

Effective Communication of Risks to Young Adults: Using Message Framing and Visual Aids to Increase Condom Use and STD Screening

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Sexually Transmitted Diseases (STDs)—including HIV/AIDS—are among the most common infectious diseases in young adults. How can we effectively promote prevention and detection of STDs in this high risk population? In a two-phase longitudinal experiment we examined the effects of a **brief risk awareness intervention (i.e., a sexual health information brochure)** in a large sample of sexually active young adults ($n = 744$). We assessed the influence of **gain- and loss-framed messages**, and visual aids, on affective reactions, risk perceptions, attitudes, behavioral intentions, and reported behaviors relating to the prevention and detection of STDs. Results indicate that **gain-framed messages** induced greater adherence for **prevention behaviors** (e.g., condom use), whereas **loss-framed messages were more effective in promoting illness-detecting behaviors** (e.g., making an appointment with a doctor to discuss about STD screening). The influence of the framed messages on prevention and detection of STDs was mediated by changes in participants' attitudes toward the health behaviors along with changes in their behavioral intentions. Moreover, **when visual aids were added to the health information, both the gain- and loss-framed messages became equally and highly effective in promoting health behaviors**. These results converge with other data indicating that well-constructed visual aids are often among the most highly effective, transparent, fast, memorable, and ethically desirable means of risk communication. Theoretical, economic, and public policy implications of these results are discussed.

Keywords: message frame, visual aids, sexually transmitted diseases, young adults, condom use

Health messages can have profound effects on economically and personally significant health related choices and behaviors. The investigation of the influence and efficacy of health messages is a topic of considerable interest in the cognitive and decision sciences (Bruine de Bruin & Fischhoff, 2000; Garcia-Retamero & Galesic, in press a; Kuhberger, 1998; Wilson, Purdon, & Wallston, 1988). A prominent example concerns the impact of message framing on people's attitudes, risk perceptions, and risky behaviors (Levin, Schneider, & Gaeth, 1998; McNeil, Pauker, Sox, & Tversky, 1982;

Rothman & Salovey, 1997; Tversky & Kahneman, 1981). Health information can be framed in terms of the benefits afforded by adopting a health behavior (i.e., a *gain-framed* appeal) or in terms of the costs associated with failing to adopt a health behavior (i.e., a *loss-framed* appeal; Edwards, Elwyn, Covey, Matthews, & Pill, 2001; Rothman, Bartels, Wlaschin, & Salovey, 2006; Salovey & Wegener, 2003; Schneider, 2006). To illustrate, a brochure promoting condom use can emphasize the benefits of this practice (e.g., using condoms helps prevent sexually transmitted diseases, STDs), or the costs of avoiding this practice (e.g., failing to use condoms increases your risk of contracting STDs).

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This study is part of the project, "How to Improve Understanding of Risks about Health (PSI2008-02019)," funded by the Ministerio de Ciencia e Innovación (Spain). The authors declare independence from this funding agency in each of the following: design of the study; collection, management, analysis, and interpretation of the data; and preparation of the manuscript.

We thank Mirta Galesic for her assistance with the literature review and data analysis and for her comments on early drafts of the manuscript.

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Two perspectives have shaped our understanding of when gain- and loss-framed messages are maximally persuasive. One perspective has investigated whether the *function* of the health-related behavior moderates the impact of the framed messages (Rothman & Salovey, 1997). The other perspective has studied the extent to which *individual differences* moderate the impact of the framed messages (Mann, Sherman, & Updegraff, 2004; see Sherman, Updegraff, & Mann, 2008, for a review). Efforts investigating how these two approaches are related to each other have only begun to appear (e.g., Rothman, Wlaschin, Bartels, Latimer, & Salovey, 2008).

The premise that the *function* of the behavior moderates the impact of framed appeals was motivated by Prospect Theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). According to Prospect Theory, people are relatively more likely to act to avoid risks when considering the potential gains afforded by their decisions, but are relatively more willing to take risks when

considering the potential losses caused by their decisions (i.e., they are *risk averse* for gains but *risk seeking* for losses). Hence, the influence of a given health message on people's behavior would depend on whether the behavior is perceived to reflect a risk-averse or a risk-seeking course of action (Rothman & Salovey, 1997). To the extent that a decision affords a relatively low risk of an unpleasant outcome (e.g., it might help prevent the onset of health problems; "exercising everyday helps your heart stay healthy"), gain-framed appeals would tend to be more persuasive. Conversely, to the extent that a decision to engage in a behavior involves some risk of an unpleasant outcome (e.g., it may detect a health problem; "early detection of cancer can save your life"), loss-framed appeals would tend to be more persuasive (Rothman et al., 2006; Salovey & Wegener, 2003).

Consistent with these hypotheses, gain-framed appeals tend to be more effective than loss-framed appeals in promoting health-affirming (prevention) behaviors such as physical exercise (Jones, Sinclair, & Courneya, 2003; Latimer et al., 2008; McCall & Ginis, 2004), parental use of children's car seat restraints (Christophersen & Gyulay, 1981; Treiber, 1986), safe driving behaviors (Millar & Millar, 2000), reduced alcohol use (Gerend & Cullen, 2008), smoking cessation (Schneider et al., 2001b; Toll et al., 2010, 2007), and skin cancer prevention behaviors (Detweiler, Bedell, Salovey, Pronin, & Rothman, 1999; Rothman, Salovey, Antone, Keough, & Martin, 1993). Gain-framed messages, however, have not been useful in promoting vaccination against the flu (McCaul, Johnson, & Rothman, 2002) or the human Papillomavirus (Gerend, Shepherd, & Monday, 2008), or in promoting preventive dietary behaviors (Brug, Rutter, & van Assema, 2003; see O'Keefe & Jensen, 2007, for a meta-analysis).

In contrast, loss-framed messages tend to be more effective than gain-framed appeals in promoting illness-detecting (screening) behaviors such as engaging in breast self-examination (Meyerowitz & Chaiken, 1987; Williams, Clarke, & Borland, 2001; but see Lalor & Hailey, 1990), skin cancer detection (Block & Keller, 1995; Rothman et al., 1993), mammography screenings (Abood, Black, & Coster, 2005; Abood, Coster, Mullis, & Black, 2002; Banks et al., 1995; Cox & Cox, 2001; Finney & Iannotti, 2002; Schneider et al., 2001a), blood-cholesterol screenings (Maheswaran & Meyers-Levy, 1990), and HIV screenings (Apanovitch, McCarthy, & Salovey, 2003; Kalichman & Coley, 1995; but see also Lauver & Rubin, 1990; see O'Keefe & Jensen, 2009, for a meta-analysis).

Some of the most compelling evidence that framing effects are contingent on the function of the advocated behavior comes from several studies in which a single health behavior served either as a prevention or detection function. For example, Rothman, Martino, Bedell, Detweiler, and Salovey (1999, 2003) presented participants with framed messages advocating the use of a mouth rinse that was designed either to prevent the accumulation of plaque (i.e., a prevention behavior) or to detect the presence of plaque (i.e., a detection behavior). The results of the study indicated that participants were more likely to request a free sample of the plaque-preventing mouth rinse after having read a gain-framed message while participants were more likely to request a free sample of the plaque-detecting mouth rinse after having read a loss-framed message. Rivers, Salovey, Pizarro, Pizarro, and Schneider (2005) replicated these findings in a randomized field study examining utilization of the Papanicolaou test (also known as the "Pap test,"

the most common examination for premalignant and malignant cervical cancer).

In this paper, we conducted an experiment to address three goals. The first goal was investigating the influence of framed messages in promoting prevention and detection of STDs. STDs—including the HIV/AIDS—are among the most common infectious diseases (European Commission, 2003). Young adults aged 15 to 24 are the group of people at highest risk (Dehne & Riedner, 2005). In fact, one in four sexually active young adults contracts a STD every year (Child Trends, 2006). Investigating the content and structure of health messages about STDs targeting this population could have important implications. In our study, we documented the effect of framing messages (i.e., by presenting either gain- or loss-framed appeals), and the effect of the function of the health behavior (i.e., by focusing on the use of condoms to prevent STDs and the promotion of screening to detect STDs). In line with the reviewed research, we hypothesized that gain-framed messages would be most effective in promoting the use of condoms to prevent STDs, whereas loss-framed messages would be very useful in promoting STDs screening.

The second aim of our research was to document influential factors mediating the effect of gain- and loss-framed messages. As noted by Rothman and Salovey (1997; see also Rothman et al., 1999), risk perceptions along with cognitive and affective processes can mediate the influence of framed messages on people's behavior. To the best of our knowledge, this hypothesis has yet to be investigated in prevention and detection of STDs. In our study, we measured (1) young adults' affective reactions to health messages about STDs, (2) their perceptions of the risk of suffering these diseases, (3) their attitudes toward the recommended behavior, and (4) their behavioral intentions. We then evaluated the extent to which these factors served as mediators of the effect of framed messages on reported behaviors (i.e., condom use or screening for STDs). We hypothesized that young adults' attitudes and behavioral intentions would be powerful mediators of this effect.

Lastly, we aimed to investigate the efficacy of visual aids on sexual health risk communication. Visual aids have been proposed as promising methods for efficiently communicating health information (Edwards, Elwyn, & Mulley, 2002; Galesic & Garcia-Retamero, in press b; Lipkus, 2007; Lipkus & Hollands, 1999; Paling, 2003; Peters, Hibbard, Slovic, & Dieckmann, 2007). Visual aids can also improve understanding of risks associated with different medical treatments, screenings, and lifestyles (Ancker, Senathirajah, Kukafka, & Starren, 2006; Galesic, Garcia-Retamero, & Gigerenzer, 2009; Garcia-Retamero & Galesic, 2010b; Lipkus, 2007), and promote consideration of beneficial treatments that have side effects (Waters, Weinstein, Colditz, & Emmons, 2007). Visual aids are also effective in eliminating errors induced by anecdotal narratives (Fagerlin, Wang, & Ubel, 2005) and biases (Garcia-Retamero & Dhami, 2011; Garcia-Retamero & Galesic, 2009; Garcia-Retamero, Galesic, & Gigerenzer, 2010; Peters et al., 2009). In addition, risk information presented via visual aids is perceived as easier to understand (Goodyear-Smith et al., 2008), and has been shown to increase risk avoidance substantially (Schirillo & Stone, 2005). To the best of our knowledge, however, there is no published research investigating whether visual aids (e.g., bar graphs representing health information about STDs) make gain- and loss-framed messages more effective in

promoting both prevention and detection behaviors as compared to presenting the same information only in written text. We hypothesized that this might be the case and reasoned that the impact of bar graphs might not be due solely to the fact that graphs provide numerical information about STDs. On the contrary, adding bar graphs to health messages might make these messages more effective because they represent the health information in a more transparent and accessible way (e.g., a format that facilitates information search, memory encoding, and representation). Accordingly, we manipulated the format of the health message about STDs by presenting information in (1) written text, (2) in written text and numerically (by adding statistics about STDs), and (3) in written text and graphically (by representing the statistics via visual aids).

Experiment

We conducted an experiment to investigate the factors influencing the effectiveness of message framing. We manipulated three between-groups variables including *Message Frame* (gain vs. loss), *Function of Behavior* (prevention vs. detection), and *Message Format* (text based only vs. text and numerically based vs. text and graphically based). The experiment had two phases (see Figure 1). In a first phase, participants read a brochure about STDs and indicated their affective reactions to the brochure, their perceptions of the risk of contracting a STD, their attitudes toward the recommended behavior in the brochure, and their behavioral intentions. In the second phase—conducted 6 weeks after the first—participants reported whether they performed any of several behaviors during this period.

Method

Participants. The study was conducted between May, 2009 and March, 2010. Respondents were 744 undergraduates (average age of 19 years, range 18–21 years; 46% males) from various disciplines including Psychology, Economics, History, and Pedagogy. All participants were recruited by the first author from the universities of Granada and Jaén (Spain) and received course credit for participating in the study. To be eligible for recruitment, participants had to report that they had at least one sexual encounter involving sexual intercourse during the 3 months before the experiment (as was the case for 86% of all individuals who wanted to participate in the study). Participants were assigned randomly to the groups (n per group = 62). Male and female participants were evenly distributed in the groups. Of the young adults who partic-

ipated in the first phase of the study, 662 (89%; average age of 19 years, range 18–21 years; 45% males) came to our lab to participate in the second phase. We only considered these participants' responses in data analyses. Sixty-five percent of these participants said that they had at least one sexual encounter in which they did not use condoms during the year before the experiment, and only 9% of these participants reported that they had participated in a screening test to detect STDs during that period. At the beginning of the experiment, all participants consented to participation via a written consent form.

Materials. The information about STDs was presented in a six-page brochure. The brochure was attributed to the project "Helping people understand and communicate information about medical risks and health" at the University of Granada and the Max Planck Institute for Human Development (Berlin), and was printed in color by a professional printing company. Half of the participants received a version of the brochure that promoted the use of condoms to *prevent* STDs, while the rest received a version of the brochure that promoted screening to *detect* STDs. Half of the participants who received the brochure promoting the use of condoms read the benefits afforded by adopting the health behavior (i.e., a gain-framed version of the brochure), while the other half of the participants read the costs associated with failing to adopt the health behavior (i.e., a loss-framed version of the brochure). Similarly, half of the participants who received the brochure promoting screening read the gain-framed message and half read the loss-framed message. We ensured that the gain- and loss-framed versions of the brochure were comparable in terms of length and general content.

The brochure was divided into the following three sections:

1. **General information about STD.** Participants were provided with information defining frequent STDs and the consequences and incidence rates of these diseases in young adults. We emphasized that STDs are important problems in people aged 15 to 24. This information was taken from the American Social Health Association (ASHA, 2005) and Dehne and Riedner (2005) (see also Ministerio de Sanidad y Consumo, 2009).
2. **Information about the behavior.** Participants who received the version of the brochure promoting the use of condoms read that doctors strongly recommend that everyone use condoms when engaged in sexual intercourse. The brochure also described different types of condoms

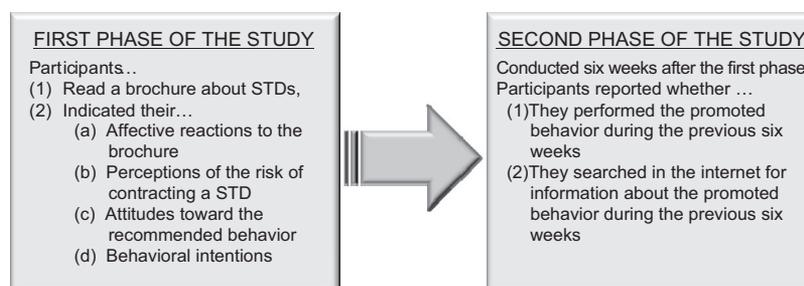


Figure 1. Design of the study showing the time sequence, the phases in the study, and the variables measured in each phase.

and how they should be used. Participants who received the version of the brochure promoting screening read that doctors strongly recommend that everyone make at least one appointment to do screening to detect STDs every year. The brochure also described different screening tests for STDs and how they are conducted.

3. **Message framing manipulation.** The brochure included three framed appeals. The title and two sections (see Appendix for an excerpt).¹ The gain-framed version of the brochure promoting the use of condoms emphasized that using condoms reduced the chance of both contracting STDs and of suffering several severe health symptoms (particularly when sexual intercourse involved an infected partner). In contrast, the loss-framed version of the brochure promoting the use of condoms emphasized that not using condoms increased the chance of both contracting a STD and of suffering several severe health symptoms (particularly when sexual intercourse involved an infected partner).

The gain-framed version of the brochure promoting screening emphasized that conducting screening increased the chance of receiving an effective treatment and decreased the chance of suffering several, severe health symptoms (particularly if the screening was conducted at an early stage of STD infection). Finally, the loss-framed version of the brochure promoting screening emphasized how not conducting screening reduced the chance of receiving effective treatment and increased the chance of suffering several, severe health symptoms (particularly if the screening was not conducted at an early stage, but instead was conducted at a late stage of infection).²

In addition to the health message, one third of the participants who received the version of the brochure promoting the use of condoms read representative numerical information about the estimated chances of contracting a STD in people who had sexual intercourse with an infected partner and used (or did not use) condoms. Specifically, participants were informed that scientists found that 17% of people who engaged in sexual intercourse with an infected partner and used condoms contracted a STD, whereas 38% of people who had sexual intercourse with an infected partner and did not use condoms contracted a STD. Similarly, one third of the participants who received the version of the brochure promoting screening read representative information about one's chance of receiving effective treatment for those who contracted some STD and conducted (or did not conduct) a screening test at an early stage of the disease. These participants were informed that scientists found that 95% of people who contracted a STD and participated in a screening test at an early stage of the disease were effectively treated, whereas 67% of people who have contracted a STD and did not participate in a screening test at an early stage of the disease (but only at a late stage) were effectively treated. Another third of the participants received the same numerical information represented in a bar graph (see Figures 2 and 3). All other participants only received the health message (i.e., they

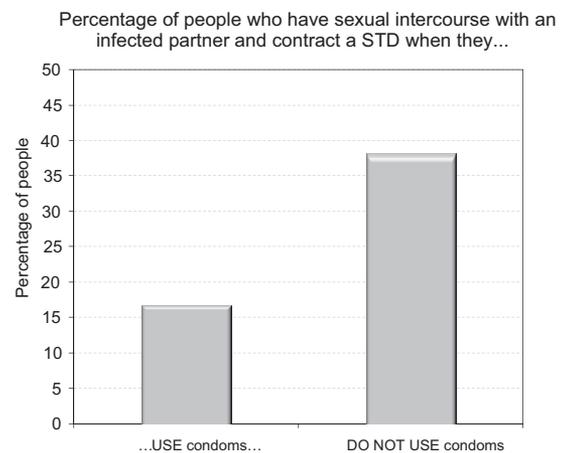


Figure 2. Example of the bar graph presented to participants when they read the version of the brochure promoting the use of condoms with visual aids (translated from Spanish).

did not receive the numerical or graphical information). The numerical information was taken from the National Institute of Statistics in Spain (see Instituto Nacional de Estadística [INE], 2003, 2004a, 2004b; for comparable data in other countries see published studies about the issue; e.g., Palella et al., 2003; Shlay, McClung, Patnaik, & Douglas, 2004; Vidanapathirana, Abramson, Forbes, & Fairley, 2005; Weller & Davis-Beatty, 2002).

Finally, the brochure described several web pages with information about the promoted behavior (condom use or screening for STDs) and suggested that the reader should search for further information on those web pages if he or she was interested in learning more about the topic.

Measures.

Premeasures. Two groups of dependent variables were measured before providing participants with the brochure.

1. **Demographics.** Participants reported their age, gender, educational level, and ethnic background. They also reported whether they had at least one sexual encounter involving sexual intercourse in the 3 months before the experiment. Finally, participants reported whether they used condoms consistently in the year before the experiment and whether they did at least one screening test to detect a possible STD during that period.
2. **Risk perceptions.** On 9-point scales ranging from 1 (*very unlikely*) to 9 (*very likely*), participants evaluated how likely they were to contract a STD if they continued behaving as they did in the past. On 9-point scales ranging from 1 (*not*

¹ Readers interested in the brochure can email authors for a copy of any or all versions of it.

² We focused on the consequences of conducting screening at different stages of a STD as this factor substantially influences both the impact of the symptoms and treatment effectiveness (Centers for Disease Control & Prevention, 2003; Wortley et al., 1995).

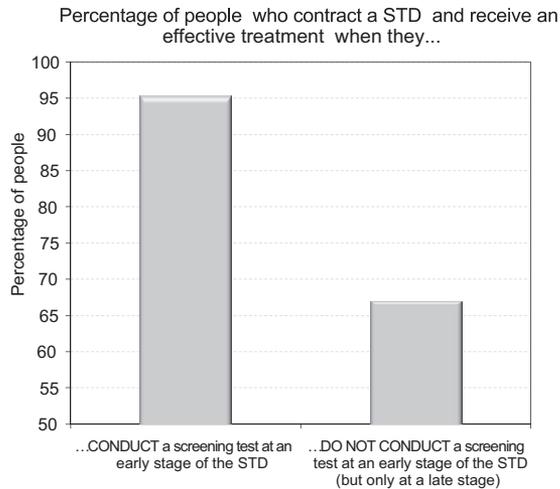


Figure 3. Example of the bar graph presented to participants when they read the version of the brochure promoting screening for STDs with visual aids (translated from Spanish).

at all) to 9 (*very much*) participants also rated how worried they were about contracting a STD and how serious the consequences of contracting a STD would be for them.

Postmeasures. Five groups of dependent variables were measured after participants read the brochure (see also Rothman et al., 1999, for a similar method).

- 1. Risk perceptions.** Participants again answered the three questions about risk perceptions included in the premeasures. These questions were combined into a single index (Cronbach's $\alpha = .78$).
- 2. Affective reactions to the brochure.** Participants indicated how they felt while they were reading the brochure. On 9-point scales ranging from 1 (*not at all*) to 9 (*very much*), participants indicated to what extent they felt assured, calm, cheerful, happy, hopeful, relaxed, and relieved (positive adjectives). On 9-point scales ranging from 1 (*not at all*) to 9 (*very much*), they also indicated the extent to which they felt anxious, afraid, discouraged, disturbed, sad, troubled, and worried (negative adjectives). Scores in negative adjectives were reversed and combined with positive adjectives into a single composite score (Cronbach's $\alpha = .91$).
- 3. Attitudes toward the behavior.** On 9-point scales ranging from 1 (*not at all*) to 9 (*very much*), participants evaluated the effectiveness of the behavior (i.e., using condoms or conducting screening for STDs), how important it was for them to perform the behavior, how beneficial it was to perform the behavior, and how favorable they felt toward engaging in the behavior. These questions were combined into a single index (Cronbach's $\alpha = .79$).
- 4. Behavioral intentions.** On 9-point scales ranging from 1 (*I have no intention of doing this*) to 9 (*I am certain that*

I will do this), participants who received the brochure promoting the use of condoms indicated how likely it was that they would use condoms within the next few weeks. They also indicated how likely it was that they would search on the Internet for further information about condom use. On 9-point scales ranging from 1 (*I have no intention of doing this*) to 9 (*I am certain that I will do this*), participants who received the brochure promoting screening indicated how likely it was that they would make an appointment with their doctor to ask about screening for STDs within the next few weeks. They also indicated how likely it was that they would search on the Internet for further information about screening for STDs.

- 5. Evaluation of the brochure.** On 9-point scales ranging from 1 (*not at all*) to 9 (*very much*), participants evaluated how interesting, involving, and informative the brochure was. On 9-point scales ranging from -4 (*mostly negative*) to 4 (*mostly positive*), participants also evaluated the tone of the information in the brochure. Finally, on 9-point scales ranging from -4 (*costs*) to 4 (*benefits*), participants indicated whether the brochure emphasized the benefits of adopting the behavior or the costs associated with failing to adopt the behavior.

Reported behaviors. Participants who received the brochure promoting the use of condoms indicated whether they used condoms in every sexual encounter involving sexual intercourse in the previous 6 weeks. They also reported whether they searched for information on the Internet about condom use during that period. Participants who received the brochure promoting screening for STDs indicated whether they made an appointment with their doctor to ask about such screening in the previous 6 weeks. They also reported whether they searched on the Internet for information about screening for STDs during that period.

Procedure. The experiment was conducted in two phases 6 weeks apart and in groups of 6 to 12 participants. In the first phase, all participants signed an informed consent form, provided their demographics, and answered several questions (see premeasures). Next, the experimenter explained that the purpose of the study was to evaluate the effectiveness of a brochure about STDs. Participants read the brochure and answered several questions (see postmeasures). In the second phase of the experiment, participants indicated whether they performed any of several behaviors in the previous 6 weeks (see reported behaviors). Participant responses were self-reported in an anonymous response booklet.

Results

To test whether participants' perceptions of the different versions of the brochure reliably differed as a function of how the health information was framed, we first conducted analyses of variance (ANOVAs) with Message Frame (gain vs. loss), Function of Behavior (prevention vs. detection), and Message Format (text based only vs. text and numerically based vs. text and graphically based) as between-groups factors on participants' evaluation of the brochure. Second, to test our hypotheses that the manipulation of message frame and format can improve prevention and detection

of STDs, we conducted (1) an analysis of covariance (ANCOVA) on risk perceptions with Message Frame (gain vs. loss), Function of Behavior (prevention vs. detection), and Message Format (text based only vs. text and numerically based vs. text and graphically based) as between-groups factors controlling for participants' initial risk perceptions, and (2) ANOVAs with Message Frame (gain vs. loss), Function of Behavior (prevention vs. detection), and Message Format (text based only vs. text and numerically based vs. text and graphically based) as between-groups factors on participants' affective reactions to the brochure; their attitudes toward the behavior promoted in the brochure; and their behavioral intentions and reported behaviors. Tukey's honestly significant difference (HSD) test was used for all post hoc analyses. In the interest of space, only significant and predicted nonsignificant effects are reported. Finally, we conducted mediational analyses to test our hypothesis about the factors that mediated the effects of framed messages on the prevention and detection of STDs.

Evaluation of the brochure. The ANOVA revealed a moderate effect of Message Frame on emphasis of benefits versus costs, $F(1, 650) = 90.45, p = .001, \eta^2 = .12$,³ and on tone of the information in the brochure, $F(1, 650) = 47.16, p = .001, \eta^2 = .07$. As expected, participants who read the gain-framed message evaluated the brochure as emphasizing more the benefits afforded by adopting the health behavior than the costs of failing to adopt that behavior. Perceptions were reversed in participants who read the loss-framed message ($M = .80, SEM = .10$ and $M = -.57, SEM = .11$, respectively). Similarly, participants who read the gain-framed message evaluated the tone of the brochure as more positive than those who read the loss-framed message ($M = 1.81, SEM = .12$ vs. $M = .61, SEM = .13$).

The ANOVA also revealed a main effect of Message Format on the extent to which the brochure was perceived as informative, $F(2, 650) = 59.69, p = .001, \eta^2 = .15$, with higher estimates when the health information was provided in written text and numerically ($M = 6.10, SEM = .07$), or in written text and graphically ($M = 6.04, SEM = .08$), than when the health information was provided only in written text ($M = 5.14, SEM = .07$). Participants' estimates of the quality of the brochure (i.e., how interesting and involving the brochure was) were not influenced by Message Frame, Function of Behavior, or Message Format (the average scores are $M = 5.06, SEM = .04$, and $M = 5.08, SEM = .04$, respectively). There were no higher order interactions. Overall, perceptions of the different versions of the brochure reliably differed as a function of how the health information was framed. Moreover, versions of the brochure providing numerical or graphical information were judged as more informative than those providing the health information only in written text.

Risk perceptions. The ANCOVA controlling for participants' initial risk perceptions on the composite scores combining estimates of likelihood of contracting a STD, perceptions of being worried about contracting a STD, and of seriousness of the consequences of the STD revealed a large effect of Function of Behavior, $F(1, 647) = 21.51, p = .001, \eta^2 = .25$. In particular, participants who read the version of the brochure promoting the use of screening felt more at risk than those who read the version of the brochure promoting the use of condoms (see Table 1). There were no higher order interactions.

Affective reactions to the brochure. The ANOVA on the composite scores combining participants' ratings to positive and

negative adjectives showed a small effect of Function of Behavior, $F(1, 650) = 12.29, p = .001, \eta^2 = .02$. Participants who read the version of the brochure promoting the use of screening tended to experience slightly more negative emotions than those who read the version of the brochure promoting the use of condoms (see Table 1). There were no higher order interactions.

Attitudes toward the behavior. The ANOVA on the composite scores combining participants' attitudes toward the behavior promoted in the brochure revealed a reliable effect of Message Frame, $F(1, 650) = 7.51, p = .006, \eta^2 = .01$, Function of Behavior, $F(1, 650) = 4.18, p = .041, \eta^2 = .003$, and Message Format, $F(2, 650) = 10.93, p = .001, \eta^2 = .14$. These effects were qualified by a three-way interaction, $F(2, 650) = 91.07, p = .001, \eta^2 = .13$. When the risk information was provided *in written text only* or *in written text and numerically*, participants who read the gain-framed message promoting the use of condoms had more positive attitudes toward engaging in the behavior than those who read the loss-framed message ($p = .0001$ for written text, and $p = .0001$ for written text and numerically). In contrast, participants who read the loss-framed message promoting screening had more positive attitudes toward the behavior than those who read the gain-framed message ($p = .0001$ for written text, and $p = .0001$ for written text and numerically). When the risk information was provided *in written text and graphically*, both gain- and loss-framed messages equally and highly influenced participants' attitudes toward engaging in condom use ($p = .608$) and screening ($p = .577$; see Table 2).

Behavioral intentions and reported behaviors. The ANOVA on participants' intentions to perform the behavior promoted in the brochure revealed a small effect of Function of Behavior, $F(1, 650) = 8.98, p = .003, \eta^2 = .01$, and Message Format, $F(2, 650) = 3.69, p = .03, \eta^2 = .01$. These effects were qualified by an interaction between Message Frame, Function of Behavior, and Message Format, $F(2, 650) = 13.04, p = .001, \eta^2 = .04$. Similarly, the ANOVA on the percentage of participants who indicated that they had performed the behavior promoted in the brochure during the first and the second phase of the experiment showed an effect of Message Format, $F(2, 650) = 8.07, p = .0003, \eta^2 = .02$, and an interaction between Message Frame, Function of Behavior and Message Format, $F(2, 650) = 6.97, p = .001, \eta^2 = .02$. **In line with our hypotheses, when the risk information was provided in written text only or in written text and numerically, participants who read the gain-framed message promoting the use of condoms reported stronger intentions to perform the behavior than those who read the loss-framed message ($p = .0002$ for written text, and $p = .047$ for written text and numerically; see Figure 4). More participants also reported using condoms when they read the gain-framed than the loss-framed message promoting the behavior ($p = .0006$ for written text, and $p = .008$ for written text and numerically; see Figure 5).** In contrast,

³ Note that the standard η^2 —used in our study—is typically more conservative (smaller) than the partial η^2 often used in current research (Pierce, Block, & Aguinis, 2004). The rule of thumb for interpreting the results of η^2 is concluding that the effect size is small if it is $\sim .01$, and medium and large if it is $\sim .06$ and $\sim .14$, respectively. Our effects are consistent with those in other studies in this area of research see (Galesic et al., 2009).

Table 1

Participants' Risk Perceptions and Affective Reactions to the Brochure as a Function of Message Frame, Function of Behavior, and Message Format

	Condom use				Screening for STDs			
	Gain-framed message		Loss-framed message		Gain-framed message		Loss-framed message	
	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>
Text based only								
Risk perceptions								
Likelihood of suffering a STD ^a	4.46	.20	4.04	.21	5.08	.21	5.22	.21
Perception of being worried ^a	6.89	.26	6.43	.30	7.50	.28	8.21	.22
Perception of seriousness ^a	7.43	.10	7.46	.11	8.46	.10	8.52	.13
Single composite score	6.26	.12	5.98	.13	6.98	.14	7.30	.12
Affective reaction to the brochure								
Single composite score	6.77	.16	6.74	.17	6.53	.13	6.63	.19
Text and numerically based								
Risk perceptions								
Likelihood of suffering a STD ^a	4.36	.18	4.32	.25	5.19	.18	5.32	.16
Perception of being worried ^a	6.93	.23	6.64	.31	8.30	.15	7.64	.20
Perception of seriousness ^a	7.54	.13	7.36	.14	8.37	.11	8.11	.18
Single composite score	6.27	.13	6.11	.16	7.26	.09	6.96	.13
Affective reaction to the brochure								
Single composite score	6.88	.18	6.59	.19	6.24	.18	6.12	.18
Text and graphically based								
Risk perceptions								
Likelihood of suffering a STD ^a	4.88	.25	4.59	.25	5.38	.17	5.07	.18
Perception of being worried ^a	6.81	.22	6.56	.27	7.59	.25	7.78	.27
Perception of seriousness ^a	7.15	.20	7.44	.11	8.15	.22	8.30	.12
Single composite score	6.25	.17	6.07	.16	7.01	.14	7.05	.11
Affective reaction to the brochure								
Single composite score	6.96	.19	6.90	.15	6.21	.19	6.59	.26

Note. Larger values indicate larger risk perceptions and more positive affective reactions.

^a Means are adjusted for covariates.

participants who read the loss-framed message promoting screening for STDs reported stronger intentions to make an appointment with their doctor to ask about screening than those who read the gain-framed message ($p = .0001$ for written text, and $p = .0005$ for written text and numerically). **More participants also reported making such an appointment when they read the loss-framed than the gain-framed message ($p = .0003$ for written text, and $p = .063$ for written text and numerically).** Finally, when the risk information was provided in written text and graphically, both the gain- and loss-framed messages equally and highly influenced participants' intentions to perform the behavior ($p = .294$ for condom use, and $p = .883$ for screening), and their reported behaviors ($p = .188$ for condom use, and $p = .218$ for screening; see Figures 4 and 5). In other words, gain-framed (loss-framed) messages no longer induced greater adherence for prevention (detection) behaviors.

The ANOVA on participants' intentions to search on the Internet for information about the behavior showed an effect of Function of Behavior, $F(1, 650) = 53.56$, $p = .001$, $\eta^2 = .07$, and Message Format, $F(2, 650) = 14.57$, $p = .001$, $\eta^2 = .04$, and an interaction between Message Frame, Function of Behavior, and Message Format, $F(2, 650) = 9.98$, $p = .001$, $\eta^2 = .02$. In a similar vein, the ANOVA on the percentage of participants who indicated that they had searched for further information about the behavior on the Internet during the first and the second phase of the experiment revealed an effect of Message Format, $F(2, 650) = 4.61$, $p = .01$, $\eta^2 = .01$, and an

interaction between Message Frame and Function of Behavior, $F(1, 650) = 7.01$, $p = .008$, $\eta^2 = .01$, and between Function of Behavior and Message Format, $F(2, 650) = 5.21$, $p = .006$, $\eta^2 = .02$. The interaction between Message Frame, Function of Behavior, and Message Format approached the conventional significance level, $F(2, 650) = 2.33$, $p = .09$, $\eta^2 = .01$. In line with the previous results, when the risk information was provided in written text only, participants who read the gain-framed message promoting the use of condoms reported stronger intentions to search on the Internet for information about condom use than those who read the loss-framed message ($p = .0001$), and more participants indicated that they searched for this information ($p = .009$; see Table 3). In contrast, participants who read the loss-framed message promoting the use of screening for STDs reported stronger intentions to search on the Internet for information about screening than those who read the gain-framed message ($p = .0001$), and more participants indicated that they searched for this information ($p = .004$). The trend in the data suggested that results were similar when the risk information was provided in written text and numerically. However, the loss-framed message promoting the use of screening for STDs was less appealing than when the risk information was provided in written text only (i.e., it was only slightly better than the gain-framed message). Finally, when the risk information was provided in written text and graphically, both the gain- and loss-framed messages equally and highly influenced participants' intentions to search for information ($p = .927$ for condom use, and

Table 2
Participants' Attitudes Toward the Behavior as a Function of Message Frame, Function of Behavior, and Message Format

	Condom use				Screening for STDs			
	Gain-framed message		Loss-framed message		Gain-framed message		Loss-framed message	
	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>
Text based only								
Attitudes toward the behavior								
Effectiveness of behavior	8.14	.09	6.07	.11	6.85	.19	8.07	.18
How important the behavior is	8.57	.08	6.39	.11	7.11	.18	8.54	.12
How beneficial the behavior is	8.39	.15	5.79	.22	6.52	.27	8.32	.17
How favorable participants felt	8.75	.06	6.57	.08	7.19	.16	8.64	.12
Single composite score	8.46	.06	6.21	.09	6.92	.17	8.39	.10
Text and numerically based								
Attitudes toward the behavior								
Effectiveness of behavior	7.82	.18	6.32	.08	6.07	.15	7.71	.18
How beneficial the behavior is	8.54	.08	6.79	.07	6.48	.13	8.08	.18
How favorable participants felt	8.50	.14	6.32	.21	6.07	.20	6.96	.32
How important the behavior is	8.75	.08	6.89	.04	6.52	.11	8.21	.14
Single composite score	8.40	.08	6.58	.08	6.29	.12	7.74	.15
Text and graphically based								
Attitudes toward the behavior								
Effectiveness of behavior	7.96	.16	8.18	.13	7.89	.14	8.11	.12
How beneficial the behavior is	8.59	.09	8.79	.06	8.22	.13	8.44	.09
How favorable participants felt	8.11	.29	8.07	.22	8.15	.09	7.93	.26
How important the behavior is	8.74	.08	8.64	.07	8.26	.10	8.33	.12
Single composite score	8.35	.11	8.42	.07	8.13	.09	8.20	.10

Note. Larger values indicate more positive attitudes.

$p = .388$ for screening), and their reported search behavior ($p = .858$ for condom use, and $p = .703$ for screening; see Table 3).

Mediational Analyses

We conducted mediational analyses to investigate whether the effect of the framed message on reported behaviors was mediated

by their perceptions of the risk of suffering a STD, their affective reactions to the message, their attitudes toward the behavior recommended in the message, or their behavioral intentions. Because the effect of Message Frame on reported behaviors interacted with Function of Behavior and Message Format, we conducted the analyses for each behavior (condoms use or screening) when

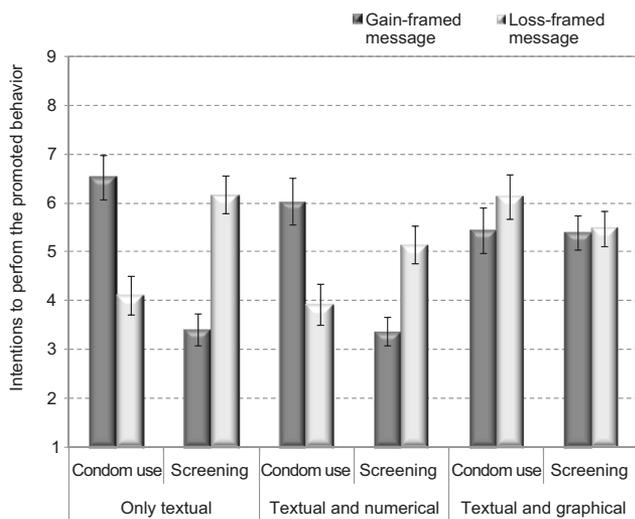


Figure 4. Participants' intentions to perform the promoted behavior as a function of Message Frame, Function of Behavior, and Message Format. Larger values indicate stronger intentions. Error bars indicate 1 SE.

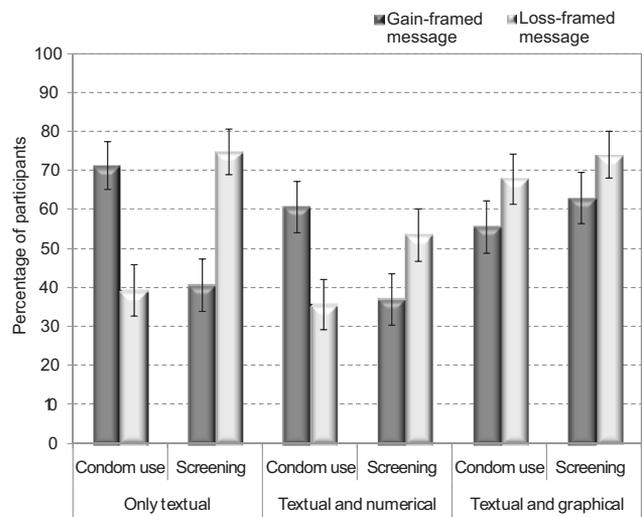


Figure 5. Percentage of participants who reported performing the promoted behavior during the 6 weeks between the first and the second phase of the experiment as a function of Message Frame, Function of Behavior, and Message Format. Error bars indicate 1 SE.

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Table 3

Participants' Intentions to Search for Information on the Internet, and Percentage of Participants Who Reported Searching for Information on the Internet, as a Function of Message Frame, Function of Behavior, and Message Format

	Condom use				Screening for STDs			
	Gain-framed message		Loss-framed message		Gain-framed message		Loss-framed message	
	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>	<i>M</i>	<i>SEM</i>
Text based only								
Behavioral intentions								
Likelihood of searching on the Internet	3.75	.36	1.71	.20	4.11	.36	6.82	.34
Reported behaviors								
Percentage of participants who researched	40.71	6.46	21.43	5.53	37.04	6.63	64.29	6.46
Text and numerically based								
Behavioral intentions								
Likelihood of searching on the Internet	3.79	.38	2.18	.25	3.41	.32	4.18	.34
Reported behaviors								
Percentage of participants who researched	50.00	6.74	32.14	6.30	37.04	6.63	45.71	6.46
Text and graphically based								
Behavioral intentions								
Likelihood of searching on the Internet	4.33	.35	4.29	.38	4.81	.34	5.26	.38
Reported behaviors								
Percentage of participants who researched	51.85	6.86	53.57	6.72	48.15	6.86	51.85	6.86

Note. For behavioral intentions, larger values indicate stronger intentions.

information was provided both in written text only and in written text and numerically, and when the information was provided in written text and graphically. In addition, we combined participants' intentions to perform the behavior promoted in the brochure and to search for information into a single, averaged score. Similarly, we combined reported behaviors (i.e., whether participants indicated that they had performed the behavior or had searched for further information on the Internet) in a single score ranging from 0 (if they did none) to 2 (if they did both).

As Rothman et al. (1999, p. 1366) suggested, to test for mediation, Message Frame should have influenced participants' behaviors, and the potential mediators (i.e., risk perceptions, affective reactions, attitudes toward engaging in the behavior, and behavioral intentions) must be both affected by message frame and related to participants' behaviors (see also Baron & Kenny, 1986).

Condom use when providing written only or written and numerical risk information. When the risk information was provided in written text only or in written text and numerically, regression analyses showed that Message Frame strongly influenced participants' behavioral intentions. Participants who read the gain-framed message promoting the use of condoms had stronger intentions to perform the behaviors than those who read the loss-framed message, $\beta = -.35$, $t(222) = -5.57$, $p = .001$ (see Figure 6a). Similarly, Message Frame strongly influenced participants' attitudes toward the behavior, $\beta = -.86$, $t(222) = -25.46$, $p = .001$, with participants showing more favorable attitudes toward using condoms when they read the gain-framed than the loss-framed message. Message Frame, however, did not affect participants' affective reactions, $\beta = -.06$, $t(222) = -.96$, $p = .34$, or their risk perceptions, $\beta = -.11$, $t(222) = -1.66$, $p = .10$.

When participants' attitudes toward using condoms were included in the regression analysis, the effect of Message Frame on participants' intentions to perform the behaviors was significantly

reduced, $\beta = .11$, $t(221) = .90$, $p = .37$. In addition, the result of the Sobel test⁴ suggests that participants' attitudes toward the behavior fully mediated the influence of Message Frame on participants' behavioral intentions, $z = -7.06$, $p = .001$.

Similarly, Message Frame strongly influenced reported behaviors. More participants indicated that they had performed the behaviors (i.e., used condoms in their sexual encounters and searched on the Internet for information about the topic) after reading the gain-framed message than the loss-framed message, $\beta = -.30$, $t(222) = -4.73$, $p = .001$. Participants' attitudes toward using condoms also influenced their reported behaviors, $\beta = .35$, $t(222) = 5.56$, $p = .001$ (i.e., more positive attitudes toward using condoms increased the chances of performing the behaviors). Interestingly, when participants' behavioral intentions were included in the regression analysis, the effect of both Message Frame, $\beta = -.01$, $t(221) = -1.42$, $p = .16$, and attitudes toward using condoms, $\beta = .07$, $t(221) = 1.22$, $p = .22$, on reported behaviors was significantly reduced. Again, the results of the Sobel test suggest that participants' behavioral intentions fully mediated the effect of Message Frame, $z = -5.16$, $p = .001$, and participants' attitudes, $z = 6.48$, $p = .001$, on their reported behaviors.

Screening when providing written only or written and numerical risk information. Regression analyses on screening for STDs showed similar results to those described above (see Figure 6b). In particular, when the risk information was provided in written text only and in written text and numerically, Message Frame strongly influenced behavioral intentions: Participants who read the loss-framed message promoting screening for STDs

⁴ The Sobel test (see Sobel, 1982) indicates whether the mediator significantly carries the influence of an independent variable to a dependent variable. That is, whether the indirect effect of the independent variable on the dependent variable through the mediator variable is significant.

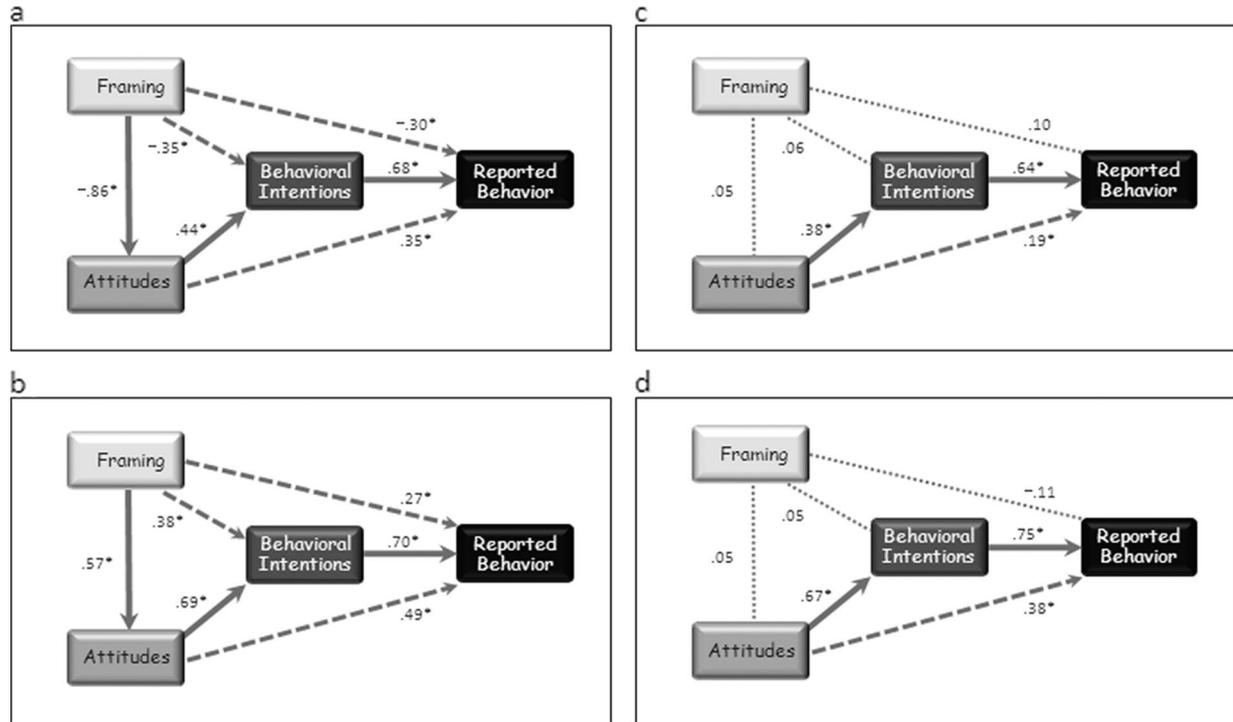


Figure 6. Path analysis of the effect of Message Frame on reported behaviors, and the mediational effect of attitudes and behavioral intentions. (a) Results for condom use when the health information was provided in written text and when numerical information was added to the written text. (b) Results for screening for STDs when the health information was provided in written text and when numerical information was added to the written text. (c) Results for condom use when the visual aid was added to the written text. (d) Results for screening for STDs when the visual aid was added to the written text. Note: Standardized coefficients are shown. * $p < .05$.

showed stronger intentions to perform the behaviors (i.e., make an appointment with their doctor to ask about screening for STDs, and search for information about screening on the Internet) than those who read the gain-framed message, $\beta = .38$, $t(218) = 6.15$, $p = .001$. Message Frame also influenced participants' attitudes toward the behavior, $\beta = .57$, $t(218) = 10.15$, $p = .001$, with participants showing more favorable attitudes toward conducting screening when they read the loss-framed than the gain-framed message. Message Frame, however, did not affect participants' affective reactions, $\beta = -.06$, $t(218) = -.94$, $p = .35$, or their risk perceptions, $\beta = .001$, $t(218) = .01$, $p = .99$.

When participants' attitudes toward screening were included in the regression analysis, the effect of Message Frame on participants' intentions to perform the behaviors was significantly reduced, $\beta = -.01$, $t(217) = -.12$, $p = .90$. Consistent with this result, the result of the Sobel test indicated that participants' attitudes toward screening fully mediated the influence of Message Frame on their behavioral intentions, $z = 8.25$, $p = .001$.

Mediational analyses were also conducted on reported behaviors. Regression analyses showed that Message Frame strongly influenced these behaviors. More participants indicated that they had performed the behaviors after having read the loss-framed message than the gain-framed message, $\beta = .27$, $t(218) = 4.09$, $p = .001$. Reported behaviors were also influenced by participants' attitudes toward screening, $\beta = .49$, $t(218) = 8.34$, $p = .001$. More positive attitudes toward screening increased the chances of indi-

cating that they had performed the behaviors. When participants' behavioral intentions were included in the regression analysis, however, the effect of Message Frame, $\beta = -.003$, $t(217) = -.08$, $p = .94$, and participants' attitudes toward screening, $\beta = .02$, $t(217) = .25$, $p = .80$, on reported behaviors was significantly reduced. The results of the Sobel test indicated that participants' behavioral intentions fully mediated the influence of Message Frame, $z = 5.57$, $p = .001$, and participants' attitudes toward screening, $z = 10.13$, $p = .001$, on their reported behaviors.

Condom use and screening when providing written and visual risk information. When the risk information was provided in written text and graphically, only participants' attitudes toward the behavior influenced their behavioral intentions [$\beta = .38$, $t(108) = 4.29$, $p = .001$ for condom use, and $\beta = .67$, $t(106) = 9.42$, $p = .001$ for screening for STDs] and reported behaviors [$\beta = .19$, $t(108) = 2.05$, $p = .04$ for condom use, and $\beta = .38$, $t(106) = 4.35$, $p = .001$ for screening for STDs; see Figure 6c, d]. When participants' behavioral intentions were included in the regression analysis, the effect of participants' attitudes toward the behavior on their reported behaviors was significantly reduced [$\beta = -.06$, $t(107) = -.76$, $p = .45$ for condom use, and $\beta = -.21$, $t(105) = -2.49$, $p = .014$ for screening]. The results of the Sobel test suggested that participants' behavioral intentions fully mediated the influence of their attitudes on their reported behaviors ($z = 3.84$, $p = .001$ for condom use, and $z = 7.29$, $p = .001$ for screening for STDs).

General Discussion

In a two-phase longitudinal experiment, we documented the benefits of a brief risk awareness intervention (i.e., a sexual health brochure) for a large sample of sexually active young adults. Many of these young adults had at least one sexual encounter in which they did not use condoms during the year before the experiment. However, very few participants reported any screening for STDs during that period. Consistent with our hypotheses, results indicated that gain-framed messages induced greater adherence for condom use, whereas loss-framed messages were more effective in promoting screening for STDs when health information about STDs was provided in written text, or when numerical information was added to the text. In contrast, when a visual aid was added to the health information, both the gain- and loss-framed messages were equally and highly effective in promoting condom use and screening for STDs. That is, gain-framed (loss-framed) messages no longer induced greater adherence for prevention (detection) behaviors. Several theoretical and clinical implications follow from these findings.

Mechanisms of Effective Risk Communication and Theoretical Implications of the Results

Our results provide more evidence on the utility of the conceptual framework by Rothman and Salovey (1997; see also Rothman, Stark, & Salovey, 2003; Rothman et al., 2006, 1999, 2008; Salovey, Schneider, & Apanovitch, 2002; Salovey & Wegener, 2003). Rothman and colleagues have argued that the relative influence of gain- and loss-framed messages tends to be contingent on how people *perceive* the behavior promoted in health messages. When people believe that engaging in a behavior is risky, loss-framed messages should be more effective than gain-framed messages. In contrast, when people think that a behavior affords a relatively low risk of an unpleasant outcome, gain-framed messages should be more appealing than loss-framed messages. Consistent with this framework, participants in our study acted as if they perceived screening for STDs as a risky behavior that might help detect health problems (see risk perceptions in results; see also Boletín Informativo del INE, 2004, for consistent findings). Indeed, many participants might perceive themselves at risk because they often had unprotected sex during the year before the study. Consequently, the health message emphasizing the costs of not conducting screening for STDs was more effective than the message explaining the benefits of engaging in such behavior (see Abood et al., 2005, 2002; Banks et al., 1995; Gerend & Shepherd, 2007; Kalichman & Coley, 1995; Meyerowitz & Chaiken, 1987; Schneider et al., 2001a; Williams et al., 2001, for similar results in other domains). Conversely, because condom use was perceived to be a safety promoting behavior that prevents the onset of health problems, the health message emphasizing the benefits of condom use was more persuasive than that explaining the costs of not using condoms (see Detweiler et al., 1999; Jones et al., 2003; Millar & Millar, 2000; Schneider et al., 2001b; Toll et al., 2007, 2010, for a similar result).

Our findings build on the conceptual framework of Rothman and Salovey (1997). In particular, our results reveal some key aspects of the processes that underlie the impact of message frame on participants' prevention and detection behaviors. When the

health message was provided in written text only, or when the numerical information was added to the text, message frame had a significant influence on participants' reported behaviors. Message frame also had a clear impact on participants' attitudes toward the promoted behaviors and their behavioral intentions. Interestingly, these attitudes influenced participants' behavioral intentions, and fully mediated the effect of message frame on participants' behavioral intentions. Furthermore, participants' behavioral intentions substantially affected their reported behaviors. These behavioral intentions also mediated the impact of attitudes on behaviors. In other words, participants who read the positive-framed message promoting condom use more often performed this behavior because the framed message caused their attitudes toward the behavior to become more favorable. Similarly, participants who read the loss-framed message promoting screening for STDs more often made an appointment with their doctor to ask about screening because the framed message caused their attitudes toward the behavior to become more favorable. These attitudes ultimately strengthened their intentions toward engaging in the behavior, which in turn affected participants' health behaviors.

Our research is unique in its efforts to show that framed messages can be more influential when accompanied by visual aids. When the bar graph representing risk information about STDs was added to the message, many participants reading either the gain- or the loss-framed message reported clear intentions to use condoms or intentions to make an appointment with their doctor to ask about screening for STDs. More importantly, participants indicated that they often had engaged in such behaviors. Thus, adding visual aids to health messages made both gain- and loss-framed messages equally and highly effective, conferring benefits without any noteworthy costs.

Why did we find such a different pattern of results when the health information was provided along with a visual aid?⁵ The results of the mediational analyses indicated that attitudes were again key variables (see Norman, 2004, for related ideas): When the risk information was reported in written text and graphically, participants' attitudes toward engaging in detection and prevention behaviors were often very positive and were not influenced by framed messages. These positive attitudes strongly influenced participants' behavioral intentions, which in turn affected their reported behaviors. In line with research examining debiasing of framing effects (e.g., Almashat, Ayotte, Edelman, & Margrett, 2008; Simon, Fagley, & Halleran, 2004), we hypothesize that

⁵ Our results are not due to differences in perceptions of the *quality* of the health message as participants' perceptions were similar in all experimental conditions. Similarly, our results cannot be explained by a misunderstanding of the *framing manipulation* because participants evaluated the gain-framed message as emphasizing the benefits afforded by adopting the health behavior, whereas they evaluated the loss-framed message as focusing on the costs of failing to adopt the behavior regardless of the message format. Finally, our results are not due to the *amount of information* provided in the health message: Participants who read the text message either with the numerical or with the visual information evaluated such message as more informative than those who only read the text message. If the amount of information in the health message explained our finding, we would have found similar results when the health information was provided in written text and numerically and in written text and graphically. Instead, we found quite different results in these conditions.

visual aids may increase the likelihood of better or more elaborate encoding of the relevant information relating to the prevention and detection of STDs. Visual aids might lead to a more thorough encoding of potential benefits of adopting the promoted behavior and drawbacks associated with failing to adopt such behavior. We speculate that more accurate memory for information about potential costs and benefits would tend to overshadow the impact of framed messages on people's attitudes. However, the current experiment was not designed to test this hypothesis; more work will be required before we can evaluate the merits of this argument. Nonetheless, previous research is consistent with our expectations. Visual aids improve reasoning by making part-to-whole relations in the data visually available (e.g., the number of sick patients who received a medical treatment and the overall number of treated people; Ancker et al., 2006; Garcia-Retamero & Galesic, 2010b), or by helping people to clearly understand and represent superordinate classes (e.g., the overall number of treated people; Garcia-Retamero & Galesic, 2009; Reyna & Brainerd, 2008). In a similar vein, individuals with higher cognitive abilities—who are known to more elaborately encode and thoroughly process information during learning and risky decision making (Cokely & Kelley, 2009; Cokely, Kelley, & Gilchrist, 2006)—also tend to be less susceptible to the effects of message framing (Stanovich & West, 1998; but see also Corbin, McElroy, & Black, 2010, for boundary conditions), and benefit less from visual aids (Garcia-Retamero & Galesic, 2010a; Galesic et al., 2009). It is then possible that the more proximal mechanisms that might give rise to the observed changes in participants' attitudes toward the promoted behavior are cognitive (e.g., changes in information search and encoding or changes to specific content in memory; Ajzen & Gilbert Cote, 2008; Johnson, Haubl, & Keinan, 2007; Weber & Johnson, 2006; Weber et al., 2007). Ongoing research is currently using cognitive process tracing techniques (e.g., eye-tracking, memory assessments, reaction time analyses, and protocol analyses) to assess the validity of these and alternative memory based theoretical accounts.

The current results also provide converging evidence consistent with the *Theory of Planned Behavior* (Ajzen, 1985, 1987, 1988, 1991; Ajzen & Fishbein, 2000, 2005; Ajzen & Manstead, 2007). This theory suggests that people's intentions to perform a behavior can often be accurately predicted from their attitudes toward this behavior (see also Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002; Sheeran & Taylor, 1999). The theory further suggests that people's behavioral intentions have a strong impact on their behaviors (Ajzen, 1985; Ajzen, Czausch, & Flood, 2009). A large number of studies have applied the Theory of Planned Behavior to examine the psychological antecedents of specific health related behaviors. More recent attempts have also been made to use the theory as a framework for behavioral interventions (see Ajzen & Manstead, 2007, for a review). The critical role of people's attitudes on their behavioral intentions has also been reported in different domains including using illicit drugs (Conner & McMillan, 1999), losing weight (Schifter & Ajzen, 1985), eating a low-fat diet (Armitage & Conner, 1999), consuming dairy products (Kim, Reicks, & Sjoberg, 2003), practicing exercise (Courneya, 1995; Godin, Vezina, & Leclerc, 1989), performing breast self-examination (Norman & Hoyle, 2004), and condom use (Albarracín et al., 2001; Sheeran & Orbell, 1998; Sheeran & Taylor, 1999). Similarly, some authors have documented the impact of

people's behavioral intentions on behaviors in domains such as exercise and condom use (Albarracín et al., 2001; Godin & Kok, 1996; Hausenblas, Carron, & Mack, 1997; Sheeran & Orbell, 1998), and smoking (Godin, Valois, Lepage, & Desharnais, 1992). Of note, however, the current research goes one step further. Here, we have demonstrated the important role of attitudes in intentions to perform prevention and detection behaviors of STDs and documented how to avoid the impact of framed messages on these attitudes (i.e., using the potentially powerful impact of well designed visual aids). Our findings also provided evidence on the influence of people's behavioral intentions on reported behaviors relating to the prevention and detection of STDs.

Informed Decision Making and Benefits of Visual Aids

Persuading people by using framed health messages can substantially reduce illness morbidity and premature mortality (Rothman et al., 1999), and it is an effective way of promoting health behaviors (Banks et al., 1995; Kalichman & Coley, 1995; Meyerowitz & Chaiken, 1987). However, some authors have noted that framing information to enhance the effect of health messages might not be consistent with truly informed decision making and thus should be avoided (e.g., Edwards et al., 2001, 2002; Gigerenzer, 2003; Redelmeier, 2005). To date, however, few investigations have successfully attempted to reduce or make salient the effect of framing on risk perception (e.g., Garcia-Retamero & Galesic, 2010a; Sieck & Yates, 1997; but see Levin, Johnson, & Davis, 1987). For instance, a study by Jou, Shanteau, and Harris (1996) showed that the effect of gain- and loss-framed messages can be eliminated when the two messages are related by a causal schema that illustrates that they are equivalent. Similarly, Al-mashat et al. (2008) showed that asking decision makers to list the advantages and disadvantages of decision options, as well as providing a rationale for the option they plan to choose, eliminates the effect of framed messages. To the best of our knowledge, however, previous research has not yet investigated this issue in framed messages concerning benefits and costs associated with health behaviors. The current results therefore offer a potentially effective method for communicating health information in a way that is consistent with informed decision making: Health information could be framed in positive or negative terms as long as visual aids such as bar graphs representing the risk information are provided.

Our findings also support and extend our own and others' previous findings about the usefulness of visual aids to enhance comprehension of health messages (Fagerlin et al., 2005; Fagerlin, Ubel, Smith, & Zikmund-Fisher, 2007; Galesic et al., 2009; Garcia-Retamero & Galesic, 2009, 2010a, 2010b, in press a; Garcia-Retamero et al., 2010; Garcia-Retamero, Galesic, & Gigerenzer, 2011; Lipkus, 2007; Lipkus & Hollands, 1999; Palling, 2003). Critically, these findings provide evidence for the notion that problems in communicating medical risks do not simply result because biases prevent good decision making. In contrast, errors occur because inappropriate information formats complicate and mislead adaptive decision makers (Gigerenzer & Edwards, 2003; Gigerenzer, Gaissmaier, Kurz-Milcke, Schwartz, & Woloshin, 2008).

Implications for Medical Practice and Public Policy

Although young people aged 15 to 24 represent 25% of the sexually active population, they account for about half of all new

cases of STDs, including HIV infections (ASHA, 2005; Weinstein, Berman, & Cates, 2004). This means, that nearly 4 million cases of STDs occur annually among teens in the United States alone (see Bermudez & Teva-Álvarez, 2003; European Commission, 2003; World Health Organization, Europe, 2005, for similar results in Europe). In particular, human papillomavirus (HPV), trichomoniasis, and chlamydia were and continue to be the most prevalent—causing 88% of the new STDs cases in those between the ages of 15 and 24 (ASHA, 2005). In the United States, the associated lifetime medical treatment costs were estimated to be ~\$6.5 billion annually (Chesson, Blandford, Gift, Tao, & Irwin, 2004; see also Walensky, Freedberg, Weinstein, & Paltiel, 2007).

The health repercussions of STDs, particularly undiagnosed infections, can be serious and include death (National Institute of Allergy, Infectious Diseases, 2001). Asymptomatic infections, which can result in unknown transmission of STDs, are important factors in perpetuating STD/HIV infections. Many sexually transmitted infections can cause adverse pregnancy outcomes including, but not limited to, miscarriage, still birth, intrauterine growth restrictions, and perinatal (mother-to-child) infections. Some STDs are associated with infertility and one—the human papillomavirus—can cause cervical cancer among women. In addition, studies have shown that both ulcerative and nonulcerative STDs promote HIV transmission by augmenting HIV infectiousness and HIV susceptibility (Fleming & Wasserheit, 1999; Sangani, Rutherford, & Kennedy, 2004). Therefore, our results suggest an efficient and effective way to communicate health information about STDs promoting prevention and detection behaviors to the group of people at highest risk (Dehne & Riedner, 2005; Downs, Bruine de Bruin, Murray, & Fischhoff, 2006; European Commission, 2003) without any noteworthy costs.

Open Questions for Future Research

To the best of our knowledge, this paper is the first to show that framed messages about STDs can be made more appealing for young adults by representing the information in visual aids. Nevertheless, several clinically and theoretically relevant questions remain open for future research. For example, in our study we measured young adults' reported behaviors relating to the prevention and detection of STDs rather than their actual behaviors. It may be that participants' self-reports in some experimental conditions (e.g., when the risk information was represented via visual aids) are gross overestimates of their actual behaviors. Although more work is needed, we do not think this is the case: Participants in *all conditions* were carefully instructed to report their actual behaviors but they more often indicated that they had performed the behaviors in *some conditions* (i.e., when they were provided with a gain-framed message promoting the use of condoms or a loss-framed message promoting STDs screening, and when the risk information was represented via visual aids). At the very least, we can be confident that the intervention changed attitudes, which seems to be an essential step along the way toward behavioral change. However, there is a need for further research investigating the efficacy of visual aids on sexual health risk communication that involves objective measures of clinically relevant behaviors (e.g., buying condoms, tracking Internet searches, clinical visits). Future research should also explore whether the impact of visual aids on the effect of framed messages promoting condom use and

STD screening depends on participants' topic knowledge (Bruine de Bruin, Downs, & Fischhoff, 2007; Bruine de Bruin & Fischhoff, 2000; Downs et al., 2006), and their numerical and/or graphical skills (Galesic & Garcia-Retamero, 2010, 2011, in press a; Garcia-Retamero & Galesic, in press b). Another open question concerns generalizability such as the efficacy of visual aids when used in actual patient—doctor interactions. Such interactions seem likely to involve the exchange of high volume of information in short periods of time. It is reasonable to assume that under such conditions, visual aids would be likely to be even more valuable.

In summary, health messages effectively promoting prevention and detection of STDs could save lives and reduce the cost of health care. As several authors have argued, investigating the content and the structure of these health messages is crucial (e.g., Kirby & Laris, 2009; Kirby, 2008; Kohler, Manhart, & Lafferty, 2008). Moreover, the current results highlight the potential impact of both message framing and visual aids (i.e., the influence of appropriately framed brochures that include well-constructed visual aids). Larger scale implementation of the methods used in the current study holds the promise of large and meaningful benefits (e.g., money, health, and time) that are relatively inexpensive and ethically desirable.

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Appendix

Health Message Framing

Health Message Promoting Condom Use for the Prevention of STDs (Translated From Spanish)

Title: “[Using/not using] condoms during your sexual encounters substantially [reduces/increases] the chance of contracting STDs”

Section 1. If you [use/do not use] condoms in all your sexual encounters that involve sexual intercourse, you [will/will not] take care of your own health:

Experts believe that many STDs do not show any symptoms for a long time. Therefore, by [using/not using] condoms in all sexual encounters, people [will/will not] look after their own health. Most crucially, they will also [reduce/increase] substantially the chance of contracting a STD, especially if they have a sexual encounter with an infected partner.

Doctors suggest: By [using/not using] condoms in all your sexual encounters, you [will/will not] feel the peace of mind that comes with knowing about your health, and [will/will not] feel relaxed and comfortable in your daily life.

Section 2. If you [do not use/use] condoms in all your sexual encounters that involve sexual intercourse, it is most likely that you [do not suffer/suffer] severe health symptoms.

These *symptoms* include infertility, pelvic chronic pain, damage to other parts of the body (including heart, kidneys, and brain), adverse pregnancy outcomes if you are a woman such as miscarriage, still birth, intrauterine growth restrictions, and perinatal (i.e., mother-to-child) infections, and even death.

Similarly, you [will not/will] not put the people you love at risk of losing you or having to take care of you while you are sick.

(Appendix continues)

Health Message Promoting Screening to Detect STDs (Translated From Spanish)

Title: “[Conducting/not conducting] screening tests substantially [increases/reduces] the chance of detecting STDs”

Section 1. If you frequently [conduct/do not conduct] screening tests, you [will/will not] know whether you suffer a STD:

Experts believe that many STDs do not show any symptoms for a long time. Therefore, by [conducting/do not conducting] screenings tests frequently, people who suffer a STD [will/will not] know that they are infected. Most crucially, they will also [increase/reduce] substantially the chance of receiving an effective treatment (if they suffer a STD), especially if the screening is conducted when the disease is at an early stage.

Doctors suggest: By [conducting/do not conducting] screening for STDs frequently, you [will/will not] feel the peace of

mind that comes with knowing about your health, and [will/will not] feel relaxed and comfortable in your daily life.

Section 2. If you frequently [do not conduct/conduct] screening tests, it is most likely that you [suffer/do not suffer] severe health symptoms.

These *symptoms* include infertility, pelvic chronic pain, damage to other parts of the body (including heart, kidneys, and brain), adverse pregnancy outcomes if you are a woman such as miscarriage, still birth, intrauterine growth restrictions, and perinatal (i.e., mother-to-child) infections, and even death.

Similarly, you [will not/will] not put the people you love at risk of losing you or having to take care of you while you are sick.

Received August 11, 2010

Revision received March 10, 2011

Accepted March 23, 2011 ■

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