Describing Treatment Effects to Patients

How They Are Expressed Makes a Difference

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OBJECTIVE: To examine the impact of different presentations of equivalent information (framing) on treatment decisions faced by patients.

DESIGN: A systematic review of the published literature was conducted. English language publications allocating participants to different frames were retrieved using electronic and bibliographic searches. Two reviewers examined each article for inclusion, and assessed methodological quality. Study characteristics were tabulated and where possible, relative risks (RR; 95% confidence intervals) were calculated to estimate intervention effects.

MEASUREMENTS AND MAIN RESULTS: Thirty-seven articles, yielding 40 experimental studies, were included. Studies examined treatment ($N = 24$), immunization ($N = 5$), or health behavior scenarios ($N = 11$). Overall, active treatments were preferred when outcomes were described in terms of relative rather than absolute risk reductions or number needed to treat. Surgery was preferred to other treatments when treatment efficacy was presented in a positive frame (survival) rather than a negative frame (mortality) (relative risk [RR] = 1.51, 95% confidence interval [CI], 1.39 to 1.64). Framing effects were less obvious for immunization and health behavior scenarios. Those with little interest in the behavior at baseline were influenced by framing, particularly when information was presented as gains. In studies judged to be of good methodological quality and/or examining actual decisions, the framing effect, although still evident, was less convincing compared to the results of all included studies.

CONCLUSIONS: Framing effects varied with the type of scenario, responder characteristics, scenario manipulations, and study quality. When describing treatment effects to patients, expressing the information in more than one way may present a balanced view to patients and enable them to make informed decisions.

KEY WORDS: information framing; informed decision making; systematic review.

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The doctor-patient relationship has evolved so that patients are now encouraged to be actively involved in decisions regarding their medical care. Before patients can participate in the decision-making process, they must first be adequately informed about treatment alternatives and outcomes.^{1,2} It is possible, however, that the manner of presentation of such outcomes may influence patients' decisions.

The psychological literature on decision making suggests that the interpretation of information varies depending on the presentation format or the "frame" used.^{3,4} For example, a 30% chance of survival (positive frame) is logically equivalent to a 70% chance of mortality (negative frame).⁵ However, each statement impacts differently on the attitudes formed, and decisions made, by the reader. This phenomenon has also been shown to extend to medical scenarios. For instance, studies investigating framing in physician decision making have found that information expressed as gains or relative risk reductions (RRR) tend to increase physicians' enthusiasm for given treatments, although other factors such as physician experience, type of risk, and the clinical setting also exert influences.⁶ A comprehensive review has also indicated that among patients, loss-framed messages may be more effective in promoting the uptake of screening than those framed in terms of gains.⁷

These observations indicate that those imparting information on treatment options may have the potential to manipulate perceptions and inadvertently compromise informed patient choice. The objective of this study was to examine the impact of information framing on treatment decisions, and determine whether factors such as the scenario, the nature of the intervention, participant characteristics, or the amount of information described modify the effect. This was achieved by conducting a systematic review of the published literature.

METHODS

Literature Search

We searched MEDLINE (1966-August 2002), PsycINFO (1967-August 2002), and CINAHL (1982-August 2002) databases. Searches were initially carried out using key words, such as *framing* and *message fram*. All citations from this search were reviewed for relevant articles. The search was then expanded using related terms such as *decision making* and *persuasive communication*. These were identified by examining the tree structure of each database. As this search identified a large volume of citations, it was combined with key words and subheadings aimed at

identifying research based on patients or volunteers. Terms such as *patients* and *physician-patient relations* were used.

As the literature on framing tends to cover a wide range of topics, additional searches were undertaken to locate articles possibly missed by subheadings and key words alone. The Social Science Citation Index (1986 to August 2002) and Science Citation Index (1993 to August 2002) were examined for articles citing prominent authors who had published articles on framing.^{3,8} Reference lists of all articles obtained were reviewed for other relevant articles.

Criteria for Inclusion

We included studies which:

- Were published in English;
- Assigned participants to a framing condition, such as positive (or gain) versus negative (or loss) frames. Randomized, nonrandomized, and within-subject comparisons were included;
- Used a verbal or numerical frame format. Articles analyzing the effect of graphical displays on decision making were excluded;
- Described patients and/or volunteers making either real or hypothetical personal treatment decisions or evaluations.

Review Method for Selected Studies

Two reviewers (AM and PMG or DOC) independently examined each article for inclusion criteria, methodological quality, and data extraction. All disagreements were resolved by consensus. Information abstracted from each article that met our selection criteria included type of participants, the decision-making scenario, study design (whether subjects were randomized to framing conditions), type of framing, type of control group (if applicable), and outcomes reported.

Standard scales exist to assess the quality of randomized controlled trials.^{9,10} Such instruments were found to be unsuitable to assess studies found in this literature search, which included quasi-experimental designs, with and without control groups. They were also unable to address central issues surrounding the framing literature, such as participant selection, and the use of an appropriate comparison group. The authors therefore evaluated methodological quality using criteria considered by them to be appropriate to this area of research. Study quality was assessed using five quality categories: subject selection (consecutive vs convenience sampling, and whether representative of those likely to make the decision); method of allocation (randomized or nonrandomized) and adequacy of assignment (generation and concealment of schedule); blinding of researchers and/or participants; inclusion of a nonintervention control group; and comparability of baseline characteristics between groups. Rather than calculating an overall score, which would have little meaning for the reader, reviewers tabulated the elements that appeared in each study. As for other stages in the review process, all disagreements were resolved by consensus.

Statistical Analysis

The characteristics of included studies were summarized and presented in table form (Appen. A–C). The estimated effects of information framing from similar studies were combined using Cochrane Review Manager Software (Meta View 4.1). We calculated relative risks (RR) and 95% confidence intervals (CI) to estimate intervention effects. Outcomes were pooled using the random effects model, which is equivalent to the fixed effects model when there is no heterogeneity. Heterogeneity was examined using the Q statistic.

RESULTS

Results of Literature Search

Our search identified 146 potentially relevant articles. Of these, 37 citations were included in the review.^{8,11–46} As some authors reported more than one experiment per article, a total of 40 studies have been summarized and analyzed.

Reasons for exclusion were: review or discussion paper on framing ($n = 25$); inappropriate frames ($n = 21$); non-treatment decisions or non-health care scenario ($n = 14$); descriptive or qualitative studies with no allocation of participants ($n = 4$); one framing condition ($n = 1$); and insufficient information for analysis ($n = 2$). A further 15 articles were excluded as they assessed societal rather than personal treatment decisions such as Tversky and Kahneman's Asian disease problem.³ Twenty-seven studies examined the effect of framing on screening decisions and were excluded also.

Three different health areas were described in the included studies: treatment scenarios ($n = 24$); immunization scenarios ($n = 5$); and health behavior scenarios ($n = 11$).

Study Characteristics

Study Design. Six studies assessed the impact of framing using a within-subjects design, whereby participants received all frames.^{11,16,21,36,41,42} Thirty-four studies employed a parallel group design, of which 25 randomly allocated participants received one frame only. The remaining studies provided no information about how participants were allocated.

Treatment Scenario. Participants were asked to indicate preferences for various treatments, such as surgery and medication use (Appen. A; available at www.jgim.org). All studies presented numerical information to respondents. One study presented information to participants using audio-visual communication rather than written data.¹⁵ Only one study assessed the actual treatment decision made by participants.¹⁷

Immunization Scenario. Four studies presented information to respondents using probabilities^{14,18,27,38} and one study verbally described the benefits and costs associated with obtaining or not obtaining a vaccine³⁰ (Appen. B; available

Table 1. Methodological Quality of All Framing Studies (N = 40)

Quality Category	Quality Criterion Code	Studies Meeting Criterion n (%)
1. Subject selection (N = 40)		
Consecutive selection	1a	7 (18)
Representative target group	1b	14 (35)
2. Assignment		
Randomized	2a	25 (74)
(parallel groups design, N = 34)		
Order of presentation randomized	2b	2 (33)
(within-subjects design, N = 6)		
3. Blinding (N = 40)		
Research team unaware of allocation	3a	2 (5)
Participants unaware of other frames/purpose of study	3b	2 (5)
4. Comparison frames (N = 40)		
No information control	4a	2 (5)
Mixed frame*	4b	6 (15)
5. Comparability		
Comparison groups comparable or analyses adjusted	5a	12 (35)
(parallel groups design, N = 34)		
Reported baseline characteristics	5b	6 (100)
(within-subjects design, N = 6)		

* Both positively and negatively framed information presented together.

at www.jgim.org). One study assessed actual immunization status.²⁷ The remaining studies measured intentions to become immunized, three of which were for hypothetical vaccines.^{14,30,38}

Health Behavior Scenario. The effects of framing were examined on various health behaviors, in particular the use of sun protection to prevent skin cancer (Appen. C; available at www.jgim.org). With the exception of one article,²⁰ authors tended to frame the information verbally using gains and losses. Two studies implemented a video presentation of the framing conditions rather than using written information.^{23,39} Four studies assessed the impact of framing on actual behavior^{29,34,37,39} and two studies examined both actual behavior and intentions;^{13,30} the remainder assessed behavioral intentions only.

Methodological Quality

The overall methodological quality was considered to be poor as judged by the number of studies fulfilling each quality criterion (Table 1). The individual quality criteria met by each study are included in Tables 5–7. Most studies employed convenience samples: 26 of 40 studies recruited student volunteers who often participated to fulfill a course requirement. Fewer than half of the studies were carried out in groups likely to make the decision of interest. Representative groups were, for example, beach-goers for the promotion of sun screen use¹³ and current smokers for the application of a quit smoking program.³⁴

Although 25 articles indicated that a randomized design was employed, only three described the method of allocation.^{13,17,46} The method reported (alternation) was considered inappropriate in all cases. Few authors stated

that participants were unaware that different frames were being presented in their study. In some instances, questionnaires were assigned in a group setting where participants may have had the opportunity to discuss responses. Only two studies indicated that investigators themselves were unaware of group assignment. Relevant control groups were often not included in the study design and in most cases, only the comparison between positive and negative framing could be assessed.

All studies employing a within-subjects design reported information on participant characteristics. A large proportion (25 of 34) of parallel group design studies also provided baseline characteristics such as age, gender, and education. However, only 12 studies presented the information separately by frame assignment, and reported that these groups were comparable. As groups could not be compared, it was therefore unclear whether any baseline factors influenced study results. As most studies were conducted over short time frames, the durability of the participants' intentions remained unclear.

Effects of Framing

Treatment Scenario Surgical Treatment. Table 2 summarizes the results of studies examining framing effects in treatment scenarios. Studies assessing the hypothetical choice between surgery and radiotherapy or no treatment for various conditions suggested that when probabilities were expressed in terms of survival (positive frame), more people chose the option of surgery compared with those receiving information on mortality (negative frame). This was particularly evident in those who did not enjoy thinking about persuasive messages; that is, those who preferred not to overly deliberate about the information given (low

Table 2. Results of Framing Studies (Treatment Scenarios)

Study	Results	Effect Modifiers	Quality Criterion
Positive Versus Negative Framing (surgical treatment decision)			
Gurm 2000 ¹⁵	Favored angioplasty in positive frame, $P < .001$.	Not examined.	1b, 2a, 5a
McNeil 1982 ⁸	Favored surgery in positive frame, $P < .001$.	No significant interaction between input data (cumulative probability vs life expectancy), treatment identification, and framing.	1b
Smith 1996 ³³	Favored surgery in positive frame, $P < .05$ low cognition group.	Those with high need for cognition not influenced by framing, low group preferred surgery in positive frame.	2a
Marteau 1989 ²²	Favored surgery in positive frame (40% survival), $P < .02$.	No framing effect at 10%, 60%, or 90% chance of survival.	2a
Wilson 1987 ³⁵	Favored surgery in positive frame, $P < .05$.	Framing effect at 10%, 20%, 40%, and 60% survival but not at 80% survival.	2a
McNeil 1988 ²⁴	Favored surgery in positive frame, to lesser extent in mixed frame, P value not reported.	Not examined.	4b
Rybash 1989 ³¹	Favored surgery in negative frame, $P < .003$.	More likely to choose surgery in negative frame when patient in scenario refused treatment ($P < .03$).	None reported
Positive Versus Negative Framing (medication treatment decision)			
O'Connor 1989 ²⁶	Toxic treatment favored in positive and mixed frame. Volunteers (50% survival) $P < .0001$, patients (10% survival) $P < .01$.	At lower levels of probability, decline in preference greater in negative frame. Higher preference scores in patients.	1a, 1b, 2a, 4b
Jasper 2001 ⁴⁶	No significant framing effect on intention to use medication, positively framed information decreased birth defect risk estimates, $P < .05$.	Not examined.	1a, 1b, 2a, 5a
Bernstein 1999 ¹¹	Favored drug in positive frame, over mixed frame ($P < .005$), mixed frame preferred over negative frame ($P < .0001$).	Results for segregated editing condition.	2b, 4b, 5b
Jacoby 1993 ¹⁷	No significant framing effect.	Not examined.	1a, 1b, 2a
Zimmerman 2000 ³⁶	No significant framing effect.	Not examined.	1a, 1b, 5b
Farrell 2001 ⁴⁵	Blood transfusion rated as being safer in positive frame, $P < .05$.	No interaction between donation history, stress appraisals, and framing on perceived safety.	2a, 5a
O'Connor 1985 ²⁵	IV favored in positive and mixed frame. Visitors (treatment A 50%, treatment B 35% survival) $P < .01$, students (50%, 35% survival) $P < .05$.	No significant effect of professional status, gender, age, medium, and student class in treatment preferences.	2a, 4b
Krishnamurthy 2001 ⁴⁴ Study 2	See effect modifiers.	Those receiving attribute description more likely to discuss treatment in positive frame ($P < .05$), no significant frame effect for goal description.	1b, 2a
Krishnamurthy 2001 ⁴⁴ Study 1	See effect modifiers.	Those receiving attribute description more likely to discuss treatment in positive frame ($P < .01$); those receiving goal description more likely to discuss treatment in negative frame ($P < .01$).	2a
Blumenschein 1998 ⁴³	See effect modifiers.	Favored treatment in positive frame for standard gamble scenario (i.e., willing to risk mortality for good health), $P < .01$. No significant framing effect for time trade-off scenario.	2a

Table 2. (Continued)

Study	Results	Effect Modifiers	Quality Criterion
Levin 1988 ¹⁹	Treatment rated as more effective in positive frame, $P < .05$.	Not examined.	5a
Bier 1994 ¹² Studies 1 and 2	Favored ambiguous treatment in positive frame ($P < .05$), unambiguous treatment in negative frame (not significant).	Optimistic subjects preferred ambiguous treatment in positive frame.	None reported
RRR Versus NNT or ARR (medication treatment decision)			
Straus 2002 ⁴²	Favored medication when framed as RRR, P value not reported.	Not examined.	1a, 1b, 2b, 5b
Malenka 1993 ²¹	Preferred medication framed as RRR, reported as significant.	Those with higher education and/or being treated for condition more likely to select medication expressed as RRR.	1a, 1b, 5b
Hux 1995 ¹⁶	Favored medication when framed as RRR, $P < .0001$.	No relation between demographic variables and willingness to take medication.	1b, 5b
Misselbrook 2001 ⁴¹	Favored medication when framed as RRR, 95% confidence interval for RRR did not overlap with those for ARR, NNT, or personal probability.	No significant difference in responses by age, gender, housing tenure, and familiarity with stroke. Those with hypertension ($P < .01$) or taking other chronic medications ($P < .0001$) more likely to accept treatment framed as RRR.	1b, 5b
Probability Versus Frequency (medication treatment decision)			
Siegrist 1997 ³²	See effect modifiers.	Willing to pay more for medication when framed as frequency, $P < .05$ for high risk group.	None reported

Quality criterion met by each study: 1a, consecutive sample; 1b, representative target group; 2a, randomized parallel group; 2b, within-subjects order of presentation randomized; 3a, attempts blinding of researchers; 3b, attempts blinding of participants; 4a, no information control group; 4b, mixed frame control group; 5a, parallel groups comparable on baseline characteristics; 5b, within-subjects baseline characteristics reported.

need for cognition).³³ There was no consistent impact of scenario manipulations, such as the probability of survival, treatment identification, and patient characteristics, on the framing effect. One study presented information on survival and mortality together (mixed frame).²⁴ Although surgery was again favored over other treatments, participants were more likely to choose surgery when presented with survival information alone.

Meta-analysis of Surgical Treatment Studies. Four papers yielding five comparisons provided enough information for a meta-analysis of data on the proportion preferring surgery over other treatments.^{8,15,24,33} On average, respondents were one and a half times more likely to choose surgery over other treatments when treatment efficacy was framed in positive terms (percent survival) as opposed to negative information (mortality) (RR = 1.51; 95% confidence interval [CI], 1.39 to 1.64) (Fig. 1). Further analysis found no difference between the intentions of patients (RR = 1.61; 95% CI, 1.35 to 1.92) and students (RR = 1.48; 95% CI, 1.35 to 1.63). There was no evidence of heterogeneity in the framing effect across studies.

Medical Treatment. Positively framed information elicited an increase in preference for more invasive or toxic treat-

ments compared to information framed in negative terms. However, in the one study that varied the chance of survival presented, the decline in treatment preference when a low probability of survival was described appeared to be greater in the negative frame than in other frames.²⁶ There was no evidence of a framing effect when actual as opposed to hypothetical treatment decisions were studied.¹⁷ The presentation of a mixed frame condition had a similar effect to that of the positive frame, suggesting that information on survival was more influential in the decision-making process than information on mortality.^{11,25,26} Only one study provided sufficient information for a meta-analysis of data on the proportion choosing medical treatment⁴⁶ (Fig. 1).

Treatment effects expressed as RRR were consistently favored over those described by all other frames, including absolute risk reduction (ARR) and number needed to treat (NNT). While these studies were undertaken in a relevant patient population, the order of presentation of treatment choices was randomized in only one study.⁴² Order effects may have influenced treatment preference as information on RRR was presented first to participants in the remaining three studies.^{16,21,41}

One study investigated the impact of presenting information in terms of probability (e.g., 0.01) or frequency (e.g., 1 in 100).³² Participants were willing to pay more money

Comparison: 02 Framing (All Studies)

Outcome: 01 Number Choosing Treatment or Behavior

FIGURE 1. Effects of framing: positive versus negative framing by health scenario.

for a hypothetical new medication when its effect was presented as a frequency, but only when the risk of dying without the medication was high.

Immunization Scenario. Overall, no significant framing effect was evident in studies assessing either actual immunization status or behavioral intention (Table 3). Framing was, however, shown to influence patient perception of the risks and benefits associated with being immunized. In general, positively framed information increased expectations of benefits of immunization and decreased the expectation of incurring side effects. More favorable attitudes toward immunization were also seen in the positive frame, particularly among subjects with little involvement in the topic. Only one study provided enough information for a meta-analysis of data on the proportion choosing to be immunized²⁷ (Fig. 1).

One study examined the influence of information framed as a probability of survival or life expectancy (in years).³⁸ Participants were more likely to consider receiving the hypothetical pneumonia vaccine when information was framed as a probability. However, participants were willing to pay more for the vaccine when its effect was presented in a life expectancy frame, but only when the magnitude of benefit was high.

Framing effects were evident when the detail of the information presented was manipulated.¹⁸ Preference for an influenza vaccine using vague descriptions of efficacy ("estimated to be around") was greater when the probability of incurring a side effect from the vaccine was presented (negative frame) compared to the probability of not experiencing a side effect (positive frame). This result contrasts to that described for treatment scenarios. In this case, medications using vague descriptions of efficacy were favored in the positive frame (Table 2).¹²

Health Behavior Scenario. In general, framing effects were evident in studies examining actual behavior, but the impact was influenced by some effect modifiers (Table 4). These included level of motivation, self-efficacy,³⁴ and gender.²⁹ Two studies provided analyses that were adjusted for participants' baseline intention to perform the health behavior in question.^{13,39} Overall, the desired health behavior was more likely to be performed when information was expressed in terms of gains rather than loss.

The findings from studies which examined behavioral intention were less consistent. Of these, three reported no evidence of a framing effect,^{23,29,40} one found that the direction of the framing effect varied with the type of consequences (health or self-esteem) presented to the participant,²⁸ and

Table 3. Results of Framing Studies (Immunization Scenarios)

Study	Results	Effect Modifiers	Quality Criterion
Positive Versus Negative Framing			
O'Connor 1996 ²⁷	No framing effect on actual immunization rates, positively framed information increased expectations of benefits of immunization and decreased expectation of incurring side effects, $P < .05$.	Not examined.	1b, 2a, 3a, 3b, 5a
Donovan 2000 ¹⁴	No framing effect for intention to immunize or desire for more information when analyzed separately, favored behavior in positive frame when combined, $P < .05$. More favorable attitudes toward immunization in positive frame, $P < .05$.	Low involved respondents showed more favorable attitudes and intentions to immunize or seek information in positive frame. Analyses adjusted for age.	2a, 3b, 5a
Kuhn 1997 ¹⁸	Vaccine described vaguely favored in negative frame.	"Vague" vaccine favored in negative frame when vagueness described verbally and low estimate (of 2 conflicting studies) presented first ($P < .001$), favored in positive frame when high estimate presented first.	2a
Gain Versus Loss Framing			
Rothman 1999 ³⁰ Study 1	No framing effect.	Stratified by need for cognition—both low and high groups not influenced by framing.	2a
Probability Versus Life Expectancy			
Morris 2001 ³⁸	More likely to favor vaccine when framed as probability, $P < .01$.	Those accepting vaccine willing to pay more for it when framed as life expectancy with high magnitude of benefit (age 60), $P < .01$.	1a, 2a, 5a

Quality criterion met by each study: 1a, consecutive sample; 1b, representative target group; 2a, randomized parallel group; 2b, within-subjects order of presentation randomized; 3a, attempts blinding of researchers; 3b, attempts blinding of participants; 4a, no information control group; 4b, mixed frame control group; 5a, parallel groups comparable on baseline characteristics; 5b, within-subjects baseline characteristics reported.

one illustrated that baseline intentions modified the effect.¹³ Although one of the remaining studies provided limited methodological information,²⁰ the results mirrored studies assessing actual behavior.^{20,30}

The presence and direction of the framing effect tended to vary in studies that included a nonintervention control group.^{23,28} Overall, both positively and negatively framed information appeared to increase the likelihood of performing the desired behavior. It is difficult to determine, however, whether these studies were describing the impact of framing or the effect of receiving information.

Meta-analysis of Health Behavior Studies. Three studies provided enough information for a meta-analysis of data on the proportion undertaking the desired health behavior.^{13,37,40} On average, respondents were more likely to perform the behavior when information was framed as gains as opposed to loss (RR = 1.22; 95% CI, 1.04 to 1.43) (Fig. 1). There was no evidence of heterogeneity in the framing effect across studies.

Effects of Framing and Methodological Quality

Although a small proportion of studies met each quality criterion, there appeared to be no consistent relationship between study quality and the presence and direction of a framing effect. For example, three of the four studies assessing positive/negative framing that employed a consecutive sample of participants found no evidence of a framing effect. In contrast, all studies employing a mixed frame comparison group found that the treatment or behavior of interest was favored in a positive or gain frame compared to the negative or loss frame.

Three articles were found to describe at least one element from four of the five specified quality categories.^{13,27,34} These studies also examined the influence of framing on actual behavior rather than intentions. Of these, two studies found that participants were more likely to perform the desired behavior when information was expressed as gains rather than loss.^{13,34} However, the effect was modified by other participant characteristics (Table 7). Possible effect

Table 4. Results of Framing Studies (Health Behavior Scenarios)

Study	Results	Effect Modifiers	Quality Criterion
Positive Versus Negative Framing Linville 1993 ²⁰	Protective behavior favored in positive frame, $P < .05$.	Not examined.	None reported
Gain Versus Loss Framing Detweiler 1999 ¹³	More likely to request sunscreen sample in gain frame, $P < .01$. See effect modifiers for behavioral intentions.	Actual behavior: results for sunscreen requests adjusted for baseline intentions. Intentions: those with no prior plans to use sunscreen more likely to intend to use sunscreen, use SPF 15+, and apply regularly when framed as gains, $P < .05$. No relation between gender and framing.	1b, 2a, 3a, 5a
Wilson 1990 ³⁴	See effect modifiers.	Those highly motivated in gain frame smoked fewer cigarettes ($P < .05$), those in mixed frame with high self-efficacy smoked fewer cigarettes ($P < .05$).	1b, 2a, 4b, 5a
Robberson 1988 ²⁸	Intention to exercise higher in negative and mixed frame compared to control when health consequences described ($P < .05$), higher in positive and mixed frame when self-esteem consequences described ($P < .05$).	No relation between framing, vulnerability, and self-efficacy. Negative health message produced stronger beliefs in consequences of not exercising.	2a, 4a, 4b
van Assema 2001 ⁴⁰ Wong 2002 ³⁷	No significant framing effect. No significant framing effect (small sample size).	No interaction effects. Those with no prior plans to stop smoking more likely to have quit if given gain frame, those with baseline intentions more likely to have quit if given negative frame.	2a 2a, 5a
Schneider 2001 ³⁹	Greater reduction in smoking 6 weeks after presentation in gain-framed audio track—past 30 days ($P < .01$), past day ($P < .05$). Greater reduction in smoking 6 weeks after presentation in gain-framed visual—past 30 days ($P < .01$), past week ($P < .05$).	Results adjusted for baseline intentions to quit smoking and baseline weekly rate of smoking. No visual by audio framing interactions. No significant framing effect when all measures of smoking behavior combined.	2a, 5a
Rothman 1993 ²⁹ Study 2	See effect modifiers.	Women in gain frame more likely to use SPF 15+ than women in loss frame ($P < .01$), women more likely than men to request free sample and extra information.	2a
Rothman 1999 ³⁰ Study 2	More likely to request sample of mouth wash in gain frame, $P < .005$. Higher intentions to use mouth wash ($P < .01$), willing to pay more for sample ($P < .05$) in gain frame.	No interaction between age, gender, ethnicity, education, dental history, and framing on intentions.	2a
Martinez 2000 ²³	No significant framing effect, both framing groups combined were successful in promoting preventative behaviors compared to control group, P value not reported.	Not examined.	4a
Rothman 1993 ²⁹ Study 1	No significant framing effect.	Women more likely than men to intend to perform skin cancer prevention behaviors ($P < .0001$).	None reported

Quality criterion met by each study: 1a, consecutive sample; 1b, representative target group; 2a, randomized parallel group; 2b, within-subjects order of presentation randomized; 3a, attempts blinding of researchers; 3b, attempts blinding of participants; 4a, no information control group; 4b, mixed frame control group; 5a, parallel groups comparable on baseline characteristics; 5b, within-subjects baseline characteristics reported.

modifiers were not examined in the remaining study which found no evidence of a framing effect.²⁷ It is unclear whether framing may have influenced a particular subgroup of participants in this example (Table 6).

Of the 8 studies which assessed the actual decisions made by participants, 3 found no framing effect^{17,27,37} and 5 found that information framed as gains rather than loss influenced behavior.^{13,29,30,34,39} Two of the latter reported that certain participant characteristics modified the effect. It appears that when limiting the results to studies of good quality and/or actual decisions, the framing effect, although still evident, was less convincing compared to the results of all included studies.

DISCUSSION

The clearest framing effects were seen in treatment scenarios. For both surgical and medical treatment scenarios, the more invasive or toxic therapy tended to be preferred when information was expressed in a survival (positive) frame compared to a mortality (negative) frame. There was no difference between the intentions voiced by students or volunteers and those indicated by patients.

The intention to use a medication was greater where the benefits were expressed as RRR as opposed to ARR or NNT frames. Although similar results were seen in physician decision making,⁶ it is possible that patients ignored estimates of the underlying risk of death and compared RRR directly to ARR or NNT.²¹ In these instances, RRR, being numerically greater than ARR, might suggest greater treatment efficacy. Another explanation is that patients understood that medications were equally effective but preferred the effects of the medication that was presented first (order effect).

Framing effects were less obvious in immunization and health behavior scenarios. In particular, framing did not impact upon actual or intended behaviors toward immunization. Overall, those with little involvement in the topic, or who had no intention of undertaking the behavior at baseline, appeared to be influenced by framing, particularly when information was presented as gains. Previous research has suggested that those with low involvement in the area of interest are less likely to process messages in detail or assess how the new information relates to their existing knowledge. In these circumstances, people tend to form attitudes based on the feelings produced by the information.⁴⁷ We found that gain-framed information elicited more favorable attitudes toward immunization, and increased expectations of the benefits than loss-framed information.^{14,27,46} For respondents with low involvement and baseline intentions, the positive effect of the gain-framed message may have swayed them to agree to the behavior in question regardless of the message content.

In studies with methodologies that satisfied at least 4 out of 5 quality categories, framing effects were still

seen, albeit less convincing. Although good quality studies were limited in number, the results suggested that framing effects were influenced by various effect modifiers. It is notable that the majority of studies that found no evidence of a framing effect failed to examine effect modification. Hence, true differences may have been obscured.

Framing effects were also less convincing when actual decisions rather than behavioral intentions were described. Hypothetical decision makers tended to be influenced by framing regardless of whether they were from a population likely to make the decision of interest. Because only a fraction of studies investigated the effect of framing on actual decision making, it is difficult to make a strong judgment on its real-life impact. Current research involving willingness to pay issues has provided varied results as to whether intentions in a research setting differ from actual decisions.^{48,49}

These results may be contrasted with suggestions that loss rather than gain-framed messages are more effective in persuading individuals to undertake screening.⁷ According to prospect theory, greater value is given to outcomes worded as losses in risky situations compared with outcomes perceived as gains.³ Performing a behavior such as screening may be perceived as "risky" because of the possibility of detecting an abnormality. As choices involving loss-framed information are risk taking, patients may be more likely to adopt screening when the information is described in negative terms. But how does such theory explain our findings?

One explanation is that preventive health behaviors are actually perceived as safe, and the choice not to practice them is considered risky due to the various consequences.⁵⁰ Negatively framed information may therefore inhibit people from performing preventive behaviors, such as applying sunscreen to protect against skin cancer. A similar effect may be expected for treatment decisions for existing health problems. Although surgery is invasive and carries some risk, choosing a less effective treatment with fewer side effects, or no treatment at all, may still be perceived as the riskier option when presented in a negative frame. Patients may therefore become risk averse when exposed to positively framed information.

Few studies examined the impact of framing when both positive and negative information was presented together. Mixed-framed information yielded similar results to that of a positive frame for medication treatment decisions, suggesting that information on survival was more influential in the decision-making process than information on mortality. Hence, the treatment option described was still considered safer, even when negatively framed information was present.

Methodological Shortcomings

Few studies investigated the effect of information framing on relevant populations, instead relying on convenience

samples such as student volunteers. While convenience populations appear not to be an optimal source of sampling, the results of the meta-analysis for the surgical treatment scenario showed that these groups, when making hypothetical choices, did not behave any differently from participants from groups likely to make the decision of interest. Although the face validity would be enhanced if studies were undertaken among subjects making real treatment decisions, there may be ethical implications in assessing framing effects in certain representative groups, for example, cancer or life-threatening illnesses.

The reporting of study methods did not improve over time. Few papers included a nonintervention control group or provided information on how groups were allocated. Baseline characteristics were not consistently reported across the articles. Although the medium used to present information has changed, study design and reporting have remained the same. More recent studies have assessed the impact of framing using audio-visual presentations of information, without addressing the methodological limitations of previous studies.

Strengths and Weaknesses of the Review

We undertook extensive literature searching to uncover articles relating to the effects of framing on patient decision making. However, because non-English articles were excluded, it is possible that some relevant studies were omitted. Papers were carefully examined to ensure they met inclusion criteria. All studies were reviewed and quality was assessed by more than one researcher and disagreements were resolved by consensus.

As a consequence of the variability in the types of scenarios presented and the measurements of outcomes, as well as the lack of data reported, we were unable to provide a quantitative estimate of effect for most research questions. The impact of graphical displays of information on decision making was considered to be outside the scope of our study. It is possible that data presentation in forms other than written/oral may influence patient decision making.

The findings from this review complement those reported by Edwards et al.⁷ The criteria for inclusion in that review were limited to actual or hypothetical decisions made by patients in a health care setting, or decisions of current personal interest (e.g., protection against skin cancer). Using these criteria, few studies were available for analysis regarding treatment decisions. We have taken a broader approach by examining all health/medical decisions made by participants. As indicated in our review, there was little difference between the decisions made by patients and those of students or volunteers. Consequently, only seven studies are common to both reviews. We also attempted to explore further the influence of various effect modifiers on information framing, as well as individually examining aspects of methodological quality of the studies included.

Recommendations for Future Research Design

Overall, future research into the effects of framing will need to incorporate a high-quality design if the results are to be deemed applicable to real-life medical practice. It is advised that researchers examine actual behavior if ethically possible. More research is required to determine whether hypothetical decisions differ from the decisions made in real life. To improve the generalizability of results, subjects must be sampled consecutively from a representative target group likely to face the decisions of interest rather than a convenience or volunteer sample.

To minimize selection bias, concealed, computer-generated randomization schedules could be employed when allocating participants to each framing condition. In the case of a within-subjects design, the order of presentation of each frame must be randomized to eliminate order effects. Researchers should attempt to conduct the study in a double-blinded manner. This may be achieved by having participants complete the study measures individually rather than in a group setting, thereby ensuring participants are unaware that other frames are available. Research teams should also be unaware of frame allocation when analyzing subject choices. In addition, adequate researcher or interviewer training will ensure that measures are introduced and administered in a standard fashion across all comparison groups.

Future research will also need to provide an adequate control group such as a mixed frame, "usual care," or a "no information" comparison group. Finally, baseline characteristics such as age, gender, and level of education should be recorded and compared for each frame. Other characteristics and comorbidities relevant to the scenario presented should be evaluated also. With randomization, known and unknown confounding variables should be evenly distributed among the groups investigated.

Recommendations for Physicians

Notwithstanding the shortcomings of the existing studies, our review suggests that methods for describing probabilities of side effects and treatment efficacy need to be considered carefully by physicians. In addition, as physicians themselves may be influenced by framing, these biases could be passed on to the patient. The main question for physicians concerns how information should be presented to patients when eliciting consent for treatment or when patients are actively involved in making a health decision. This may be of particular concern with patients who are not familiar with the treatment.

The main message from our review is that treatment effects need to be expressed in more than one way. Although few studies were carried out using a mixed frame group, this is a feasible method of information framing that ensures patients form an accurate impression of treatment worth, bearing in mind that information on survival may dominate in the decision-making process. Physicians should also be aware that describing treatments only in

terms of RRR is insufficient for patients to form an accurate perception of their underlying risk. Estimates of ARR, NNT, or the probability of survival/mortality with and without treatment are also required.

For decisions involving preventive health care and screening programs, health professionals may experience conflict between manipulating the information to promote the desired behavior and presenting the information in a balanced way to facilitate informed choice. Each method has benefits and drawbacks but ultimately, a balanced view should be presented to patients to enable them to make informed decisions.

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APPENDIX A

Participants, Study Characteristics, and Frames for Treatment Scenarios

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Positive Versus Negative Framing (surgical treatment)						
Gurm 2000 ¹⁵	Patients in waiting area of outpatients clinic $N = 116$	RCT parallel groups	Video presentation describing risks and benefits of angioplasty. Two scenarios: (A) to improve symptoms of chest pain, (B) to reduce the risk of heart attack.	Positive frame—0% safe Negative frame—number with complication out of 100	Intention to undergo angioplasty	No control group. Baseline characteristics on age, gender, education, and experience with angioplasty comparable (no data given).
Smith 1996 ³³	Psychology students and students approached on campus $N = 73$	RCT parallel groups	Information presented on surgery vs radiotherapy for a rare cancer. Describes survival during treatment, at 1 year, and at 5 years.	Positive frame—number alive out of 100 people after treatment Negative frame—number dying out of 100 people after treatment	Intention to undergo surgery/radiotherapy	No control group. No information on how questionnaires were administered. Baseline characteristics on gender reported but not examined by framing group. Results stratified by enjoyment in thinking about persuasive messages (low vs high need for cognition).
Marteau 1989 ²²	Medical students participating in psychology course $N = 74$	RCT parallel groups	Information presented on surgery vs no treatment for terminal liver disease. Subjects responded either as a patient or doctor. Probability of survival varied.	Positive frame—0% surviving the operation Negative frame—0% dying after operation	Intention to undergo surgery	No control group. 2×2 design (role by message frame). Baseline characteristics not reported.
Rybash 1989 ³¹	Psychology students $N = 301$	Non-RCT parallel groups	Presents scenario of a male patient deciding whether to consent to surgery for heart disease. Whether patient consents/refuses surgery and age of patient (40 vs 70) manipulated.	Positive frame—0% survive surgery, expected to live 10–15 years Negative frame—0% die during surgery, expected to die 10–15 years	Intention to undergo surgery	No control group. $2 \times 2 \times 2$ design (framing by patient age by patient choice). Participants tested in group setting. Baseline characteristics not reported.
McNeil 1988 ²⁴	Radiology students $N = 390$ Medicine and science students $N = 402$	Non-RCT parallel groups	Information on surgery vs radiation therapy for lung cancer. Describes survival during treatment, at 1 year, and at 5 years.	Positive frame—number alive out of 100 people Negative frame—number dying out of 100 people Mixed frame—number dying and alive out of 100 people	Intention to undergo surgery	Mixed frame control group. Little methodological information given. No information on baseline characteristics.

APPENDIX A (continued)

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Wilson 1987 ³⁵	Psychology students participating for course N = 91	RCT parallel groups	Information on surgery vs no treatment for terminal liver disease. Probability of survival after surgery varied.	Positive frame—% surviving the operation Negative frame—% dying after operation	Intention to undergo surgery	No control group. Questions presented in random order. Baseline characteristics on age and gender reported but not examined by framing group.
McNeil 1982 ⁸	Chronically ill outpatients N = 238 Business school students N = 491 Radiologists N = 424	Non-RCT parallel groups	Information on surgery vs radiotherapy for lung cancer. Describes survival during treatment, at 1 year, and at 5 years. Treatment was either identified (surgery vs radiotherapy) or unidentified (treatment A vs B). Outcomes expressed as cumulative probability and life expectancy.	Positive frame—number alive out of 100 people Negative frame—number dying out of 100 people	Intention to undergo surgery/radiotherapy	No control group. Patients interviewed individually, students and physicians written questionnaire (mode of administration not described). Baseline characteristics on age reported but not examined by framing group.
Positive Versus Negative Framing (medication treatment)						
Jasper 2001 ⁴⁶	Consecutive female “Motherisk” callers seeking information about allergy-related drugs during pregnancy N = 105	RCT parallel groups	Information on teratogenic risk for applicable allergy-related drug information and measures administered over the telephone.	Positive frame—% risk of not giving birth to a child with a birth defect Negative frame—% risk of giving birth to a child with a birth defect	Intention to take allergy medication	No control group. Women alternately allocated to framing groups. Baseline information on age, gravidity, parity, first-time caller, currently pregnant, and exposure to medication comparable.
Farrell 2001 ⁴⁵	Students responding to class announcements N = 254	RCT parallel groups	Written information on risk of contracting HIV and hepatitis C through a blood transfusion. Presents scenario of requiring a blood transfusion during surgery.	Positive frame—number not infected out of 2 million units transfused Negative frame—number infected out of 2 million units transfused Mixed frame—number infected out of 2 million units transfused, embedded in positive context of safe blood transfusion history	Perceived safety of receiving a blood transfusion	Mixed and negative frame report same numerical data. Completed tasks in group setting (states participants did not see other conditions). Baseline characteristics on age, gender, and donation history comparable. Results stratified by donation history.
Krishnamurthy 2001 ⁴⁴ Study 1	Students N = 143	RCT parallel groups	Presented two versions with different phrasing: attribute frame—percentage of patients improving; goal frame—chance of improvement. Varied probability of better results from treatment. Participants chose a personal health condition.	Positive frame—% chance of better results Negative frame—% chance treatment fails to provide better results	Intention to see physician about treatment	No control group. 2 × 2 design (frame by phrasing). Baseline characteristics on age and gender reported but not by framing group.

APPENDIX A (continued)

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Krishnamurthy 2001 ⁴⁴ Study 2	Patients attending health clinic N = 117	RCT parallel groups	As above.	Positive frame—0% chance of better results Negative frame—% chance fails to provide better results	Intention to see physician about treatment	No control group. 2 × 2 design (frame by phrasing). Baseline characteristics on age and gender reported but not by framing group.
Zimmerman 2000 ³⁶	Consecutive breast cancer patients at oncology outpatient clinic N = 35	Within subjects	Presented information using a modified decision board instrument on adjuvant chemotherapy at 3 different levels of cure/recurrence.	Positive frame—0% cure Negative frame—% disease recurrence	Intention to undergo chemotherapy	Fixed order of presentation (positive frame presented 2 months after negative). Baseline characteristics on age, marital status, employment, and clinical characteristics provided.
Bernstein 1999 ¹¹	Psychology students responding to posted notice N = 216	Within subjects	Presented information on 2 supplementary drugs for a chronic disease that either prolonged or shortened life from the 20-year effect of a baseline drug. Effects were described separately for supplementary and baseline drugs (segregated editing) or combined (integrated editing). Expected value (EV) in years of life varied from -5 to +25.	Gain frame—supplementary drug prolongs life Loss frame—supplementary drug shortens life Mixed frame—either prolongs or shortens life	Intention to take supplementary drug	Between-subjects design for editing type, within-subjects design for framing condition—order randomized. No order effects found. Baseline characteristics on gender and age reported.
Blumenschein 1998 ⁴³	Pharmacy students N = 182	RCT parallel groups	Presented written information on treatment for arthritis. Received information described as time trade-off (years) and standard gamble (percent).	Positive frame—years in full health, % chance of success Negative frame—years willing to give up for full health, % chance of failure	Intention to undergo treatment	No control group. Completed tasks in group setting. Baseline characteristics not reported.
Bier 1994 ¹²	Psychology students participating for course requirement N = 140 (study 1) N = 256 (study 2)	Non-RCT parallel groups	Information on effectiveness and side effects of 2 treatments for various conditions (e.g., cholesterol lowering). One treatment described as ambiguous with conflicting results from 2 studies reported.	Positive frame—0% experiencing no side effects from treatment Negative frame—% experiencing side effects from treatment	Intention to undergo treatment	No control group. 2 × 2 × 2 design (framing by ambiguity by probability order). Baseline characteristics on age and gender reported but not examined by framing group. Results stratified by level of optimism (LOT).

APPENDIX A (continued)

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Jacoby 1993 ¹⁷	Consecutive epilepsy patients eligible for medication withdrawal N = 72	RCT parallel groups	Written information on seizure recurrence after medication withdrawal provided to patients.	Positive frame—likelihood of remaining seizure free Negative frame—risk of seizure recurrence	Actual treatment choice	No control group. Patients alternately allocated to framing groups. Baseline characteristics not reported.
Levin 1988 ¹⁹	Psychology students N = 160	Non-RCT parallel groups	Information on a hypothetical medical treatment for cancer.	Positive frame—0% success rate Negative frame—% failure rate	Perceived treatment effectiveness	No control group. Baseline characteristics for gender comparable.
O'Connor 1989 ²⁶	Consecutive outpatients from cancer clinic N = 154. Healthy volunteers of university staff, students, and their neighbors N = 129	RCT parallel groups	Information presented on 2 hypothetical treatments for cancer. Only treatment A had side effects. Probability of survival for treatment B varied.	Positive frame—% survival after 1 year Negative frame—% dying after 1 year Mixed frame—both % survival and % dying after 1 year given	Intention to undergo treatment	Mixed-frame control group. Order of probability level randomized (ascending or descending). No order effects in mixed frame group. Baseline characteristics on age, gender, health professionals, and therapy reported but not examined by framing group.
O'Connor 1985 ²⁵	Nursing students N = 216 Visitors to an open house at Ontario Cancer Institute N = 208	RCT parallel groups	Describes 2 treatments for cancer (IV versus tablet). IV treatment has higher chance of side effects. Probability of survival varied for treatment in tablet form.	Positive frame—% survival after 1 year Negative frame—% dying after 1 year Mixed frame—% survival then dying after 1 year given Mixed frame—% dying then survival after 1 year given	Intention to undergo treatment	Mixed-frame control group. Visitors self-selected to medium of questionnaire administration (computer vs pen/paper). No order effects in mixed-frame group. Baseline characteristics on age, gender, professional status, and class (students) reported but not examined by framing group.
RRR Versus ARR or NNT (medication treatment)						
Straus 2002 ⁴²	Consecutive patients with NVAf N = 17	Within subjects	Information presented on warfarin medication for stroke.	Same information framed as RRR/ARR, ARR/ARI, NNT/NNH, LHH	Intention to take medication	Order of presentation randomized. Baseline characteristics on age, gender, and previous stroke provided.

APPENDIX A (continued)

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Misselbrook 2001 ⁴¹	Hypertensive patients <i>N</i> = 102. Matched non-hypertensive patients <i>N</i> = 207	Within subjects	Information presented on advantages and disadvantages of treating mild hypertension (labeled as stroke prediction factor). Data obtained from MRC Mild Hypertension Trial.	Same information framed as RRR, ARR, NNT, personal probability	Intention to take medication	Participants unaware of hypertension focus of study. Baseline characteristics on age, gender, housing tenure, and familiarity with stroke provided.
Hux 1995 ¹⁶	Outpatients from family practice, hypertension, and cardiology clinics <i>N</i> = 100	Within subjects	Presented information on a cholesterol-lowering drug used to reduce CAD. Data obtained from Helsinki Heart Study. Two scenarios on hypertension medication inserted to reduce respondents discerning that a single medication was being described.	Same information framed as RRR, ARR, NNT, average and stratified gain in disease-free survival	Intention to take medication	All received same information. Questions appeared in random order—not varied between questionnaires. Baseline characteristics on gender, age, history of heart disease, attending cardiology clinic, and taking cardiovascular medication provided.
Malenka 1993 ²¹	Consecutive outpatients from general internal medicine practice <i>N</i> = 470	Within subjects	Information on 2 medications for a life-threatening disease. Both medications were equivalent in costs, side effects, and effectiveness. Underlying risk of death and treatment benefit varied (10% or 80% for both).	Medication A—framed as RRR Medication B—framed as NNT	Intention to take medication	Within-subjects design for framing, between-subjects for underlying risk of death and treatment benefit. Baseline characteristics on age, gender, education, medical history, and overall health reported.
Probability Versus Frequency (medication treatment)						
Siegrist 1997 ³²	Psychology students <i>N</i> = 105	Non-RCT parallel groups	Presented information on hypothetical new medication for a serious illness. Risk of dying varied (high vs low).	Probability frame—probability of dying after treatment Frequency frame—number dying out of 1 million after treatment	Willingness to pay for treatment	No control group. 2 × 2 design (framing by level of risk). Completed questionnaires in groups. Baseline characteristics on age and gender reported but not examined by framing group.

RCT, randomized controlled trial; non-RCT, nonrandomized controlled trial; within-subjects, participants received all frames; RRR, relative risk reduction; RRI, relative risk increase; ARR, absolute risk reduction; ARI, absolute risk increase; NNT, number needed to treat; NNH, number needed to harm; LHH, likelihood of being helped or harmed; CAD, coronary artery disease; IV, intravenous; HIV, human immunodeficiency virus; NVAf, nonvalvular atrial fibrillation.

APPENDIX B

Participants, Study Characteristics, and Frames for Immunization Scenarios

Article	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Positive Versus Negative Framing Donovan 2000 ¹⁴	Females aged 18–45 approached in shopping mall N = 102	RCT parallel groups	Hypothetical immunization against bronchitis and pneumonia for infants age <1 year.	Positive frame—% infants who do not develop side effect of influenza Negative frame—% infants who develop side effect of influenza	Intention to immunize, seek information	No control group. Blinding (participants not told purpose of study). Results stratified by level of interest in immunization (low vs high involvement).
	Kuhn 1997 ¹⁸ Psychology students participating for course requirement N = 83	RCT parallel groups	Information on 2 influenza vaccines, probability of side effects varied. Vaccine B was described “vaguely” by using a verbal qualifier (e.g., “estimated to be around”) or reporting conflicting results from 2 studies. The lower probability was presented either first or second (low-high and high-low range, respectively).	Positive frame—% who do not experience side effects from vaccine Negative frame—% who experience side effects from vaccine	Preference for vaccine A or B	No control group. 3 × 2 design (vagueness description by message frame). Completed questionnaires in groups. Baseline characteristics on gender reported but not examined by framing group.
O'Connor 1996 ²⁷	Respiratory and cardiac outpatients eligible for influenza vaccine N = 292	RCT parallel groups	Oral presentation of risks and benefits of influenza vaccine with large-print flip charts and decision poster with graphic displays.	Positive frame—% who remain free of disease and side effects of vaccine Negative frame—% who acquire disease and side effects from vaccine	Actual vaccine choice	No control group. Blinding (patients unaware of differences in presentation, research team unaware of allocation). Baseline characteristics on age, gender, cardiac disease, awareness of vaccine, mean time with nurse, and location comparable.
Gain Versus Loss Framing						
Rothman 1999 ³⁰ Study 1	Student volunteers N = 176	RCT parallel groups	Hypothetical contagious respiratory disease (Letrolisus virus). Received written information on preventing the disease (vaccine).	Gain frame—benefits of obtaining vaccine to prevent disease Loss frame—costs associated with not obtaining vaccine	Intention to use vaccine	No control group. Baseline characteristics on gender reported but not examined by framing group. Results stratified by enjoyment in thinking about persuasive messages (low vs high need for cognition).
Probability Versus Life Expectancy Morris 2001 ³⁸	Random sample of general public = 970	RCT parallel groups	Hypothetical pneumonia vaccine. Varied age at which vaccine given (60 vs 70).	Probability frame—% decrease in mortality Life expectancy frame—years gained with vaccine	Intention to use vaccine, willingness to pay for vaccine	No control group. 2 × 2 design (framing by age). Baseline characteristics on age, gender, income, education, marital status, children, race, and quality of life comparable.

RCT, randomized controlled trial.

APPENDIX C

Participants, Study Characteristics, and Frames for Health Behavior Scenarios

Study	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Positive Versus Negative Framing Linville 1993 ²⁰	Students, number not reported	Non-RCT parallel groups	Information presented on the use of condoms to prevent HIV.	Positive frame—% success rate Negative frame—% failure rate	Intention to use condoms	No control group. Little methodological information provided.
Gain Versus Loss Framing Wong 2002 ³⁷	Current smokers: Students participating for course requirement N = 31 General public N = 39	RCT parallel groups	Written information on the advantages and disadvantages of quitting smoking.	Gain frame—benefits for quitting smoking Loss frame—costs for not quitting smoking	Actual behavior (if quit smoking)	No control group. Three months' follow-up. Baseline characteristics on age, gender, smoking behavior, subject group, and self-efficacy comparable.
Schneider 2001 ³⁹	Students, smokers, and non-smokers N = 437	RCT parallel groups	Eight-minute audio-visual presentation about quitting smoking.	Gain frame—benefits for quitting smoking, positive images Loss frame—costs for not quitting smoking, negative images	Actual behavior (cigarettes smoked)	No control group. Six weeks' follow- up. Completed tasks in groups. Adjusted analyses used.
van Assema 2001 ⁴⁰	Students N = 152	RCT Parallel groups	Booklet containing information on the impact of diet on general health, cancer, and heart disease. Two dietary descriptions (fruit and vegetable vs fat intake).	Gain frame—chance for good health by having a good diet Loss frame—chance of disease by not having a good diet	Intention to begin a healthy diet and request a self-help guide	No control group. 2 × 2 design (framing by dietary description). Completed tasks in groups (ordered not to talk to classmates). Baseline characteristics on age, gender, and education comparable.
Martinez 2000 ²³	Students N = 151	Non-RCT parallel groups	Two-hour HIV prevention intervention session.	Gain frame—not described Loss frame—not described Control—not described	Intention to use condoms	Little methodological information. Assessed HIV attitudes, intentions, and behavior at baseline and at 2 months, follow-up.
Detweiler 1999 ¹³	Beach-goers age >18 approached at a public beach. Received free lottery ticket on completion N = 217	RCT parallel groups	Presented in brochure format information on the use of SPF 15+ sun screen to protect against skin cancer.	Gain frame—benefits gained/ undesirable outcomes avoided by sun-protective behavior Loss frame—benefits foregone/ undesirable outcomes incurred by unsafe behavior	Actual behavior and intention to use sun screen	No control group. Blinding (investigators unaware of assignment). Some questionnaires completed in groups. Alternate allocation to framing groups. Adjusted analyses used. Results stratified by baseline intention to use sun screen.

APPENDIX C (continued)

Study	Subjects	Design	Scenario Presented	Frames	Outcomes	Methodological Comment
Rothman 1999 ³⁰ Study 2	Students responding to posted notice. Received \$5 for completing experiment N = 120	RCT parallel groups	Received pamphlet with information on an oral hygiene behavior that prevents dental health problems. Described reasons for using mouth rinse to prevent plaque accumulation.	Gain frame—benefits of using mouth rinse to prevent disease Loss frame—costs associated with not using mouth rinse	Actual behavior and intention to use mouth wash, willingness to pay for mouth wash	No control group. Some questionnaires completed in groups. Baseline characteristics on gender reported but not examined by framing group. Loss frame group had higher ratings of perceived risk, seriousness, and anxiety of developing gum disease.
Rothman 1993 ²⁹ Study 1	Caucasian students N = 525	Non-RCT parallel groups	Provided skin cancer information sheet describing ways to prevent skin cancer.	Positive frame—benefits and positive aspects of performing sun-protective behaviors Negative frame—risks of not performing sun-protective behaviors	Intention to use sun screen	No control group. Task administered in groups (instructed to complete individually). No information on how participants were allocated to groups. Results stratified by gender.
Rothman 1993 ²⁹ Study 2	Caucasian students participating for course credit or responding to posted notice (received \$5 for completing experiment) N = 146	RCT parallel groups	Information sheet from study 1 was converted into a 4-page pamphlet. Provided information on preventing skin cancer by performing sun-protective behaviors.	Positive frame—emphasized benefits and positive aspects of performing sun-protective behaviors Negative frame—emphasized risks of not performing sun-protective behaviors	Actual behavior (sunscreens requests)	No control group. Completed task in group setting. Results stratified by gender.
Wilson 1990 ³⁴	Cardiovascular patients referred by cardiologists or responded to newspaper advertisement. Current smokers N = 70	RCT parallel groups	Information on how to quit smoking was presented in the form of contracts. Participants and counselors negotiated contract and reward on reaching goals.	Gain frame—if complete contract will receive reward. Mixed frame—if complete contract will receive reward, if not complete contract will not receive reward.	Actual behavior (cigarettes smoked)	Mixed frame control group. Twelve months' follow-up. Baseline characteristics on age, gender, cigarettes smoked, desire to quit, cessation self-efficacy, and counseling variables comparable between groups. Gain frame subjects were heavier smokers in past than mixed frame group.
Robberson 1988 ²⁸	Female psychology students who did not exercise regularly N = 84	RCT parallel groups	Provided written information describing the impact of exercise on health (e.g., stamina, weight loss) and self-esteem (e.g., self-confidence, appearance).	Positive frame—advantages of exercise program. Negative frame—disadvantages of not being involved in exercise program Mixed frame—combined positive and negative information Control—no information, completed questionnaire containing measures	Intention to exercise	No information control group. 2 × 3 design (health vs self-esteem by framing and control). Subjects participated in groups. No information on baseline characteristics. Assessed confounders of credibility of information and beliefs in severity, vulnerability, and self-efficacy in relation to exercise.

RCT, randomized controlled trial; non-RCT, nonrandomized controlled trial; HIV, human immunodeficiency virus.