

# Health Message Framing Effects on Attitudes, Intentions, and Behavior: A Meta-analytic Review

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Published online: 13 October 2011  
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## Abstract

**Background** Message framing has been an important focus in health communication research, yet prior meta-analyses found limited support for using framing to increase persuasiveness of health messages.

**Purpose** This meta-analysis distinguished the outcomes used to assess the persuasive impact of framed messages (attitudes, intentions, or behavior).

**Methods** One hundred eighty-nine effect sizes were identified from 94 peer-reviewed, published studies which compared the persuasive impact of gain- and loss-framed messages.

**Results** Gain-framed messages were more likely than loss-framed messages to encourage prevention behaviors ( $r=0.083$ ,  $p=0.002$ ), particularly for skin cancer prevention, smoking cessation, and physical activity. No effect of framing was found when persuasion was assessed by attitudes/intentions or among studies encouraging detection.

**Conclusions** Gain-framed messages appear to be more effective than loss-framed messages in promoting prevention behaviors. Research should examine the contexts in which loss-framed messages are most effective, and the processes that mediate the effects of framing on behavior.

**Keywords** Message framing · Persuasive communication · Attitudes · Intention · Behavior · Health

Public health advocates often use persuasive messages as one strategy to motivate people to adopt healthy behaviors

or modify unhealthy ones. Accordingly, the most recent report published by the US Office of the Surgeon General, *Healthy People 2020*, details the importance of research and evaluation as an aid in the development of these health communication programs [1]. In accordance with this objective, researchers have sought to take advantage of the important interplay between theory and practice in designing effective health communication strategies. One consideration in the communication of health information is how the behavior recommendations and health outcomes in a message are framed.

## Health Message Framing

Health messages can be framed to highlight either the benefits of engaging in a particular behavior (a gain-frame) or the consequences of failing to engage in a particular behavior (a loss-frame). For example, a gain-framed message aimed at increasing exercise might be “Exercising regularly can help you lose weight.” On the other hand, a loss-framed message might be “Not exercising regularly can make you gain weight.” This simple variation in how health information can be framed is important because research has shown that although often conveying essentially identical information, one type of message frame may be more effective than another at promoting health behavior change [2].

The apparent phenomenon, whereby essentially identical information can have differential effects on people’s choices depending on how it is framed, originated out of work on Prospect Theory [3]. The framing postulate of Prospect Theory proposes that when faced with two choices—one posing little risk and one posing some higher degree of risk—a person’s preference

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for one option over the other will be influenced by the manner in which the choices are framed. If the choices emphasize potential losses, individuals are often willing to choose a risky option to prevent those losses. However, if the choices emphasize potential gains, individuals are generally less willing to choose options involving risk to secure those gains.

Rothman and Salovey [2] applied this reasoning to how people might respond to framed health messages. In particular, they suggested that gain-framed messages should be more effective than loss-framed messages for promoting health behaviors perceived to be only minimally risky to carry out. For health behaviors perceived to have some higher degree of risk associated with performing them, loss-framed messages should be more effective. Specifically, Rothman and Salovey [2] proposed that the function of a behavior can suggest how risky people are likely to view performing the behavior to be. Behaviors that serve an illness *prevention* function (i.e., physical activity) should often be viewed as involving very little risk, because as Rothman and Salovey suggest, the only thing risky about them is not engaging in them. On the other hand, behaviors that serve an illness *detection* function (i.e., mammography) should be more likely to be viewed as involving a higher degree of risk because of the possibility that a serious illness could be discovered. In this respect, Rothman and Salovey [2] proposed that the underlying function of a health behavior should serve as a useful heuristic for the perceived riskiness of a health behavior and should moderate people's responses to framed messages. Specifically, they proposed that gain-framed messages should be more persuasive for illness prevention behaviors, and loss-framed messages should be more persuasive for illness detection behaviors.

## Previous Reviews

To date, Rothman and Salovey's [2] hypotheses have been the dominant predictions in health message framing research. A number of reviews of the health message framing literature have recently appeared [4–7], two of these being the first meta-analyses specifically examining the role of framing in promoting preventive health behaviors [6] and detection health behaviors [7]. These reviews [6, 7] report finding limited support for Rothman and Salovey's [2] predictions regarding the role of health behavior function. For preventive health behaviors, there was a significant but weak advantage of gain-framed messages over loss-framed messages (effect size  $r=0.032$ ,  $p=0.015$ ). In particular, the strongest effects were found for studies that promoted preventive dental hygiene behaviors ( $r=0.154$ ) while other effect sizes ranged from  $r=0.018$

(safe-sex behaviors) to  $r=0.110$  (exercise). Excluding dental hygiene behaviors from the analysis, no significant advantage of either a gain- or loss-framed message was observed for the preventive health behaviors examined.

Similar conclusions were drawn in a review of detection health behaviors [7]. Loss-framed messages showed a significant but also weak advantage over gain-framed messages ( $r=-0.039$ ,  $p=0.020$ ). Again, one type of behavior (breast cancer detection,  $r=-0.056$ ) appeared to anchor the loss-frame advantage. Excluding breast cancer studies from the analysis, no significant advantage of either a loss- or gain-framed message was observed from the remaining subset of studies.

As has been noted elsewhere [8], an important limitation of these prior reviews is that they failed to distinguish among the various outcomes with which researchers have operationalized the "persuasiveness" of framed health messages. Many studies have used immediate measures of attitudes towards a health behavior or intentions to engage in a behavior as the primary outcome of interest. Far fewer studies have attempted to assess actual behavior change as a measure of persuasiveness. It is well known that there is often a disconnect between people's attitudes, intentions, and their behavior [9], and eliciting a change in one's immediate intentions may reflect different psychological processes than eliciting a change in a person's behavior. For an interventionist, influencing behavior is the primary aim. Yet in prior reviews [6, 7], when studies included multiple outcomes, the analyses focused on measures of immediate attitudes and intentions rather than behavior as their outcomes. Thus, an important gap in the health message framing literature is a review of the influence of gain- and loss-framed messages on health behavior, not simply attitudes and intentions [8].

## Present Review

The aim of the present review is to provide an updated review of health message framing research, with a focus on studies that assess health behavior as an outcome. We examined the persuasiveness of framed health messages in a manner that recognizes the gap often noted between intentions and behavior [9]. We ran separate analyses for measures of persuasion that are most often indicative of immediate cognitive responses to framed messages (i.e., attitudes and intentions) and those that are indicative of more meaningful behavioral responses. Consistent with Rothman and Salovey [2], we predicted that gain-framed messages would be most likely to promote the adoption of preventive health behaviors, whereas loss-framed messages would be most likely to promote the adoption of detection health behaviors.

## Method

### Identification of Studies

#### *Literature Search*

Studies were identified using one of two search methods. A bulk of the studies in the current review was identified through an examination of the reference lists from previous reviews [4–7]. In addition, we conducted our own literature search in order to identify studies that succeeded the previous reviews. Specifically, we mirrored the previous literature searches performed by O’Keefe and Jensen [6, 7] using identical key terms (*framing, framed, frame, appeal, message, persuasion, persuasive, gain, positive, positively, benefit, loss, negative, negatively, threat, and valence*) in an interdisciplinary set of computerized databases (Academic Search Premier, Alt Health Watch, CINAHL Plus, EBSCO, ERIC, Health Source, MEDLINE, PsycINFO, Psychology and Behavioral Sciences Collection, and PUBMED) current through at least February 2011. If available, we also examined the “online first” table of contents for the most commonly referenced journals in the previous reviews (*British Journal of Health Psychology, European Journal of Communication, Health Psychology, Journal of Applied Social Psychology, Journal of Communication, Journal of Experimental Social Psychology, Journal of Health Communication, Journal of Health Psychology, and Psychology & Health*). The initial search yielded close to 300 citations. After excluding duplicate search results, studies already identified from previous reviews, and those that did not meet our inclusion criteria (see next section), 27 of these were relevant to our current review and included in the main analyses alongside studies from the previous reviews (see Table 1).

#### *Inclusion Criteria*

Studies had to meet a total of five criteria to be included in the present analysis. First, studies had to be published in English and in a scholarly, peer-reviewed journal. Unlike some prior reviews [5–7], dissertations, theses, and presentations were excluded. We chose only to include published, peer-reviewed papers to enhance the quality of the studies included in our analyses and to allow for replication of our search methods. To address potential publication bias that might arise as a result of this, we performed a diverse set of publication bias analyses, reported alongside any relevant results.

Second, similar to previous reviews of health message framing [6, 7], studies needed to compare gain-framed messages (emphasizing the positive outcomes of engaging in a health behavior) with loss-framed messages (empha-

sizing the negative outcomes of failing to engage in a health behavior)<sup>1</sup>. Studies not examining a health prevention or illness detection behavior (i.e., sleep-related car crashes [91] or oocyte donation [92]) were excluded. Third, messages included in the analyses had to be representative of health promotion information that would be suitable for integration into actual health communication interventions. For example, messages that were manipulated to be intentionally weak or to be from intentionally non-credible sources were excluded (i.e., low credibility conditions [12–14]). Fourth, studies had to report primary data analysis. For studies that published several papers from one set of data, only the primary data analyses were included (i.e., [76]). Reports of secondary data analysis where we had already included the primary analyses (i.e., [93, 94]) were excluded.

Finally, measures of persuasion had to be in the form of attitudes, intentions, or behavior (self-reported or objective) with sufficient quantitative data available to estimate an effect size. Studies in which persuasion was measured in a proxy manner (i.e., making health decisions for a parent [95] or making health decisions for other students [96]) were excluded. Studies in which persuasion was measured in a form other than attitudes, intentions, or behavior (i.e., interest in a health behavior [97]) were also excluded. In situations where the appropriate quantitative data was not available from a published report, but a study met all other inclusion criteria, contact with the primary author of the report was attempted and the study was excluded if no response was given (i.e., [98, 99]).

### Outcome Variables and Effect Size Measures

#### *Outcome Variables*

Persuasion was assessed through measures of attitude towards the behavior, behavioral intention, or actual behavior. Typically, health message framing studies employ a single type of outcome measure. However, unlike previous reviews by O’Keefe and Jensen [6, 7], studies that reported multiple measures of persuasion (i.e., both intentions and behavior) were not averaged together into a single summary effect size. Rather, an effect size was calculated for each measure of

<sup>1</sup> The present review focuses on a particular type of framing effect defined by Levin and colleagues [90] as “goal framing.” As opposed to “attribute framing”, which involves manipulating the health behavior as either a good thing to engage in (positive frame) or bad thing to engage in (negative frame), “goal framing” works under the assumption that the health behavior is a good thing to do and instead uses the positive frame to describe the gains associated with performing the behavior and the negative frame to describe the losses associated with not performing the behavior.

**Table 1** Cases analyzed (organized by author)

Study	Number	<i>r</i>	95% CI	Codings <sup>a</sup>
Abhyankar et al. [10] <sup>b</sup>	142	−0.13	−0.29, 0.04	1/8/1
	142	−0.24	−0.39, −0.08	1/8/2
Apanovitch et al. [11], certain	281	0.15	0.03, 0.26	2/5/3
Apanovitch et al. [11], uncertain	144	−0.07	−0.23, 0.09	2/5/3
Arora [12], high credibility	105	0.00	−0.17, 0.17	2/1/3
	105	0.00	−0.17, 0.17	2/2/3
Arora and Arora [13], high credibility	133	−0.13	−0.31, 0.06	1/4b/1
	134	−0.18	−0.36, 0.01	1/4b/2
Arora et al. [14], <sup>b</sup> high credibility	68	0.00	−0.24, 0.24	1/4a/1
	68	0.00	−0.24, 0.24	1/4a/2
Banks et al. [15]	133	−0.02	−0.19, 0.15	2/1/1
	133	−0.15	−0.31, 0.02	2/1/2
Banks et al. [15] <sup>c</sup>	132	0.00	−0.17, 0.17	2/1/3
Bannon and Schwartz [16]	50	0.02	−0.26, 0.29	1/4b/3
Bartels et al. [17] <sup>b</sup> study 1, 90% efficacy	35	0.33	−0.01, 0.60	1/8/1
Bartels et al. [17] <sup>b</sup> study 1, 60% efficacy	35	−0.21	−0.51, 0.13	1/8/1
Bartels et al. [17] <sup>b, c</sup> study 2, health benefit	81	0.23	0.02, 0.43	2/9/2
Bartels et al. [17] <sup>b, c</sup> study 2, health problem	82	−0.22	−0.42, 0.00	2/9/2
Benz Scott and Curbow [18]	395	0.04	−0.06, 0.13	2/6/2
Berry and Carson [19] <sup>b</sup>	87	0.07	−0.15, 0.27	1/4a/1
Block and Keller [20] study 1, high efficacy	50	−0.01	−0.29, 0.27	2/5/1
	50	0.05	−0.23, 0.33	2/5/2
Block and Keller [20] study 1, low efficacy	44	−0.29	−0.54, 0.01	2/5/1
	44	−0.21	−0.48, 0.09	2/5/2
Block and Keller [20] study 2, high efficacy	58	0.17	−0.10, 0.41	2/2/1
	58	0.16	−0.10, 0.40	2/2/2
Block and Keller [20] study 2, low efficacy	57	−0.21	−0.45, 0.05	2/2/1
	57	−0.25	−0.48, 0.01	2/2/2
Broemer [21] study 1	80	−0.10	−0.31, 0.12	1/4/2
Broemer [22] study 1, easy to imagine	30	−0.48	−0.72, −0.15	1/4/1
Broemer [22] study 1, hard to imagine	30	0.29	−0.08, 0.59	1/4/1
Broemer [22] study 2, easy to imagine	30	−0.25	−0.56, 0.12	2/1/1
Broemer [22] study 2, hard to imagine	30	0.56	0.25, 0.77	2/1/1
Broemer [22] study 3, easy to imagine, serious	36	0.48	0.18, 0.70	1/8/1
Broemer [22] study 3, easy to imagine, trivial	36	−0.27	−0.55, 0.07	1/8/1
Broemer [22] study 3, hard to imagine, serious	36	0.18	−0.16, 0.48	1/8/1
Broemer [22] study 3, hard to imagine, trivial	36	0.38	0.06, 0.63	1/8/1
Brug et al. [23] <sup>c</sup> study 1	74	0.08	−0.15, 0.30	1/4b/1
	74	0.04	−0.19, 0.27	1/4b/2
Brug et al. [23] study 2	149	0.09	−0.07, 0.25	1/4b/1
	149	0.01	−0.15, 0.17	1/4b/2
Brug et al. [23] study 3	92	0.01	−0.20, 0.21	1/4b/1
	92	0.11	−0.09, 0.31	1/4b/2
Chang [24] study 2	410	0.06	−0.04, 0.16	1/7/1
Chang [25] study 2, high risk	142	−0.17	−0.33, −0.01	1/9/2
Chang [25] study 2, low risk	141	0.47	0.33, 0.59	1/9/2
Cho and Boster [26] <sup>b, c</sup>	246	−0.17	−0.29, −0.04	1/9/1
	246	−0.21	−0.33, −0.09	1/9/2
Cosedine et al. [27] <sup>b, c</sup>	132	0.08	−0.09, 0.25	2/1/3

**Table 1** (continued)

Study	Number	<i>r</i>	95% CI	Codings <sup>a</sup>
Cox et al. [28] study 2	213	−0.06	−0.19, 0.08	1/5/2
Cox and Cox [29], anecdotal	108	−0.31	−0.47, −0.12	2/1/1
	103	−0.27	−0.44, −0.08	2/1/2
Cox and Cox [29], statistical	108	0.05	−0.15, 0.23	2/1/1
	103	0.19	0.00, 0.37	2/1/2
Detweiller et al. [30]	217	0.21	0.08, 0.33	1/2/2
	217	0.17	0.04, 0.30	1/2/3
Finney and Iannotti [31] <sup>c</sup>	628	−0.04	−0.12, 0.04	2/1/3
Gallagher and Updegraff [32] <sup>b</sup>	176	0.06	−0.08, 0.20	1/4a/1
	176	0.11	−0.04, 0.25	1/4a/3
Gallagher et al. [33] <sup>b</sup>	355	−0.17	−0.29, −0.05	2/1/3
Gerend and Cullen [34], <sup>b</sup> short term	181	−0.08	−0.22, 0.07	1/9/3
Gerend and Cullen [34], <sup>b</sup> long term	181	0.26	0.12, 0.39	1/9/3
Gintner et al. [35]	96	0.16	−0.06, 0.36	2/6/2
	81	0.00	−0.20, 0.20	2/6/3
Goodall and Appiah [36], <sup>b</sup> breathing label	210	0.08	−0.06, 0.21	1/7/1
	210	0.05	−0.08, 0.18	1/7/2
Goodall and Appiah [36], <sup>b</sup> teeth label	210	0.10	−0.03, 0.24	1/7/1
	210	0.09	−0.05, 0.22	1/7/2
Hevey et al. [37] <sup>b</sup>	390	0.00	−0.10, 0.10	1/2/2
Hoffner and Ye [38] <sup>b</sup>	190	−0.02	−0.16, 0.12	1/2/2
Jones et al. [39], credible source	96	0.00	−0.20, 0.20	1/4a/1
	96	0.10	−0.10, 0.30	1/4a/2
	96	0.11	−0.09, 0.30	1/4a/3
Jones et al. [40], <sup>c</sup> credible	68	0.09	−0.15, 0.32	1/4a/1
	68	0.00	−0.24, 0.24	1/4a/2
	68	0.09	−0.15, 0.32	1/4a/3
Keller et al. [41] study 1, negative affect	43	0.31	0.01, 0.56	2/1/2
Keller et al. [41] study 1, positive affect	42	−0.34	−0.58, −0.04	2/1/2
Keller et al. [41] study 2, negative affect	62	0.32	0.07, 0.53	2/1/2
Keller et al. [41] study 2, positive affect	62	−0.33	−0.54, −0.09	2/1/2
Knapp [42], health values	98	0.05	−0.15, 0.25	1/3/2
Knapp [42], <sup>c</sup> health values	98	−0.09	−0.28, 0.12	1/3/3
Knapp [42], social values	98	−0.14	−0.33, 0.06	1/3/2
Knapp [42], <sup>c</sup> social values	98	0.31	0.12, 0.48	1/3/3
Lalor and Hailey [43]	55	0.14	−0.13, 0.39	2/1/2
	55	0.09	−0.18, 0.35	2/1/3
Latimer et al. [44] <sup>b</sup>	322	0.31	0.21, 0.41	1/4a/2
Latimer et al. [44] <sup>b, c</sup>	322	0.01	−0.10, 0.12	1/4a/3
Lauver and Rubin [45]	116	−0.08	−0.25, 0.11	2/9/3
Lawatsch [46] <sup>c</sup>	103	0.12	−0.08, 0.31	1/4b/3
Lee and Aaker [47] study 1, prevent reg focus	56	−0.22	−0.45, 0.05	1/4b/1
Lee and Aaker [47] study 1, promotion reg focus	56	0.25	−0.02, 0.48	1/4b/1
Lee and Aaker [47] study 2, prevent reg focus	81	−0.22	−0.42, −0.01	1/2/1
Lee and Aaker [47] study 2, promotion reg focus	82	0.27	0.06, 0.46	1/2/1
Lee and Aaker [47] study 3, high risk	40	−0.33	−0.58, −0.02	1/9/1
Lee and Aaker [47] study 3, low risk	41	0.38	0.09, 0.62	1/9/1
Lee and Aaker [47] study 4a, prevent reg focus	59	−0.21	−0.44, 0.05	1/4b/1
Lee and Aaker [47] study 4a, promotion reg focus	60	0.19	−0.07, 0.42	1/4b/1

**Table 1** (continued)

Study	Number	<i>r</i>	95% CI	Codings <sup>a</sup>
Lee and Aaker [47] study 5, prevent reg focus	71	−0.20	−0.41, 0.03	1/4b/1
Lee and Aaker [47] study 5, promotion reg focus	71	0.15	−0.08, 0.37	1/4b/1
Lee et al. [48], high efficacy	135	0.08	−0.09, 0.24	2/2/1
	135	0.16	−0.01, 0.32	2/2/2
Lee et al. [48], low efficacy	134	−0.19	−0.35, −0.02	2/2/1
	134	−0.02	−0.19, 0.15	2/2/2
Lerman et al. [49], high suspicion	223	−0.12	−0.25, 0.01	2/1/3
Lerman et al. [49], low suspicion	223	0.08	−0.06, 0.21	2/1/3
Levin et al. [50], <sup>b</sup> USA sample	127	−0.25	−0.41, −0.08	1/4b/2
Levin et al. [50], <sup>b</sup> Australian sample	97	−0.03	−0.23, 0.17	1/4b/2
Looker and Shannon [51]	235	0.26	0.14, 0.38	1/4b/1
	235	−0.18	−0.30, −0.05	1/4b/2
	235	0.18	0.05, 0.30	1/4b/3
Maguire et al. [52] <sup>b</sup>	103	0.08	−0.12, 0.27	2/9/2
Maheswaran and Myers-Levy [53], high involved	49	−0.37	−0.59, −0.10	2/6/1
Maheswaran and Myers-Levy [53], high involved	49	−0.43	−0.63, −0.16	2/6/2
Maheswaran and Myers-Levy [53], low involved	49	0.45	0.19, 0.65	2/6/1
	49	0.43	0.17, 0.63	2/6/2
Mann et al. [54] <sup>b</sup>	59	−0.16	−0.40, 0.10	1/3/2
	59	0.02	−0.24, 0.27	1/3/3
McCall and Ginis [55]	60	0.31	0.06, 0.52	1/4a/3
McCaul et al. [56]	6,522	−0.02	−0.04, 0.01	1/8/3
McKee et al. [57]	271	0.20	0.08, 0.31	1/7/3
Meyers-Levy and Maheswaran [58], high risk/involve	37	−0.50	−0.71, −0.22	1/6/1
Meyers-Levy and Maheswaran [58], high risk/no involve	37	0.50	0.22, 0.71	1/6/1
Meyers-Levy and Maheswaran [58], low risk/involve	37	0.10	−0.23, 0.41	1/6/1
Meyers-Levy and Maheswaran [58], low risk/no involve	36	0.34	0.01, 0.60	1/6/1
Millar and Millar [59], high involved	261	0.15	0.03, 0.27	1/9/2
Moorman and van den Putte [60] <sup>b</sup>	151	0.08	−0.08, 0.24	1/7/1
	151	0.14	−0.02, 0.29	1/7/2
Myers et al. [61]	2,201	−0.04	−0.08, 0.00	2/9/3
Nan [62] study 1	155	0.00	−0.16, 0.16	1/4a/1
	155	0.00	−0.16, 0.16	1/4a/2
Nan [62] study 2	155	0.22	0.05, 0.37	2/8/1
Nan [62] study 2, desirable, high involved	34	0.00	−0.34, 0.34	2/8/2
Nan [62] study 2, desirable, low involved	34	0.00	−0.34, 0.34	2/8/2
Nan [62] study 2, undesirable, high involved	34	−0.23	−0.53, 0.11	2/8/2
Nan [62] study 2, undesirable, low involved	34	0.31	−0.04, 0.59	2/8/2
O'Connor et al. [63] <sup>b</sup> study 2	304	−0.08	−0.19, 0.04	1/5/1
	304	−0.03	−0.14, 0.09	1/5/2
Park et al. [64] <sup>b</sup>	116	0.02	−0.16, 0.20	2/9/3
Ramirez [65]	116	0.04	−0.14, 0.22	1/3/3
Richardson et al. [66]	389	0.08	−0.02, 0.18	1/5/3
Rivers [67], detect	156	−0.12	−0.27, 0.04	2/9/3
Rivers [67], prevent	156	0.04	−0.12, 0.19	1/9/3
Robberson and Rogers [68], health	42	−0.19	−0.47, 0.12	1/4a/2
Robberson and Rogers [68], self esteem	42	0.54	0.28, 0.72	1/4a/2
Rothman et al. [69] experiment 1, detect	88	−0.33	−0.50, −0.13	2/8/2
Rothman et al. [69] experiment 1, prevent	99	0.00	−0.20, 0.20	1/8/2



**Table 1** (continued)

Study	Number	<i>r</i>	95% CI	Codings <sup>a</sup>
Rothman et al. [69] experiment 2	60	−0.26	−0.48, 0.00	2/3/1
	60	−0.26	−0.48, 0.00	2/3/2
	60	−0.39	−0.58, −0.15	2/3/3
	60	−0.26	−0.48, 0.00	1/3/1
	60	0.22	−0.03, 0.45	1/3/2
	60	0.22	−0.03, 0.45	1/3/3
Rothman et al. [70] <sup>b</sup> study 1	199	0.00	−0.14, 0.14	1/2/2
Rothman et al. [70] <sup>b</sup> study 2	143	0.28	0.12, 0.42	1/2/3
Schneider et al. [71], <sup>c</sup> multi	132	−0.11	−0.28, 0.06	2/1/3
Schneider et al. [71], <sup>c</sup> targeted	132	0.05	−0.13, 0.22	2/1/3
Schneider et al. [72] <sup>c</sup>	109	0.24	0.06, 0.41	1/7/3
Shannon and Rowan [73]	138	0.04	−0.13, 0.20	1/4/3
Sherman et al. [74]	67	−0.01	−0.25, 0.23	1/3/2
	67	0.13	−0.11, 0.36	1/3/3
Steward et al. [75]	863	0.03	−0.04, 0.10	1/7/2
Toll et al. [76] <sup>b</sup>	170	0.17	0.02, 0.31	1/7/3
Trupp et al. [77] <sup>b</sup>	70	−0.29	−0.51, −0.03	1/9/3
Tykocinski et al. [78], <sup>b</sup> actual ideal	23	−0.49	−0.75, −0.09	1/4b/2
Tykocinski et al. [78], <sup>b, c</sup> actual ideal	23	−0.12	−0.51, 0.30	1/4b/3
Tykocinski et al. [78], <sup>b</sup> actual ought	16	0.39	−0.14, 0.74	1/4b/2
Tykocinski et al. [78], <sup>b, c</sup> actual ought	16	−0.02	−0.51, 0.48	1/4b/3
Umphrey [79]	128	0.09	−0.09, 0.26	2/9/2
Updegraff et al. [80], <sup>b</sup> strong	136	0.06	−0.11, 0.22	1/3/1
	136	0.01	−0.16, 0.18	1/3/2
	136	−0.01	−0.18, 0.16	1/3/3
Urban et al. [81]	100	−0.08	−0.27, 0.12	2/5/2
Uskul et al. [82] <sup>b</sup>	100	0.02	−0.18, 0.22	1/3/2
van Assema et al. [83] <sup>c</sup>	146	0.00	−0.16, 0.16	1/4b/1
	148	0.05	−0.12, 0.21	1/4b/2
van't Riet et al. [84] <sup>b</sup> study 2	129	0.15	−0.02, 0.32	1/4a/1
	129	0.02	−0.16, 0.19	1/4a/2
van't Riet et al. [85] <sup>b</sup>	466	0.06	−0.03, 0.15	1/4a/1
	466	0.09	−0.02, 0.20	1/4a/2
	299	0.09	0.00, 0.18	1/4a/3
van't Riet et al. [86], high efficacy	62	−0.24	−0.46, 0.01	2/2/2
van't Riet et al. [86], low efficacy	62	0.13	−0.12, 0.37	2/2/2
van't Riet et al. [87], <sup>b</sup> high efficacy	575	0.12	0.00, 0.24	1/4b/2
	512	−0.08	−0.19, 0.05	1/4b/3
van't Riet et al. [87], <sup>b</sup> low efficacy	575	−0.07	−0.18, 0.05	1/4b/2
	512	0.06	−0.05, 0.17	1/4b/3
Williams et al. [88]	539	−0.10	−0.18, −0.01	2/1/3
Yu et al. [89] <sup>b</sup>	213	0.12	−0.02, 0.25	1/9/2

<sup>a</sup> The coding judgments, in order, are: behavior function category (1=disease prevention and 2=disease detection), specific behavior (1=breast cancer, 2=skin cancer, 3=oral health, 4=general obesity-related, 4a=physical activity, 4b=diet, 5=safe sex, 6=heart disease, 7=smoking, 8=virus/vaccines, and 9=other), and specific measure of persuasion (1=attitudes, 2=intentions, and 3=behavior)

<sup>b</sup> Cases not included in previous reviews [6, 7]

<sup>c</sup> Cases where multiple measures of the *same* outcome have been combined

persuasion reported (attitudes, intentions, and behavior) and a separate analyses was performed for each type of outcome.

### Effect Size Measure

The effect size  $r$  was used to summarize the comparison between each gain-framed message and its loss-framed equivalent. When the calculated difference between the messages favored the gain-framed message, the effect size was given a positive sign (+). When the difference favored the loss-framed message, a negative sign (–) was used.

### Coded Factors

Coding of all studies was completed independently by the authors, with any discrepancies resolved through discussion. Each study was coded for the following characteristics: (a) the *function* of the advocated health behavior (prevention or detection), (b) the *domain* of the advocated health behavior (breast cancer, skin cancer, oral health, diet, physical activity, general obesity prevention, safe sex, heart disease, smoking, virus/vaccines, or others), (c) the combined *sample size* of the gain- and loss-framed message conditions (with a range from 16 to 6,552), (d) the effect size of the gain- versus loss-framed comparison on all relevant outcomes, (e) the timeframe of the outcome assessment (immediate vs. at a follow-up), (f) the average age of the population, and (g) the message modality (print, audio, or video). Only characteristics (a) through (e) are reported herein, as no meaningful moderation was found for characteristics (f) and (g).

### Meta-analytic Procedures

Effect sizes were analyzed using a random effects model. A random effects model assumes that between-study differences in effect sizes arise due to between-study differences in populations and methods rather than due solely to sampling error. While more prone to producing a Type II error than a fixed effects model, a random effects model is considered a more conservative approach [100] and appropriate when a large number of studies are available.

Using the Comprehensive Meta-analysis software program [101], separate analyses were completed for each type of persuasion outcome. In each of these analyses, the independence of effect sizes was preserved by allowing each study (or each independent sample) to only contribute one effect size to each type of outcome. For instance, if a study reported two attitude measures, the mean of those attitude measures was used as the effect size for that particular study in the attitude analysis. These cases, where multiple measures of the same outcome have been combined, are noted in Table 1. Thus, each study (or each

sample) could contribute a maximum of three effect sizes. For analytic purposes, each effect size correlation was transformed to a Fisher's  $z$ . However, for purposes of presentation and interpretation, the results were then transformed back to the effect size correlation,  $r$  [102].

We assessed for the potential influence of publication bias by taking a number of approaches that ask different questions about the data. We first used a rank correlation test [103] to obtain the Kendall's tau rank correlation coefficient, the statistical equivalent of the funnel plot (which plots effect size against variance), in order to assess the presence of *any* relationship between an effect size and its associated variance, which could suggest that studies reporting stronger effect sizes with a smaller sample were more likely to be published. As the rank correlation test is generally uninformative when the number of effect sizes are small, we only pursue publication bias analyses when more than ten effects size are available for a given analysis [104]. When a summary effect size was found to be significant and the rank correlation suggested the presence of possible bias, we further examined the extent to which publication bias could be *exclusively* responsible for our findings by performing a number of additional tests. First, we conducted Rosenthal's [105] "file drawer analysis." This analysis yields the "fail-safe  $N$ ," which provides an estimate of the number of non-significant unpublished studies needed to nullify a significant meta-analytic effect size. Next, we used the nonparametric iterative "trim and fill" procedure suggested by Duval and Tweedie [106] to determine *how much* impact publication bias may have had on our significant findings and to provide an estimate of the effect size in question had there been no publication bias. Last, we examined whether there was any relationship between the year of publication and the magnitude of an effect size, to test whether there was a temporal trend in stronger effect sizes being published as the message framing literature evolved.

## Results

### Does the Function of a Health Behavior Moderate Framing Effects?

Rothman and Salovey's [2] underlying prediction was that the prevention versus detection function of a health behavior should moderate the influence of gain and loss framing on the persuasiveness of health messages. Contrary to this prediction, we observed no significant moderating effect of framing on the persuasiveness of health messages when persuasiveness was assessed as either attitudes towards the behavior ( $Q(1)=1.209, p=0.272$ ) or intentions to perform the behavior ( $Q(1)=1.588, p=0.208$ ).



However, a significant moderating effect of function was found when persuasive impact was assessed as behavior ( $Q(1)=11.635$ ,  $p=0.001$ ). Thus, the effect of gain versus loss framing on health *behavior* was dependent on the function of the advocated behavior. Next, we detail the effects of framing within prevention and detection behaviors.

### Illness Prevention Behaviors

#### *Effects on Attitudes and Intentions*

There was no significant effect of framing on attitudes among studies that examined a prevention behavior ( $k=45$ ;  $r=0.039$ ,  $p=0.149$ ) (see Table 2). Similarly, there was no significant effect of framing on intentions among studies that examined a prevention behavior ( $k=46$ ;  $r=0.028$ ,  $p=0.171$ ). Thus, when examining both attitudes and intentions as outcomes, our results largely replicate those reported by O’Keefe and Jensen [6, 7].

#### *Effects on Behavior<sup>2</sup>*

The size of the persuasive effect of gain- versus loss-framed messages *did* differ significantly among studies that employed measures of actual behavior. Among prevention behaviors, the persuasive effect of gain-framed messages was significantly different than that of loss-framed messages ( $k=32$ ;  $r=0.083$ ,  $p=0.002$ ), consistent with the predictions of Rothman and Salovey [2]. Furthermore, the method of behavioral assessment (self-reported;  $k=19$ ;  $r=0.092$ ,  $p=0.003$  vs. objective;  $k=13$ ;  $r=0.073$ ,  $p=0.110$ ) did not significantly moderate this effect ( $Q=0.120$ ,  $p=0.729$ ).

As Table 3 shows, a further breakdown within the prevention behavior category revealed that the difference in persuasive effects between the gain- and loss-framed messages was most apparent in the domains of smoking ( $k=3$ ;  $r=0.198$ ,  $p<0.001$ ), skin cancer prevention ( $k=2$ ;  $r=0.237$ ,  $p<0.001$ ), and physical activity ( $k=6$ ,  $r=0.160$ ,  $p<0.01$ ). A safe-sex study ( $k=1$ ,  $r=0.081$ ,  $p=0.11$ ) also contributed to the notable framing effects. In contrast, studies of diet ( $k=7$ ,  $r=-0.014$ ,  $p=0.805$ ) and a study of vaccination showed the weakest effect of framing ( $k=1$ ,  $r=-0.015$ ,  $p=0.226$ ). However, as Table 3 shows, in no case was there a

<sup>2</sup> Unless otherwise specified, we report “behavior” as a combined outcome of self-reported and objective behavioral measures. We note the appropriateness of this approach as the relationship between self-reported and objective measures of behavior for the most commonly cited domains in the present analysis are typically greater than the typical attitude/intention and behavior correlation of 0.50 [9]. Indeed, we see this in the domains of smoking [107, 108], mammography [109–113] diet [114], oral health [115–118], and physical activity [119–121] (all  $r$  values of  $>0.50$ , sensitivities of  $>0.90$ ).

**Table 2** Summary of results

	$k$	Mean	95% CI	Kendall’s tau ( $\tau$ ) <sup>a</sup>
Prevention				
Attitudes	45	0.039	−0.014, 0.091	0.068
Intentions	46	0.028	−0.012, 0.068	0.000
Behavior	32	0.083*	0.031, 0.134	−0.171 <sup>+</sup>
Detection				
Attitudes	16	−0.034	−0.153, 0.085	0.000
Intentions	32	−0.025	−0.098, 0.047	−0.046
Behavior	18	−0.040	−0.088, 0.008	0.072

<sup>a</sup> A statistical representation of the possible influence of publication bias determined by performing a rank correlation test between individual standardized effect sizes and their variances

<sup>+</sup>  $p<0.10$ ; \* $p<0.01$

significant loss-frame advantage within any specific domain of prevention behavior.

#### *Publication Bias*

We assessed the possible influence of publication bias on the summary effect size for each outcome in the illness prevention category. As indicated by the non-significant Kendall’s tau rank correlation coefficients in Table 2 ( $p$  values of  $>0.05$ ), there appeared to be no evidence of publication bias for the studies that examined the effect of framing on prevention attitudes or intentions. For studies that examined the effect of framing on prevention behaviors, the rank correlation coefficient approached significance

**Table 3** Summary of effects on behavioral outcomes by domain

	$k$	Mean $r$	95% CI
Prevention behaviors			
Diet	7	−0.014	−0.128, 0.099
Obesity	1	0.037	−0.131, 0.203
Oral health	7	0.052	−0.068, 0.169
Physical activity	6	0.160**	0.052, 0.264
Safe sex	1	0.081	−0.018, 0.179
Skin cancer	2	0.237***	0.137, 0.333
Smoking	3	0.198***	0.116, 0.277
Virus/vaccine	1	−0.015	−0.039, 0.009
Other	4	−0.001	−0.208, 0.206
Detection behaviors			
Breast cancer	10	−0.052	−0.109, 0.006
Heart	1	0.159	−0.061, 0.365
Oral health	1	−0.387**	−0.584, −0.148
Safe sex	2	0.049	−0.167, 0.260
Other	4	−0.043*	−0.082, −0.005

\* $p<0.05$ ; \*\* $p<0.01$ ; \*\*\* $p<0.001$

(Kendall's tau  $b = -0.171$ , one-tailed  $p = 0.084$ ), suggesting that some bias may be present [103].

When examining the *extent* to which publication bias may have been responsible for this significant effect, however, both the file drawer analysis [104] and the trim and fill analysis [105] suggested a negligible influence of publication bias. The fail-safe  $N$ , or the number of missing studies needed to nullify these significant findings, was 208, which exceeds the recommended cutoff of  $5k + 10$ , or 170 [104]. Furthermore, no values were imputed using the trim and fill procedure, yielding identical values for the summary effect size as in our original analyses. We also examined whether the magnitude of the effect of framing on prevention behavior was related to year of publication. One might expect, for example, that more recent studies would require stronger effect sizes in order to be published, compared to earlier studies. A meta-regression found no significant influence of publication year on the magnitude of the effect of framing on prevention behavior ( $p = 0.69$ ). Taken together the results of these analyses suggest that, as a class of behaviors, the findings for prevention behaviors were not likely the result of publication bias.

#### *Within-Study Comparisons of Effect Sizes*

Seventeen studies assessed prevention behavior as well as attitudes and intentions, enabling a direct comparison of differences in effect sizes among outcome measures while eliminating between-study differences inherent in the prior analyses. For each of the 17 studies, a contrast effect size was calculated that represented the difference between the behavioral effect size and the effect size on attitudes and/or intentions. For studies reporting both attitudes and intentions, a combined attitudes/intentions effect size was used to simplify analysis and presentation. Based on prior meta-analytic findings [122], we estimated the correlation between intentions and behavior to be 0.50 and attitudes and behavior to be 0.25, and followed procedures detailed by Rosenthal and Rubin [123] to estimate the contrast effect size while accounting for these correlations among multiple outcomes. Given the relatively small number of studies and our interest in determining whether the contrast effect size was significant within the pool of 17 selected studies, a fixed effect procedure was used to test the significance of the summary contrast effect size.

This analysis showed a slightly greater magnitude of framing effect for behavioral outcomes compared to attitudes/intentions (summary contrast effect size,  $r = 0.026$ ; 95% CI =  $-0.013, -0.064$ ), although this contrast was not statistically significant ( $p = 0.19$ ). While this non-significant contrast suggests similar magnitude of framing effects on behavioral compared to attitudinal/intentional

outcomes, we also note that in more than half of these studies, the behavioral outcome was assessed a week or even a month or more later than the attitudinal/intentional measures [32, 39, 40, 44, 51, 54, 74, 80, 85, 87]. Thus, the statistically similar effect size is noteworthy, given that the passage of time may have been more likely to attenuate the effect of framing on behavioral outcomes compared to the immediate attitudinal/intentional outcomes.<sup>3</sup> It is important to note that even among these 17 studies that assessed both attitudes/intentions and behavior, there appeared to be a notable disconnect between attitudes/intentions and behavior, as only one study [69] reported that the effects of gain versus loss framing was mediated by attitudes/intentions, and this mediation was only marginally significant.

#### Illness Detection Behaviors

##### *Effects on Attitudes and Intentions*

The size of the persuasive effect of gain- versus loss-framed messages did not differ significantly in studies that measured either attitudes towards a health behavior ( $k = 16$ ;  $r = -0.034$ ,  $p = 0.572$ ) or intentions to perform a health behavior ( $k = 32$ ;  $r = -0.025$ ,  $p = 0.496$ ) (see Table 2). Again, when examining both attitudes and intentions as outcomes, our results largely replicate those reported by O'Keefe and Jensen [6, 7].

##### *Effects on Behavior*

For studies that advocated detection behavior, there was also no significant difference between the persuasive effect of gain-framed versus loss-framed messages in promoting behavior ( $k = 18$ ;  $r = -0.040$ ,  $p = 0.101$ ). This effect was not moderated by how behavior was assessed ( $Q = 0.036$ ,  $p = 0.850$ ), as self-reported behavior showed a similar effect size ( $k = 12$ ;  $r = -0.036$ ,  $p = 0.300$ ) as objective behavior ( $k = 6$ ;  $r = -0.046$ ,  $p = 0.246$ ). Breaking down the detection category by behavior domain revealed one notable domain, breast cancer detection, in which there was a trend towards a significant difference in the persuasive effect of the gain-versus the loss-framed message ( $k = 10$ ;  $r = -0.052$ ,  $p = 0.077$ ).

<sup>3</sup> The strongest evidence for moderation by timeframe was found among studies that assessed prevention behavior. Although not significant using the more conservative random effects analyses ( $Q(1) = 1.810$ ,  $p = 0.178$ ), this moderation was significant in a fixed effects analysis ( $Q(1) = 6.802$ ,  $p = 0.009$ ), with behaviors assessed immediately after message presentation showing stronger effects of framing ( $k = 6$ ,  $r = 0.150$ ,  $p = 0.001$ ) than behaviors assessed at a follow-up ( $k = 26$ ,  $r = 0.077$ ,  $p = 0.007$ ). Moderation by timeframe could not be tested for attitudes/intentions as not enough studies assess these outcomes at a delayed follow-up. Furthermore, no moderation by timeframe was found for studies assessing detection behavior.

### Publication Bias

We assessed the possible influence of publication bias on the summary effect size for each outcome in the illness detection category. As indicated by the non-significant Kendall's tau statistics in Table 2 ( $p$  values of  $>0.05$ ), there appeared to be no evidence of publication bias for studies that examined the effect of framing on detection attitudes, intentions, or behaviors.

### Discussion

The goal of the present review was to clarify the conclusions made in prior meta-analytic reviews [6, 7] with regards to the effect of gain and loss framing on the persuasiveness of health messages. In this review, we distinguish between the various common outcomes used in framing studies (attitudes, intentions, and behavior), and find that although loss-framed messages were not significantly more likely than gain-framed messages to promote detection *behavior*, gain-framed messages were significantly more likely than loss-framed messages to promote prevention *behavior*.

#### Making Sense of the Findings: Prevention Behaviors

In line with O'Keefe and Jensen [6], we found a weak advantage for gain-framed messages over loss-framed messages on attitudes ( $r=0.04$ ) and intentions ( $r=0.03$ ), both of which were not significantly different from zero. However, contrary to O'Keefe and Jensen, gain-framed messages were significantly more persuasive than loss-framed messages in promoting actual preventive health *behavior* ( $r=0.08$ ,  $p=0.002$ ), and this summary effect did not appear to be due to publication bias. Although several domains of prevention behavior—smoking cessation, skin cancer prevention, and physical activity—seemed to drive this overall effect, an insufficient number of published studies were available within particular domains to make firm conclusions. Despite this, in no case was there a significant loss-frame advantage within any specific domain of prevention behavior.

In the prevention domain, our findings give rise to a central question that has potentially important theoretical and practical implications. That is, why were gain-framed messages more effective than loss-framed messages in promoting the adoption of illness prevention behavior, but gain-framed messages were no more effective than loss-framed messages in promoting favorable attitudes and intentions to adopt those behaviors?

This pattern suggests that framing effects on the adoption of prevention behaviors may not be completely

mediated by the most commonly assessed beliefs used in health message framing studies (attitudes, intentions). Further, we note that historically, it has been difficult to identify the specific beliefs that mediate the effects of message framing on health behavior (see Ref. 124, for review). For these reasons, using attitudes and intentions as proxy measures for the effect of health message framing on behavior may be misguided, and conclusions about the effect of message framing based primarily on studies that employ only measures of attitudes and intentions may either underestimate its effect or provide an incomplete picture of the effect of message framing on behavior. These findings underscore one important point of our review: the *practical* benefit of health message framing can only be realized by examining behavior as an outcome.

What, then, are the factors that might mediate the influence of message framing on prevention behavior? It may be that gain-framed messages communicate other types of information that may more directly influence behavior, such as self-efficacy, social norms, outcome expectancies, or positive emotion. For example, the prevention behaviors for which gain-framed messages had the strongest advantage were skin cancer prevention, smoking cessation, physical activity, and safe sex, with the weakest advantage found for diet and vaccination. Self-efficacy is known to be an important determinant of smoking cessation, physical activity, and safe sex [125], and a belief that may exert a direct influence on behavior. In contrast, self-efficacy may play a far lesser role in the prediction of relatively easier, one-time-only behaviors such as vaccination (that is unless the vaccination behavior is more extensive and necessitates adherence to a regimen to be effective, in which case self-efficacy does play an important role [126]). Indeed, we know that when it comes to making healthy lifestyle changes that are perceived to be challenging or complex, “self-efficacy considerations are probably paramount” ([127], pp. 87). Similarly, the framing of a message may also convey other implicit information such as the prevalence of the advocated behavior [128], which may also exert a direct effect on behavior. Lastly, gain-framed messages promoting prevention behavior appear to stimulate greater levels of information processing and better subsequent memory than loss-framed messages [129]. This enhanced level of information processing and memory for gain-framed messages over loss-framed messages may also explain why behavioral effects emerge over time in the absence of comparable effects on immediate self-reported attitudes and intentions. Thus, the findings from this meta-analysis underscore the importance of using behavior as an outcome in health message framing research, and for research to better identify the processes that mediate the effects of framed messages on behavior [124].

## Making Sense of the Findings: Detection Behaviors

O’Keefe and Jensen [7] reported finding a weak, but significant advantage of loss-framed messages ( $r=-0.039$ ) for the combined promotion of attitudes, intentions, and behaviors related to illness detection. The present findings largely replicate these prior findings when examining attitudes, intentions, and behavior separately, and do not lend support to Rothman and Salovey’s [2] prediction of an overall advantage of loss-framed over gain-framed messages in the promotion of illness detection behaviors.

We speculate that this lack of support for Rothman and Salovey’s [2] prediction may have to do with the degree of variability in how individuals think about the riskiness of detection behaviors. Rothman and Salovey’s [2] Prospect Theory-based prediction rests on the assumption that detection behaviors are typically perceived as risky. However, within any behavioral domain, there can be important variability in how people think about the risks associated with the behavior, and this variability may lead to differences in how framed messages work.

In fact, it may not necessarily be the detection or prevention function of a behavior that regulates people’s responses to framed messages, but rather people’s unique construals of the risks associated with the behavior [17]. In the case of prevention behaviors, people may generally view such behaviors to be relatively safe and certain to engage in, and hence a reliable advantage of gain-framed messages may result. Detection behaviors, on the other hand, may represent a class of behaviors for which people have more variable beliefs about their susceptibility to the relevant health condition.

To illustrate, Apanovitch and colleagues [11] showed that when promoting HIV tests, loss-framed messages were only more effective than gain-framed messages for people who were uncertain about what the outcome of the test would be. For people who were certain that the test would not find the presence of HIV, gain-framed messages were more effective in promoting testing than loss-framed messages. A similar pattern emerged in a study that manipulated college students’ perception of risk for developing heart disease as an attempt to encourage cholesterol screening [53], where loss-framed messages were more effective only when students were led to believe they were at a high risk for developing heart disease. In promoting screening mammography, Gallagher and colleagues [33] reported a loss-frame advantage only for women who considered themselves to be at high risk for breast cancer. No advantage of either frame was reported for women who felt little or no risk. Thus, people’s unique perceptions of risk reflects one individual difference variable that may moderate the extent to which loss-framed messages motivate people to take up detection

behaviors, and may help explain the minor, but not statistically significant, overall advantage of loss-framed messages over gain-framed messages for the promotion of detection behaviors.

## Limitations

Our conclusions are necessarily limited by the body of research we reviewed, including issues such as the inconsistency of statistical reporting across studies and the restricted scope of studies available to analyze. For instance, there were nearly three times as many effect sizes for measures of attitudes and intentions ( $k=139$ ) as there were effect sizes for behavioral measures ( $k=50$ ). Despite this apparent imbalance in number of studies reporting behavioral outcomes, our findings regarding the advantage of gain-framed messages over loss-framed messages in promoting prevention behaviors was statistically significant. Furthermore, very few studies provide the complete text of the framed messages, preventing us from examining how factors such as the proportion of framed information might have influenced the magnitude of the framing effects.

Our review was also limited to peer-reviewed, published studies. While this may increase the methodological quality of the studies in our review, it may also exclude studies that did not find significant effects of framing on behavior, and this may be of greatest concern in interpreting the effect of framing for the promotion of prevention behavior. However, we note that a diverse set of publication bias analyses suggested minimal, if any, influence of publication bias. Furthermore, a number of prevention behavior studies included in this analysis reported no significant overall effect of framing on behavior (e.g., 16, 39, 40, 46, 54, 56) while others included experimental manipulations that attenuated the gain-frame advantage on behavior (e.g., 34, 42, 87). Thus, while there is clearly heterogeneity in the magnitude of the gain-frame advantage for prevention behavior, our results suggest that framing matters. When a persuasive message is intended to convey the consequences of prevention, gain-framed messages should lead to greater chances of success than loss-framed messages.

Lastly, our review is guided by the predominant perspective that has guided health message framing research over the last 15 years, namely, Rothman and Salovey’s application of Prospect Theory to health communication [2]. Indeed, Rothman and Salovey’s perspective has been influential insofar as Prospect Theory is one of the few behavioral theories to explicitly suggest that gain- vs. loss-framed information can have substantially different effects on people’s choices and behaviors. Indeed, we found support for Rothman and Salovey’s underlying prediction for the moderating role of prevention vs. detection function



on health behavior. However, we acknowledge that Prospect Theory alone cannot explain the entire pattern of results we found, such as the lack of framing effects observed on attitudinal/intentional outcomes. More recently, researchers have investigated health message framing effects within the context of other motivational theories such as Protection Motivation Theory [86, 87] or Regulatory Focus Theory [47, 82]. To date, however, no single theory can account for the heterogeneity of health message framing effects observed across outcome measures and domains of health behavior [8].

### Practical Implications

Given the large disconnect between people's intentions to change their behavior and their actual likelihood of change [9], the most meaningful outcome one can hope for in an intervention is a change in actual behavior. The findings of the present review provide evidence that *how* you frame a health message is an important consideration in the design of messages promoting prevention behavior.

Although the effect of message framing on prevention behavior might seem relatively small in magnitude, it is important to keep in mind that health behaviors are complex in nature, and health message framing is but one aspect of an intervention that can contribute to its success. Indeed, Latimer and colleagues offer that “the small changes induced by framed messages may contribute to the additive effects of multiple intervention components” ([130]; p. 648). Other aspects of message-based health interventions include message tailoring, for example. Interestingly, a recent meta-analysis of tailored health behavior change interventions reported an effect of using tailored health messages over generic “one-size-fits-all” messages of  $r=0.07$  [131]. In our study, the advantage of gain-framed over loss-framed messages for promoting prevention behaviors was of similar magnitude ( $r=0.083$ ), suggesting that framing alone, at least for prevention behaviors, can have as much of an effect on the adoption of health behaviors as other more specific and comprehensive methods of message tailoring.

Although we found no overall main effect of framing for the promotion of detection behaviors, other studies suggest that framing may still be a useful part of an intervention strategy for detection behaviors, especially for interventions that have an opportunity to target people with high perceptions of risk for a relevant health condition (i.e., 11, 33, 53). Whereas reviews have concluded that “One cannot expect that using a gain-framed appeal rather than a loss-framed appeal will make much difference to the success of such messages” (6; p. 634), the present review suggests that such a conclusion may not be warranted, particularly for several domains

of prevention behaviors. Our findings also underscore the importance of assessing behavior in health communication research, as well as the potential usefulness of message framing in future behavior change interventions, such as mass media, large scale public interventions, as well as smaller-scale tailored health behavior interventions.

**Conflict of Interest Statement** The authors have no conflict of interest to disclose.

### References

1. Healthy People 2020. U.S. Department of Health and Human Services website. Available at <http://healthypeople.gov/2020/topicsobjectives2020/default.aspx>. Accessibility verified April 4, 2011.
2. Rothman AJ, Salovey P. Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychol Bull.* 1997; 121: 3–19.
3. Tversky A, Kahneman D. The framing of decisions and the psychology of choice. *Science.* 1981; 211: 453–458.
4. Edwards A, Elwyn G, Covey J, Matthews E, Roisin P. Presenting risk information—A review of the effects of “framing” and other manipulations on patient outcomes. *J Health Commun.* 2001; 6: 61–82.
5. O’Keefe DJ, Jensen JD. The advantages of compliance or the disadvantages of noncompliance? A meta-analytic review of the relative persuasive effectiveness of gain-framed and loss-framed messages. *Commun Yearbook.* 2006; 30: 1–43.
6. O’Keefe DJ, Jensen JD. The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease prevention behaviors: A meta-analytic review. *J Health Commun.* 2007; 12(7): 623–644.
7. O’Keefe DJ, Jensen JD. The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease detection behaviors: A meta-analytic review. *J Commun.* 2009; 59: 296–316.
8. Myers RE. Promoting healthy behaviors: How do we get the message across? *Int J Nurs Stud.* 2010; 47: 500–512.
9. Webb TL, Sheeran P. Does change behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull.* 2006; 132: 249–268.
10. \*Abhyankar P, O’Connor DB, Lawton, R. The role of message framing in promoting MMR vaccination: Evidence of a loss-frame advantage. *Psychol Health Med.* 2008; 13: 1–16
11. \*Apanovitch AM, McCarthy D, Salovey P. Using message framing to motivate HIV testing among low-income, ethnic minority women. *Health Psychol.* 2003; 22: 60–67
12. \*Arora R. Message framing and credibility: Application in dental services. *Health Mark Q.* 2000; 18: 29–44
13. \*Arora R, Arora A. The impact of message framing and credibility finding for nutritional guidelines. *Service Mark Q.* 2004; 26(1): 35–53
14. \*Arora R, Stoner C, Arora A. Using framing and credibility to incorporate exercise and fitness in individuals’ lifestyle. *J Cons Mark.* 2006; 23: 199–207
15. \*Banks SM, Salovey P, Greener S, et al. The effects of message framing on mammography utilization. *Health Psychol.* 1995; 14: 178–184

16. \*Bannon K, Schwartz MB. Impact of nutrition messages on children's food choice: Pilot study. *Appetite*. 2006; 46: 124–129
17. \*Bartels RD, Kelly KM, Rothman AJ. Moving beyond the function of the health behavior: The effect of message frame on behavioural decision-making. *Psychol Health*. 2010; 25: 821–838
18. \*Benz Scott L, Curbow B. The effect of message frames and CVD risk factors on behavioral outcomes. *Am J Health Behav*. 2006; 30: 582–597
19. \*Berry T, Carson V. Ease of imagination, message framing and physical activity messages. *Br J Health Psychol*. 2010; 15: 197–211
20. \*Block LG, Keller PA. When to accentuate the negative: The effects of perceived efficacy and message framing on intentions to perform a health-related behavior. *J Mark Res*. 1995; 32: 192–203
21. \*Broemer P. Relative effectiveness of differently framed health messages: The influence of ambivalence. *Eur J Soc Psychol*. 2002; 32: 685–703
22. \*Broemer P. Ease of imagination moderates reactions to differently framed health messages. *Eur J Soc Psychol*. 2004; 34: 103–119
23. \*Brug J, Ruiters JA, van Assema P. The (ir)relevance of framing nutrition education messages. *Nutr Health*. 2003; 17: 9–20
24. \*Chang CT. Beating the news blues: Mood repair through exposure to advertising. *J Commun*. 2006; 56: 198–217
25. \*Chang CT. Health-care product advertising: The influences of message framing and perceived product characteristics. *Psychol Mark*. 2007; 24: 143–169
26. \*Cho H, Boster FJ. Effects of gain versus loss frame antidrug ads on adolescents. *J Commun*. 2008; 58: 428–446
27. \*Considine NS, Horton D, Magai C, Kukafka R. Breast screening in response to gain, loss, and empowerment framed messages among diverse, low-income women. *J Health Care Poor Underserved*. 2007; 18: 550–566
28. \*Cox AD, Cox D, Zimet G. Understanding consumer responses to product risk information. *Am Market Assoc*. 2006; 70: 79–91
29. \*Cox DS, Cox AD. Communicating the consequences of early detection: The role of evidence and framing. *J Mark*. 2001; 65 (3): 91–103
30. \*Detweiler JB, Bedell BT, Salovey P, Pronin E, Rothman AJ. Message framing and sunscreen use: Gain-framed messages motivate beach goers. *Health Psychol*. 1999; 18: 189–196
31. \*Finney LJ, Iannotti RJ. Message framing and mammography screening: A theory-driven intervention. *Behav Med*. 2002; 28: 5–14
32. \*Gallagher KM, Updegraff JA. When “fit” leads to fit, and when “fit” leads to fat: How message framing and intrinsic v. extrinsic exercise outcomes interact in promoting physical activity. *Psychol Health*. 2011; Jan 1: 1–16 (*iFirst article*)
33. \*Gallagher KM, Updegraff JA, Rothman, AJ, Sims L. Perceived susceptibility to breast cancer moderates the effect of gain- and loss-framed messages on use of screening mammography. *Health Psychol*. 2011; 30: 145–152
34. \*Gerend MA, Cullen M. Effects of message framing and temporal context on college student drinking behavior. *J Exp Soc Psychol*. 2008; 44: 1167–1173
35. \*Gintner GG, Rectanus E F, Achord K, Parker B. Parental history of hypertension and screening attendance: Effects of wellness appeal versus threat appeal. *Health Psycho*. 1987; 6: 431–444
36. \*Goodall C, Appiah O. Adolescents' perceptions of Canadian cigarette package warning labels: Investigating the effects of message framing. *Health Commun*. 2008; 23: 117–127
37. \*Hevey D, Perl M, Thomas K, Maher L, Craig A, Chuinneagain SN. Body consciousness moderates the effect of message framing on intentions to use sunscreen. *J Health Psychol*. 2010; 15: 553–559
38. \*Hoffner C, Ye J. Young adults' responses to news about sunscreen and skin cancer: The role of framing and social comparison. *Health Commun*. 2009; 24: 189–198
39. \*Jones LW, Sinclair RC, Courneya SC. The effects of source credibility and message framing on exercise intentions, behaviors, and attitudes: An integration of the elaboration likelihood model and prospect theory. *J Appl Soc Psychol*. 2003; 33: 179–196
40. \*Jones LW, Sinclair RC, Rhodes RE, Courneya KS. Promoting exercise behaviour: An integration of persuasion theories and the theory of planned behaviour. *Br J Health Psychol*. 2004; 9: 505–521
41. \*Keller PA, Lipkus IM, Rimer BK. Affect, framing, and persuasion. *J Mark Res*. 2003; 40: 54–64
42. \*Knapp LG. Effects of type of value appealed to and valence of appeal on children's dental health behavior. *J Pediatr Psychol*. 1991; 16: 675–686
43. \*Lalor KM, Hailey BJ. The effects of message framing and feelings of susceptibility to breast cancer on reported frequency of breast self-examination. *Int Q of Community Health Educ*. 1990; 10: 183–192
44. \*Latimer AE, Rench TA, Rivers SE, et al. Promoting participation in physical activity using framed messages: An application of prospect theory. *Br J Health Psychol*. 2008; 13: 659–681
45. \*Lauver D, Rubin M. Message framing, dispositional optimism, and follow-up for abnormal Papanicolaou tests. *Res Nurs Health*. 1990; 13: 199–207
46. \*Lawatsch DE. A comparison of two teaching strategies on nutrition knowledge, attitudes and food behavior of preschool children. *J Nutr Educ*. 1990; 22: 117–123
47. \*Lee AY, Aaker JL. Bringing the frame into focus: The influence of regulatory fit on processing fluency and persuasion. *J Pers Soc Psychol*. 2004; 86: 205–218
48. \*Lee CKC, Brown R, Blood D. The effects of efficacy, cognitive processing and message framing on persuasion. *Australas Mark J*. 2000; 8: 5–17
49. \*Lerman C, Ross E, Boyce A, et al. The impact of mailing psychoeducational materials to women with abnormal mammograms. *Am J Public Health*. 1992; 82: 729–730
50. \*Levin IP, Gaeth GJ, Albaum G, Schreiber J. How positive and negative frames influence the decisions of persons in the United States and Australia. *Asia Pac J Market Logist*. 2001; 2: 64–71
51. \*Looker A, Shannon B. Threat vs. benefit appeals: Effectiveness in adult nutrition education. *J Nutr Educ*. 1984; 16: 173–176
52. Maguire KC, Gardner J, Sopory P, et al. Formative research regarding kidney disease health information in a Latino American sample: Associations among message frame, threat, efficacy, message effectiveness, and behavioral intention. *Commun Edu*. 2010; 59: 344–359
53. \*Maheswaran D, Meyers-Levy J. The influence of message framing and issue involvement. *J Mark Res*. 1990; 27: 361–371
54. \*Mann T, Sherman D, Updegraff J. Dispositional motivations and message framing: A test of the congruency hypothesis in college students. *Health Psychol*. 2004; 23: 330–334
55. \*McCall LA, Ginis KAM. The effects of message framing on exercise adherence and health beliefs among patients in a cardiac rehabilitation program. *J Appl Biobehav Res*. 2004; 9: 122–135
56. \*McCaul KD, Johnson RJ, Rothman AJ. The effects of framing and action instructions on whether older adults obtain flu shots. *Health Psychol*. 2002; 21: 624–628
57. \*McKee SA, O'Malley S, Steward WT, Neveu S, Land M, Salovey P. How to word effective messages about smoking and oral health: Emphasize the benefits of quitting. *J Dent Educ*. 2004; 68: 569–573



58. \*Myers-Levy J, Maheswaran D. Exploring message framing outcomes when systematic, heuristic, or both types of processing occur. *J Cons Psychol*. 2004; 14(1–2): 159–167
59. \*Millar MG, Millar KU. Promoting safe driving behaviors: The influence of message framing and issue involvement. *J Appl Soc Psychol*. 2000; 30: 853–866
60. \*Moorman M, van den Putte B. The influence of message framing, intention to quit smoking, and nicotine dependence on the persuasiveness of smoking cessation messages. *Addict Behav*. 2008; 33: 1267–1275
61. \*Myers RE, Ross EA, Wolf TA, Balschem A, Jepson C, Millner L. Behavioral interventions to increase adherence in colorectal cancer screening. *Med Care*. 1991; 29: 1039–1050
62. \*Nan X. The relative persuasive effect of gain- versus loss-framed messages: Exploring the moderating role of the desirability of end-states. *Journalism Mass Comm Q*. 2007; 84: 509–524
63. \*O'Connor DB, Ferguson E, O'Connor RC. Intentions to use hormonal male contraception: The role of message framing, attitudes and stress appraisals. *Br J Psychol*. 2005; 96: 351–369
64. \*Park P, Simmons RK, Prevost AT, Griffin SJ. A randomized evaluation of loss and gain frames in an invitation to screening for type 2 diabetes: Effects on attendance, anxiety and self-rated health. *J Health Psychol*. 2010; 15: 196–204
65. \*Ramirez A. Social influence and ethnicity of the communicator. *J Soc Psychol*. 1977; 102: 209–213
66. \*Richardson JL, Milam J, McCutchan A, et al. Effect of brief safer-sex counseling by medical providers to HIV-1 seropositive patients: A multi-clinic assessment. *AIDS*. 2004; 18: 1179–1186
67. \*Rivers SE, Salovey P, Pizarro DA, Pizarro J, Schneider TR. Message framing and pap test utilization among women attending a community health clinic. *J Health Psychol*. 2005; 10: 65–77
68. \*Robberson MR, Rogers RW. Beyond fear appeals: Negative and positive persuasive appeals to health and self-esteem. *J Appl Soc Psychol*. 1988; 18: 277–287
69. \*Rothman AJ, Martino SC, Bedell B, Detweiler JB, Salovey P. The systematic influence of gain- and loss-framed messages on interest in and use of different types of health behaviors. *Pers Soc Psychol Bull*. 1999; 25(11): 1355–1369
70. \*Rothman A J, Salovey P, Antone C, Keough K, Martin CD. The influence of message framing on intentions to perform health behaviors. *J Exp Soc Psychol*. 1993; 29: 408–433
71. \*Schneider TR, Salovey P, Apanovitch AM, et al. The effects of message framing and ethnic targeting on mammography use among low-income women. *Health Psychol*. 2001; 20: 256–266
72. \*Schneider T, Salovey P, Pallonen U, et al. Visual and auditory message framing effects on tobacco smoking. *J Appl Soc Psychol*. 2001; 31: 667–682
73. \*Shannon B, Rowan ML. Threat vs. benefit appeals for motivating adults to participate in a weight-control class. *J American Diet Assoc*. 1987; 87: 1612–1614
74. \*Sherman DK, Mann T, Updegraff JA. Approach/avoidance orientation, message framing, and health behavior: Understanding the congruency effect. *Motiv Emot*. 2006; 30: 165–169
75. \*Steward WT, Schneider TR, Pizarro J, Salovey P. Need for cognition moderates responses to framed smoking-cessation messages. *J Appl Soc Psychol*. 2003; 33: 2439–2464
76. \*Toll BA, O'Malley SS, Katulak NA, et al. Comparing gain- and loss-framed messages for smoking cessation with sustained release bupropion: A randomized control trial. *Psychol Addict Behav*. 2007; 21: 534–544
77. \*Trupp RJ, Corwin EJ, Ahijevych KL, Nygren T. The impact of educational message framing on adherence to continuous positive airway pressure therapy. *Behav Sleep Med*. 2011; 9: 38–52
78. \*Tykocinski OE, Higgins T, Chaiken S. Message framing, self-discrepancies, and yielding to persuasive messages: The motivational significance of psychological situations. *Pers Soc Psychol Bull*. 1994; 20: 107–115
79. \*Umphrey LR. The effects of message framing and message processing on testicular self-examination attitudes and perceived susceptibility. *Commun Res Rep*. 2003; 20: 97–105
80. \*Updegraff JA, Sherman DK, Luyster FS, Mann TL. The effects of message quality and congruency on perceptions of tailored health communications. *J Exp Soc Psychol*. 2006; 43: 249–257
81. \*Urban AB, Stout PA, Zimet GD, Blake DR. The influence of message framing on adolescent females' intention to obtain Chlamydia screening. *J Adolesc Health*. 2006; 38: 126–127
82. \*Uskul AK, Sherman DK, Fitzgibbon J. The cultural congruency effect: Culture, regulatory focus, and the effectiveness of gain-vs. loss-framed health messages. *J Exp Soc Psychol*. 2009; 45: 535–541
83. \*van Assema P, Martens M, Ruiters R, Brug J. Framing of nutrition education messages in persuading consumers of the advantages of a healthy diet. *J Hum Nutr Diet*. 2001; 14: 435–442
84. \*van 't Riet J, Ruiters RAC, Werrij MQ, Candel MJJM, de Vries H. Distinct pathways to persuasion: The role of affect in message-framing effects. *Eur J Soc Psychol*. 2009; doi:10.1002/ejsp.722
85. \*van't Riet J, Ruiters RAC, Werrij MQ, de Vries H. Investigating message-framing effects in the context of a tailored intervention promoting physical activity. *Health Educ Res*. 2009; doi:10.1093/her/cyp061
86. \*van 't Riet J, Ruiters RAC, Werrij MQ, de Vries H. Self-efficacy moderates message-framing effects: The case of skin-cancer detection. *Psychol Health*. 2010; 25: 339–349
87. \*van't Riet J, Ruiters RAC, Smerecnik C, de Vries H. Examining the influence of self-efficacy on message-framing effects: Reducing salt consumption in the general population. *Basic App Soc Psychol*. 2010; 32: 165–172
88. \*Williams T, Clarke V, Borland R. Effects of message framing on breast-cancer-related beliefs and behaviors: The role of mediating factors. *J Appl Soc Psychol*. 2001; 31: 925–95
89. \*Yu N, Ahern LA, Connolly-Ahern C, Shen F. Communicating the risks of fetal alcohol spectrum disorder: Effects of message framing and exemplification. *Health Commun*. 2010; 25: 692–699
90. Levin IP, Schneider SL, Gaeth, GJ. All frames are not created equal: A typology and critical analysis of framing effects. *Org Beh Human Dec Proces*. 1998; 76: 149–188.
91. Lucidi F, Russo PM, Mallia L, Devoto A, Lauriola M, Violani C. Sleep related car crashes: Risk perception and decision-making processes in young drivers. *Accid Anal Prev*. 2006; 38: 302–309.
92. Purewal S, van den Akker OBA. A study of the effect of message framing on oocyte donation. *Hum Reprod*. 2009; 24: 3136–3143.
93. Toll BA, Salovey P, O'Malley SS, Mazure C, Latimer A, McKee SA. Message framing for smoking cessation: The interaction of risk perceptions and gender. *Nicotine Tob Res*. 2008; 10: 195–200.
94. Fucito LM, Latimer AE, Salovey P, Toll BA. Nicotine dependence as a moderator of message framing effects on smoking outcomes. *Ann Behav Med*. 2010; 39: 311–317.
95. Levin IP, Gaeth GJ, Schreiber J, Lauriola M. A new look at framing effects: Distribution of effect sizes, individual differences, and independence of types of effects. *Organ Behavior Hum Dec*. 2002; 88: 411–429.
96. Kiene SM, Barta WD, Zelenski JM, Cothran DL. Why are you bringing up condoms now? The effect of message content on

- framing effects of condom use messages. *Health Psychol.* 2005; 24: 321–326.
97. Szklo AS, Coutinho ESF. The influence of smokers' degree of dependence on the effectiveness of message framing for capturing smokers for a Quitline. *Addict. Behav.* 2010; 35: 620–624.
  98. Ferguson E, Gallagher L. Message framing with respect to decisions about vaccination: The roles of frame valence, frame method and perceived risk. *Br J Psychol.* 2007; 98: 667–680.
  99. Cherubini P, Rumiati R, Rossi D, Nigro F, Calabro A. Improving attitudes toward prostate examinations by loss-framed appeals. *J App Soc Psychol.* 2005; 35: 732–744.
  100. Hedges LV, Vevea JL. Fixed- and random-effects models in meta-analysis. *Psychol Methods.* 1998; 4: 486–504.
  101. Biostat (Comprehensive Meta-Analysis) [computer program]. Borenstein M, Rothstein H; Ver 2.2.023/2005.
  102. Rosenthal R. *Meta-analytic procedures for social research* (Rev. ed.). Newbury Park, CA: Sage; 1991
  103. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics.* 1994; 50: 1088–1101.
  104. Sterne JA, Gavaghan D, Egger M. Publication and related bias in meta-analysis. *J Clin Epi.* 2000; 53: 1119–1129
  105. Rosenthal R. The “file drawer problem” and tolerance for null results. *Psychol Bull.* 1979; 86: 638–641.
  106. Duval S, Tweedie R. Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics.* 2000; 56: 455–463.
  107. Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: A review and meta-analysis. *Am J Public Health.* 1994; 84: 1086–1093.
  108. Vartiainen E, Seppala T, Lillsunde P, Puska P. Validation of self reported smoking by serum cotinine measurement in a community-based study. *J Epidemiol Community Health.* 2002; 56: 167–170.
  109. Lawrence VA, De Moor C, Glenn ME. Systematic differences in validity of self-reported mammography behavior: A problem for intergroup comparisons? *Prev Med.* 1999; 29: 577–80.
  110. King ES, Rimer BK, Trock B, Balschem A, Engstrom P. How valid are mammography self-reports? *Am J Public Health.* 1990; 80: 1386–1388.
  111. Degnan D, Harris R, Ranney J, Quade D, Earp JA, Gonzalez J. Measuring the use of mammography: Two methods compared. *Am J Public Health.* 1992; 82: 1386–1388.
  112. Etzi S, Lane DS, Grimson R. The use of mammography vans by low-income women: The accuracy of self-reports. *Am J Public Health.* 1994; 84: 107–109.
  113. Gordon NP, Hiatt RA, Lampert DI. Concordance of self-reported data and medical record audit for six cancer screening procedures. *J Natl Cancer Inst.* 1993; 85: 566–570.
  114. Martin LJ, Su W, Jones PJ, Lockwood GA, Tritchler DL, Boyd NF. Comparison of energy intakes determined by food records and doubly labeled water in women participating in a dietary-intervention trial. *Am J Clin Nutr.* 1996; 63: 483–490.
  115. Sniehotta FF, Soares VA, Dombrowski SU. Randomised controlled trial of a 1-minute intervention changing oral self-care behaviour. *J Dent Res.* 2007; 86: 641–645.
  116. Schüz B, Sniehotta FF, Wiedemann A, Seeman R. Adherence to a daily flossing regimen in university students: Effects of planning when, where, how and what to do in the face of barriers. *J Clin Periodontol.* 2006; 33: 612–619.
  117. McCaul KD, Glasgow RE, Gustafson C. Predicting levels of preventive dental behaviors. *J Am Dent Assoc.* 1985; 111: 601–605.
  118. Pitiphat W, Garcia RI, Douglass CW, Joshipura KJ. Validation of self-reported oral health measures. *J Public Health Dent.* 2007; 62: 122–128.
  119. Hayden-Wade HA, Coleman KJ, Sallis JF, Armstrong C. Validation of the telephone and in-person interview versions of the 7-day PAR. *Med Sci Sports Exer.* 2003; 35:801–809.
  120. Jacobs DR, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exer.* 1993; 25: 81–91.
  121. Hagstromer M, Oja P, Sjostrom M. The International Physical Activity Questionnaire (IPAQ): A study of concurrent and construct validity. *Public Health Nutr.* 2006; 9: 755–762.
  122. Armitage CJ, Conner M. Efficacy of the theory of planned behavior: A meta-analytic review. *Br J Soc Psychol.* 2001; 40: 471–499.
  123. Rosenthal R, Rubin DB. Meta-analytic procedures for combining studies with multiple effect sizes. *Psychol Bull.* 1986; 99: 400–406.
  124. Rothman AJ, Updegraff, JA. Specifying when and how gain- and loss-framed messages motivate healthy behavior: An integrated approach. In Keren G, ed. *Perspectives on Framing.* London: Psychology Press; 2010: 257–277.
  125. Strecher VJ, DeVellis BM, Becker MH, Rosenstock IM. The role of self-efficacy in achieving health behavior change. *Health Edu Quar.* 1986; 13: 73–92.
  126. Rhodes SD, Hergenrather KC. Using an integrated approach to understand vaccination behavior among young men who have sex with men: Stages of change, the health belief model, and self-efficacy. *J Comm Health.* 2003; 28: 347–362.
  127. Strecher VJ, DeVellis BM, Becker MH, Rosenstock IM: The role of self-efficacy in achieving health behavior change. *Health Educ Q.* 1986; 13: 73–92.
  128. Stuart AE, Blanton H. The effects of message framing on behavioral prevalence assumptions. *Eur J of Soc Psychol.* 2003; 33: 93–102.
  129. O'Keefe, DJ, Jensen, JD. Do loss-framed persuasive messages engender greater message processing than do gain-framed messages? A meta-analytic review. *Comm Studies,* 2008; 59: 51–67.
  130. Latimer AE, Salovey P, Rothman AJ. The effectiveness of gain framed messages for encouraging disease prevention behavior: Is all hope lost? *J Health Commun.* 2007; 12: 645–649.
  131. Noar SM, Benac C, Harris M. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychol Bull.* 2007; 133: 673–693.

References marked with an asterisk (\*) indicate studies included in the meta-analysis.