromised. This problem occurred despite instructions to skip relevant items "if you are not a smoker."

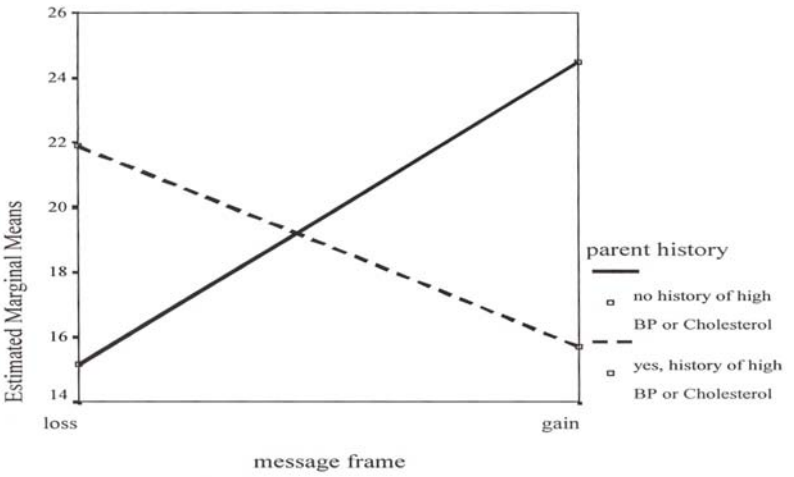
**Main and Interactive Effects of Message Frame x Risk Factor Status**

Table 8 provides the results of ANCOVAs to assess significant main and interactive effects of message frames (gain vs loss) and risk factor variables on study outcomes. Not shown are analyses using a time orientation variable (present vs future frames) as there were no main or interactive effects of time orientation on any outcomes.

There were no significant differences across messages or any health history variables in knowledge change from pre- to post-message exposure. Knowledge increased significantly among all groups of participants and across all message conditions. There was a statistically significant interaction between message frame (gain vs loss) and personal risk factor status for mean change in self-efficacy ($F[1,291] = 8.21$, $P = .004$, effect size = .02). Due to multiple comparisons the overall significance level for an individual comparison must be considered. When Bonferroni correction is used,[41] the alpha for each test is equal to the overall probability of committing a type I error (set at 0.05) divided by the number of tests (there were 5 tests for each dependent variable, therefore .05/5=.01).

Women who indicated at least one per-

**Figure 2**
**Mean Change in Perceived Intent to Check Blood Pressure or Cholesterol in the Next 30 Days: Statistically Significant Interaction between Message Variables (gain and loss framed) and Parental History of High Blood Pressure or Cholesterol**




sonal risk factor and who were exposed to a gain-framed message had a greater increase in self-efficacy to prevent HD (n = 77, M = 15.18, SD = 17.34) compared to women with personal risk factors exposed to a loss-framed message (n = 76, M = 5.46, SD = 15.94). Those women who indicated no personal risk factors had a mean change in self-efficacy that was nearly the same across messages (gain frame n = 117, M = 7.63, SD = 15.20 vs loss frame n = 121, M = 7.86, SD = 17.30). Figure 1 illustrates the finding that gain-framed messages significantly increased self-efficacy beliefs over loss-framed messages—particularly among women with HD risk factors.

Parental history of high blood pressure or cholesterol significantly interacted with message frame with regard to mean change in intent to "check blood pressure or cholesterol in the next 30 days;" women with such a history who read a loss-framed message had significantly greater mean change in intent (n = 114, M = 21.90, SD = 34.20) compared to women with a history who read a gain-framed message (n = 121, M = 15.91, SD = 31.99). An opposite trend was found among women with no parental history of high blood pressure or cholesterol; those exposed to a gain-framed message showed a greater increase in intent (n = 73, M = 24.68, SD = 35.56) compared to those exposed to a loss-framed message (n = 81, M = 14.56, SD = 29.52). This interaction is illustrated in Figure 2, and ANCOVA results are provided in Table 8. ANCOVAs revealed no other significant main or interactive effects of message and health history variables on any other outcomes.

## DISCUSSION

The data collected from participants in this study are consistent with prior national studies indicating that women have low awareness and knowledge about heart disease and are more worried about cancer (particularly breast cancer).[4,5] The percentage of participants indicating they had ever received information from their college or university on HD-related topics

were tobacco use prevention (52%), blood pressure (15.7%), and cholesterol (13.9%). Prior to message exposure, factors identified as causes of HD were smoking (39.5%), high blood pressure (18.4%), and cholesterol (29.6%). One woman who participated in a Phase 1interview stated: "Heart disease isn't something I'm scared of compared to other things out there... It just doesn't seem to have the aura of horrifyingness as some other things do." Educational strategies that effectively increase awareness, knowledge, and related perceptions and behaviors among young college women are needed, particularly strategies targeting women at elevated risk of developing HD.

The messages created for the purposes of this research were developed through an extensive qualitative data collection and analysis process. The messages significantly increased HD-related knowledge and changed perceptions and behavioral intentions. Among the most interesting findings of this research are the results concerning change in self-efficacy and behavioral intent. Women who read a gain-framed message showed a greater mean increase in self-efficacy to prevent HD compared to those who read a loss-framed message. In addition, women with at least one personal risk factor for HD had a significant interaction with message frame; those exposed to a gain-framed message showed a greater mean increase in self-efficacy beliefs whereas women with no personal risk factors had self-efficacy perceptions change from pre- to posttest on average about the same across messages. These findings suggest that loss-framed messages may not be as effective as gain-framed messages in increasing a young woman's sense of efficacy to prevent HD, particularly women with one or more personal risk factors. Increasing self-efficacy perceptions seems to be mildly related to increases in behavioral intent (to reduce cholesterol or salt intake, r=.10; and to increase exercise or reduce body fat, r=.12; both at $P \leq .05$). It is important to note that the self-efficacy measure was not behavior specific and therefore not a good predictor of intent to engage in any one behavior. Future studies should measure the effect of gain- vs loss-framed messages on the perceived efficacy of women with (and without) personal risk factors to engage in specific HD-related behaviors. Behavioral intentions also were differentially influenced by message variables and health history; women who had a parental history of high blood pressure or cholesterol and were exposed to a loss-framed message had a significantly greater mean increase in intent to check blood pressure or cholesterol compared to those who read a gain-framed message, and the opposite effect was found among women with no such history. These findings suggest that the same message can have different persuasive effects on intentions among an audience that has varying parental histories of a HD-related risk factor.

Unexpectedly, time orientation did not differentially affect the persuasiveness of messages. It could be that the arguments presented in both the present and future framed messages provided information that was relevant to participants and that the salient health and nonhealth beliefs gleaned from Phase 1 were well integrated and equally persuasive. We might also speculate that a message expressly focused on HD is inherently future oriented for a young adult audience; therefore, temporal manipulations may have failed despite focus group participants' ability to correctly identify frames.

Limitations of this study include the use of a convenience sample, which may not allow for generalizations to college students nationally or non-college-educated women. College students have experience in taking tests and are likely to be skilled learners under timed conditions such as the reading task used to expose participants to experimental messages. It is not known whether these messages would have similar effects in the real world.

Another limitation of the current study is the extent to which message factors such as the framing conditions studied here influence actual behavior change. Additional studies should explore the potential role of HD heredity in a person's motivation and ability to process HD information, and intervention studies also are needed to assess potential psychosocial variables (such as efficacy perceptions[34]) that may mediate the effects of messages and other recipient factors on behavior.[24]

The results of this study underscore the need to better understand message and recipient characteristics that may influ-

ence the effectiveness of HD prevention messages to obtain desired outcomes. HD risk factor status might be important for message designers to consider; segmenting a large heterogeneous audience into smaller homogenous groups according to risk factor status might optimize the effectiveness of health messages to influence audiences at elevated risk for HD.[42]

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