Tailoring Web Pages for Persuasion on Prevention Topics: Message Framing, Color Priming, and Gender

Luca Chittaro

Human-Computer Interaction Lab
University of Udine
via delle Scienze 206
33100 Udine, Italy
http://hcilab.uniud.it

Abstract. On the Web, as in more traditional influence contexts, the most effective persuasive strategies often depend on the individual characteristics of the message recipient. Unfortunately, most persuasive technology applications currently employ a one-size-fits-all approach to interventions. The study we illustrate investigates two different techniques (message framing and color priming) that can be used in tailoring a persuasive Web page about a prevention topic. The findings of our study highlight interactive effects between message framing and color priming, and advance the results in the literature by showing that red enhances the effects of framing in a gender-based fashion. The obtained results also provide practical guidance for automatic tailoring of persuasive Web pages about prevention topics, suggesting a strategy based on gender, an information about the user that is typically readily available in social network profiles, and other Web sites to which people register.

Keywords: tailoring, Web pages, color priming, message framing, gender differences, prevention, health, safety, persuasive technology

1 Introduction

Individual characteristics of the message recipient often affect the effectiveness of persuasive strategies on the Web as well as in other influence contexts. Unfortunately, most persuasive technology applications currently employ a one-size-fits-all approach to interventions, failing to deliver tailored persuasion that leverages user's characteristics [1]. In particular, Web audiences are large and heterogeneous, and influencing them with a one-size-fits-all intervention is difficult.

Software systems that are able to tailor content and presentation of Web pages based on a user's profile exist –see [2] for a review – and could be used for tailoring Web-based persuasive interventions. However, these tailoring systems need to be programmed with proper rules to deliver the most effective content and presentation based on user's characteristics. In persuasive interventions, the definition of such rules should be guided by theoretical frameworks of persuasion, and needs to be supported by studies of how different people are affected by different versions of a Web page.

Two important features of Web pages that could affect their effectiveness are the framing of the message contained in the page (for example, a message about health can be framed in terms of gain or loss associated with following or not the recommended behavior [28]), and the colors used by the page (for example, different background colors of a Web page can prime different attributes related to its content, influencing viewers [22]). The study in this paper focuses on both persuasion techniques (message framing and color priming), exploring how they could be exploited in tailoring a persuasive Web page. More specifically, the purpose of the paper is to (i) investigate message framing and color priming in Web pages that deal with prevention topics, (ii) study possible gender differences in users' susceptibility to the considered techniques, which could be very important for automatically tailoring Web pages based on gender as an individual user's characteristic, (iii) derive possible design guidance for tailoring Web interventions on prevention topics.

2 Related Work

A persuasive message can be framed in terms of the benefit (gain) or cost (loss) associated with adopting or not its recommendation. Several studies have shown that loss and gain frames affect people's attitudes and behavior in a different way even when they describe objectively equivalent situations, see [28, 19, 27] for reviews. In particular, the effects of framing can change with the addressed type of behavior, with gain framing being more effective when the message is a prevention recommendation (e.g., sun screen use, physical exercise, vaccinations,...), and loss framing more effective when it is a detection recommendation (e.g., checkups, breast self-exam, HIV testing,...).

However, most studies did not consider gender as a possible individual difference that may affect the influence of loss or gain framing on message recipients, see [19]. The few studies which considered gender in health communication (e.g., about sunscreen [27] and condoms [18] to prevent health risks) or in other domains (e.g., filling honestly the tax return to prevent risks such as fines, penalties and jail sentences [16]) suggest that gain framing could be more effective with women, while men could be more sensitive to loss framing. It is also worth noting that Fagley and Miller [10, 11], who studied gender differences in risky decision problems, go as far as saying that framing experiments which do not address possible gender effects may simply reflect the gender that predominates in the sample and be uninterpretable.

Another important feature of Web pages that can affect users is color. Research on color priming has investigated effects of color on different aspects of cognition and behavior, e.g. [7, 8, 9, 23, 14]. A study about Web persuasion was proposed by [22], who considered simple Web pages containing a product description and showed how background color can influence consumers. Participants who examined a car description on a Web page with a red and orange flame-like background were later more likely to mention safety as an important attribute for buying a car than participants who were exposed to a different (green) background, showing that red can help in priming safety. One of the color priming studies conducted by [23] focused specifically on prevention aspects. Participants read descriptions of three

pairs of brands on a computer screen and then reported their brand preferences. Within each pair, one brand highlighted a negative outcome people try to avoid, whereas the other brand highlighted a positive outcome people try to approach. For example, one of the pairs concerned toothpaste, with brand A particularly good for cavity prevention and brand B particularly good for tooth whitening. Across the three pairs, a red background increased preference for the brand that emphasized prevention. After ruling out mood as an alternative explanation with a post-hoc study, the study concluded that a red background contributes to activating avoidance motivation.

Gerend and Sias [13] investigated color priming together with message framing in persuasion about preventive behavior. In particular, the study concerned printed materials (a red or grey leaflet recommending a vaccination), in which the message was presented as either loss-framed or gain-framed. The results showed an interaction between color priming and message framing: loss framing was more effective but only when primed with red. Participants in this study were all male (a limitation that is acknowledged by its authors), and this could explain why the sample was more sensitive to the loss frame. The fact that red enhanced the effect of loss framing is consistent with the increase in risk avoidance motivation pointed out by [23] and with the role of red as a safety prime found by [22]. Moreover, Gerend and Sias [13] suggest that the enhancing interactive effect of color red could originate from the fact that red primes threat via associations with blood and danger, and acts as a peripheral threat cue that affects processing of persuasive health messages. More generally, other authors point out that red, as the single color most commonly associated with danger [34], has been shown to make people more vigilant [23], and the amount of attention directed to the message is an important aspect for the success of a persuasive intervention. Both perspectives would be consistent with the activation of a recently postulated "human alarm system" [6], a psychological system that people use to detect and handle threatening cues and, when activated, prompts people to process more alertly what is going on (for a discussion of the human alarm system, and some of its effects on judgment see [32]).

3 Method

The goal of our study was to advance the investigation of message framing and color priming in Web pages for prevention topics, aiming at deriving possible guidance for tailored persuasion based on gender.

We considered fires as a prevention domain of interest for their social relevance, e.g. in 2014, in the US alone, 19'050 civilians were hurt (3,275 dead, 15,775 injured) as the result of fires [17], with home fires accounting for 84% of the death toll, and a fire occurring every 86 seconds in the country. Adjusting for population, the fire death rate of some former USSR countries such as Russia, Latvia, and Estonia, is about ten times higher than the fire death rate of the US [5]. Fire risks are thus an important worldwide safety issue, and also a public health issue because they lead to hospitalizations of survivors, who can suffer long-term or even lifelong health consequences.

Current approaches to foster awareness of personal fire safety on the Web have explored the creation of different pages based on a two-groups age segmentation, producing a version of the Web site devoted to children, e.g. [30, 24], and one to adults, e.g. [31, 25]. Web pages targeted at adults currently follow a one-size fits all approach that uses the same messages for all visitors.

The study in this paper explores if tailoring message framing and color in this kind of Web pages could increase their effectiveness. Among the topics dealt with by fire prevention campaigns, the described experiment focuses on domestic smoke alarms, a preventive measure that significantly increases occupants' chances of surviving a deadly home fire [31, 25].

3.1 Design, Participants, and Hypotheses

We followed a between-groups design in which participants read a Web page about fire prevention that stressed the importance of having smoke alarms in houses. The textual message of the Web page was either gain- or loss-framed. More specifically, the message in the loss-framed (respectively, gain-framed) version of the Web page pertained how many people die (could be saved) every year if fires are not prevented (are prevented), the negative effects of noticing late a fire in the house (the positive effects of noticing early a fire in the house), the negative effects of the lack of smoke alarms in the house (the positive effects of the presence of smoke alarms in the house). Table 1 compares the two versions of the message, highlighting the parts that differ.

The study was conducted on a sample of 126 (65 male, 61 female) non-colorblind participants, recruited at the university library or through personal contact. They were volunteer undergraduate, graduate and doctoral students enrolled in different programs (Agricultural Science, Business Administration, Computer Science, Foreign Languages, Engineering, Literature,...), and people from other occupations who received no compensation. Age ranged from 19 to 38 (M=25.3, SD=4.0).

Participants were told that the purpose of the study was to evaluate a Web page. They first filled a short demographic questionnaire. Then, they read the Web page assigned to them on a computer screen. No interaction with the computer keyboard or mouse was required to read the page. Color priming was manipulated by making the background and the two uppercase section titles in the Web page either red or grey, equated on value (the relative lightness versus darkness of a color). As a result, four versions of the Web page were created (gain-framed with red or grey, loss-framed with red or grey), and each participant read one of the four pages. In all versions of the Web page, the text paragraphs were contained in a rectangular white area and were displayed in black lettering over the white area to maximize readability. The rectangular white area was placed over the red or grey background that filled the page, and its size and position did not change. The only factors that changed were message frame (gain, loss) and color prime (red, grey) as already described above. The Web page did not contain any other text (e.g., menus, links, copyright,...). After examining it, participants were asked about their:

- Perceived level of attention and alertness to the Web page. We were interested in assessing this aspect because, in general, when a persuasive attempt employs

textual messages, it is fundamental that the user attentively reads the information contained in them. Moreover, in this study, it is important to assess if and when the threatening cue (color red) is actually able to increase the level of attention and alertness as the color priming literature would suggest it is able to.

Table 1. Gain- and loss-framed message. For reader's convenience, the section titles and the text paragraphs in the message are an English translation of the original (non-English) ones, and we have highlighted differences between the gain- and loss-framed versions in italic.

Gain-Framed Version	Loss-Framed Version
HOME FIRES Fire has always been a leading cause of accidental death. Just think that *if there were no* fires in buildings, more than 5000 people a year *would be saved* in Europe alone. Homes are particularly exposed to the possibility of fire, due to a relevant concentration of electrical devices, sources of heat and flammable materials. Several studies show that in common home environments, *detecting early* the presence of a fire *can help prevent reaching* conditions of non-sustainability (that is, the death of people). *Fortunately*, many families *saved their lives* because they *did install* an important safety feature in their homes: smoke alarms. *With* smoke alarms, you *are warned* that smoke is entering your bedroom while you are sleeping: in this way, you wake up *in time*, when *it is still possible* to escape from the building. The causes of a fire can be very common and trivial: a short circuit in an electrical appliance, a cigarette left burning on an ashtray, a cloth over a lit lamp,... *The presence* of a smoke alarm *allows* us to detect these events early and *frees us from* a deadly trap. THE SOLUTION IS SIMPLE Fire alarms are cheap and easy to install. It is advisable to install a smoke alarm outside each bedroom or sleeping area of the house. If you live in a multi-story home, you need to	HOME FIRES Fire has always been a leading cause of accidental death. Just think that *because of* fires in buildings, more than 5000 people a year *die* in Europe alone. Homes are particularly exposed to the possibility of fire, due to a relevant concentration of electrical devices, sources of heat and flammable materials. Several studies show that in common home environments, *detecting late* the presence of a fire *can put at risk of reaching* conditions of non-sustainability (that is, the death of people). *Unfortunately*, many families *lost their lives* because they *did not install* an important safety feature in their homes: smoke alarms. *Without* smoke alarms, you *are not warned* that smoke is entering your bedroom while you are sleeping: in this way, you wake up *too late*, when *it is not anymore possible* to escape from the building. The causes of a fire can be very common and trivial: a short circuit in an electrical appliance, a cigarette left burning on an ashtray, a cloth over a lit lamp,... *The absence* of a smoke alarm *does not allow* us to detect these events early and *imprisons us in* a deadly trap. THE SOLUTION IS SIMPLE Fire alarms are cheap and easy to install. It is advisable to install a smoke alarm outside each bedroom or sleeping area of the house. If you live in a multi-story home, you need to

install a smoke alarm on each floor.	install a smoke alarm on each floor.

- Attitudes towards the specific prevention solution (smoke alarms) recommended by the page. We particularly focused on beliefs concerning the effectiveness of the recommended solution (response efficacy), because a broad array of theoretical perspectives – see [26, 28, 12, 33] for thorough discussions - suggests that perceived response efficacy is an important predictor of the likelihood of the recommended behavior being carried out by the message recipient.

Based on the previously surveyed literature on color priming, which has shown the general role of red in increasing vigilance and priming safety, and the specific study [13] which has shown (on a male sample) that the enhancing effect of red on persuasion shows itself with the loss frame (to which men are likely more sensitive), we hypothesized that we were going to obtain a similar result with men in our study. However, since our study extends the investigation to women, who are likely more sensitive to the gain frame, we hypothesized that we were going to obtain the best results in terms of attention and persuasion with women through the gain frame, enhanced by the general role of red mentioned above.

3.2 Measures

To measure the level of attention and alertness, we employed the items used in [32]. We asked participants whether the Web page led them to be alert *(1=very weakly, 7=very strongly)* and to be attentive *(1=very weakly, 7=very strongly)*, and their answers to the two items were averaged to form a reliable scale (Cronbach's alpha =.78).

To measure participants' attitudes towards the recommended prevention solution, we used three questions that respectively asked how useful, important, and effective is to have smoke alarms in houses. Answers were given on a 7-point Likert scale *(1=not at all, 7=a lot*), and were averaged to form a reliable scale of perceived response efficacy (Cronbach's alpha =.92).

4 Results

We conducted a three-way ANOVA with framing (loss, gain), color priming (red, gray), and gender (male, female) as factors. The results of the analysis yielded:

- for attention, a main effect of gender, $F(1,118)=10.17$, $p<.01$, $\eta_p^2=.079$, and an interaction among all three factors, $F(1,118)=10.53$, $p<.01$, $\eta_p^2=.082$;
- for response efficacy, a main effect of gender, $F(1,118)=5.24$, $p=.024$, $\eta_p^2=.042$, and an interaction among all three factors, $F(1,118)=5.94$, $p=.016$, $\eta_p^2=.048$.

Since a triple interaction among the independent variables characterized attention as well as perceived response efficacy, we followed a standard unfolding procedure to determine its meaning, by computing separately subsidiary two-way ANOVAs. Unfolding of the triple interaction for attention (see Figure 1) showed that, in men, color red generated more attention with loss (M=4.97, SD=1.66) rather than gain framing (M=3.35, SD=1.14), $F(1,28)=9.08$, $p<.01$, $\eta_p^2=.25$, and the gain frame generated less attention when coupled with red (M=3.35, SD=1.14) rather than grey (M=4.22, SD=1.15), $F(1,29)=4.39$, $p=.045$, $\eta_p^2=.13$. On the contrary, in women, it was the gain frame that generated more attention when coupled with red (M=5.33, SD=1.05) rather than grey (M=4.37, SD=1.33), $F(1,28)=4.90$, $p=.035$, $\eta_p^2=.15$. Finally, the difference in attention between women and men was statistically significant only for the gain frame enhanced with red, with higher attention elicited in women (M=5.33, SD=1.05) rather than men (M=3.35, SD=1.14), $F(1,26)=23.95$, $p<.001$, $\eta_p^2=.47$.

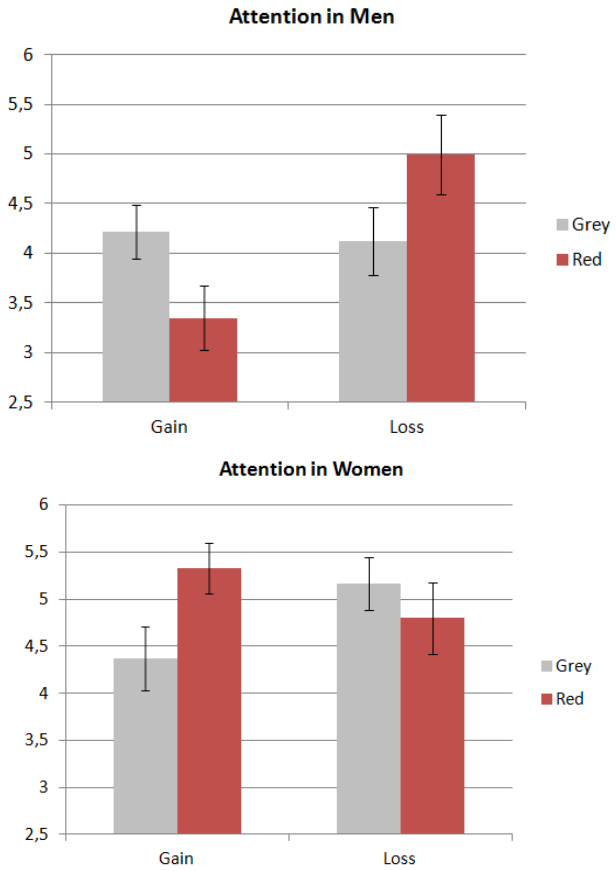

Fig. 1. Triple interaction among gender, color priming, and message framing on attention elicited by the Web page. Capped vertical bars denote ±1 SE.

Unfolding of the triple interaction for response efficacy (see Figure 2) revealed no statistically significant differences in men, while in women the gain frame produced higher perceived response efficacy when coupled with red (M=6.58, SD= 0.71) rather than grey (M=5.62, SD=1.01), $F(1,28)=9.05$, $p<.01$, $\eta_p^2=.24$.

The difference in perceived response efficacy between women and men was statistically significant only in the gain frame with red, which elicited stronger perception of response efficacy in women (M=6.58, SD=0.71) rather than men (M=5.10, SD=1.73), $F(1,26)=9.20$, $p<.01$, $\eta_p^2=.26$.

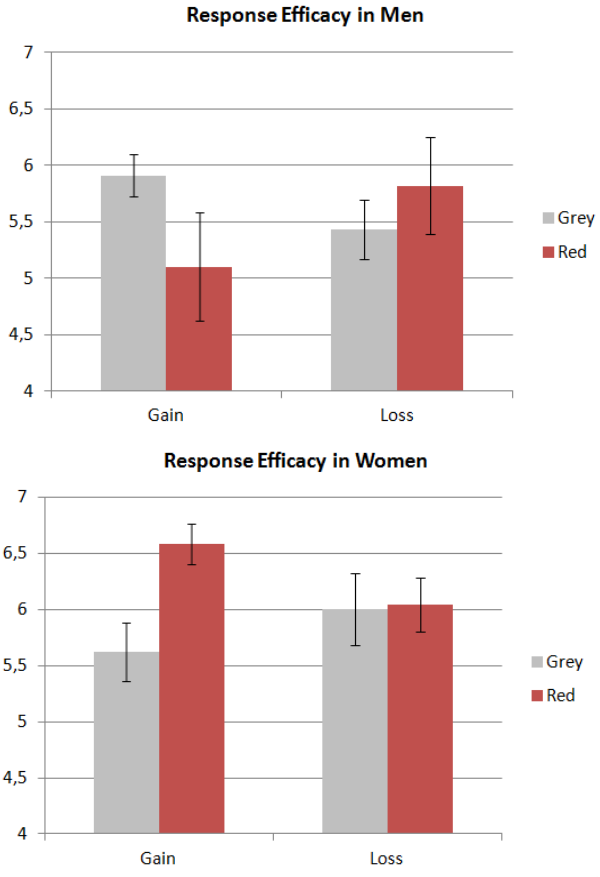

Fig. 2. Triple interaction among gender, color priming, and message framing on perceived

response efficacy of smoke alarms elicited by the Web page. Capped vertical bars ±1 SE.

5 Discussion

The results for attention and response efficacy confirmed our expectation that the effects on women and men were going to differ, and better results were in general going to be obtained by employing a gain frame strategy with women and a loss frame strategy with men, enhancing it with red color priming in both cases.

The finding that, for male participants, loss framing was more effective in eliciting attention but only when primed with red is consistent with and reinforces the results of the previously mentioned study by Gerend and Sias [13] of a male-only sample that read printed materials about a vaccination. In particular, the pattern suggested by the charts concerning men in Figure 1 (and also in Figure 2) is remarkably similar to the one found in that study when they measured the effectiveness of their persuasive message. However, to the best of our knowledge, our study is the first to extend the investigation of the interactive effects of message framing and color priming to women, showing that a different pattern characterizes women, with gain framing (instead of loss framing) primed with red as the possible strategy of choice.

Our results contribute evidence to what has been suggested (but not extensively studied in different conditions and domains) by some authors in the literature (see Section 2), i.e. that in communication about prevention topics a gain framing strategy could be more effective with women, while men could be more sensitive to loss framing. However, our study suggests that for this difference to become significant, the persuasive intervention may have to enhance the framing of the textual message with further stimuli. In our case, the additional stimulus was a peripheral threat cue (red color in the page). An interesting consideration concerns how a subtle cue (such as page color) peripheral to the information being processed can actually have considerable effects. Previous research on Web pages had shown that different choices of background color can change the perception of Web page loading time [15], can influence final scores on general knowledge tests conducted through Web pages [14] or influence users into considering some features of a product description more important than others [22]. In our study, color priming was instead effective in amplifying the effects of a persuasive framing strategy in terms of attention obtained by the Web page and elicited perception of efficacy of the recommendation made by the Web page. Taken together, these different studies highlight how the design of persuasive Web pages should be very careful and grounded on persuasion research, even for those peripheral page features such as background color that are typically dealt with only from the point of view of usability (e.g., readability of information) and aesthetics (e.g., pleasant and coherent color schemes).

It is worth remembering that color priming is context-dependent: while red activates avoidance motivation [23] when associated with safety topics, it can have different effects in other contexts, e.g. in interpersonal relationships it can enhance male (physical and sexual) attraction towards a woman [9] instead of avoidance motivation. One should thus be careful in trying to generalize the results of our experiment outside the context of messages about risk prevention.

On a practical level, our findings indicate that gender-based tailoring of Web pages in persuasive interventions concerning prevention topics can be effective. The versions of the Web page we tested produced different results in participants, based on their gender. For an automated system that has access to gender information, e.g. most applications in social networks, it would be very easy to present the user with the version of the Web page that maximizes the desired effects.

As a final consideration, a limitation of the study might involve cultural aspects: the meaning attributed by people to colors can be culture-dependent (e.g., in some cultures black is the color of mourning, while in others it is white) and our experiment involved only a European sample. However, our finding on color concerned red, whose impact is supposed to be universal [7].

6 Conclusions

This paper explored the effectiveness of a loss frame versus a gain frame strategy in formulating a persuasive message for a Web page that included either a grey or red color prime. We focused on possible gender differences that could provide design guidance for rules that drive automated systems for Web page tailoring.

First, the results of the study support the idea of gender-based tailoring of Web pages in persuasive attempts concerning prevention topics: the most effective conditions were different between men and women.

Second, it confirms gender differences in the effectiveness of message framing hypothesized in the literature [18,27,16]: gain framing was the best strategy for female users, while loss framing could be more suited to male users.

Third, it confirms the interactive effects between message framing and color priming obtained in the literature with men [13], but extends those results by showing that red enhances the effects of framing in a gender-based fashion: it is better to associate red to a gain frame for female users and to a loss frame for male users. This extended result provides practical guidance for automatic tailoring of persuasive Web pages about prevention topics.

A particular situation in which the suggested automatic tailoring could become less effective concerns users who access social networks or Web sites with a fake profile in which they misrepresent their gender. However, in the context of large-scale campaigns, the benefits of maximizing effectiveness on the large number of people who build real profiles on the social network will overshadow the suboptimal results that could be obtained with the smaller number of those who fake their identity. Moreover, it must also be noted that automatic technologies able to detect gender misrepresentation on the Web are available, e.g. Twitter claims that its gender recognition technology is 90% accurate [29]. Gender recognition technologies based on multilingual automatic text analysis [3] allow a social network to detect user's gender also when the profile does not include gender information (as in current Twitter profiles).

We now plan to carry out further studies to extend and refine rules for tailoring persuasive Web pages based on simple information about the visitor that can be readily available, such as gender. For example, recent research on health and safety

campaigns, e.g. [4, 20, 21], has suggested that men could be less sensitive than women to messages that resort to high physical threats (such as death and injuries), while they might respond better to humorous appeals, a difference that – if confirmed – could be important for Web content tailoring.

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