Optimizing Persuasive Strategies: A Meta-Analysis of the Combined Effects of Gain-Loss Framing and Evidence Type

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Abstract

This meta-analysis examines the persuasive effects of gain-loss framing and evidence type (narrative and non-narrative), and their interactions, to identify the most effective communication strategies.

The findings reveal that neither gain nor loss frames consistently outperform the other, and narrative evidence generally has a stronger impact on persuasion than non-narrative. Importantly, the combination of a gain frame with non-narrative evidence emerged as particularly effective, enhancing both behavioral intentions and attitudes. However, loss-framed narratives were found to be most engaging in terms of information processing. Moderating variables were explored, with sample type showing marginal significance; gain frames performed better in convenience samples.

Keywords: gain-loss framing; evidence type; narrative persuasion; Construal Level Theory

gain-loss framing and evidence type:

H1: The relative effectiveness between gain and loss frames is not significant for persuasive outcomes.

H2: Message containing narrative evidence is more persuasive compared to non-narrative evidence for persuasive outcomes.

Next, we directly compare the persuasiveness of four different message designs combining these elements:

RQ1: Among these four designs (with loss frame-non-narrative message as the reference), is there at least one that shows a significant persuasive advantage?

RQ2: Among these four designs, is there at least one that significantly influences information processing, compared to the reference message design?

Finally, we examine the potential influence of moderating variables:

RQ3: To what extent are the effects of these message designs moderated by theoretically relevant factors?

Method

Literature Search

This systematic review followed the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)(Page et al., 2020).

Search Strategy

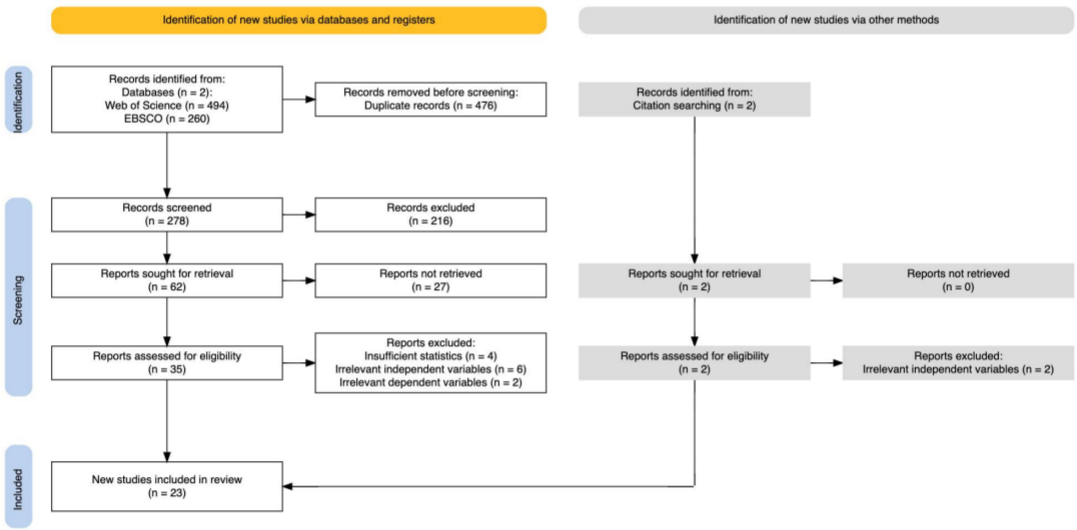
Literature retrieval, inclusion, and coding are critical processes for mete-analysis. Particularly in the stages of screening, we engaged in multiple, iterative discussions

different variables, both studies were included. If there were multiple experiments or experiments uses different samples in one publication, each was considered a separate study and included.

After applying the above criteria, a total of 23 articles, with a total sample size of 7056 individuals were included in the meta-analysis. Figure 1 provides the flow diagram of retrieval and selection procedures (Haddaway, 2022).

Figure 1

The PRISMA flow diagram of retrieval and selection procedures



Study Characteristics Coding

We categorized two types of variables extracted from each study (Lipsey & Wilson, 2001). The first category is study descriptors, which provide basic information about the study, such as the article name, publication year and type, sample size, and effect sizes. The second category comprises study characteristics.

----------one sample from "Method"----------

Table 1

Overview of Studies Included in Meta-Analysis

Research id	*Study Name & Year*	*Publication Type*	*N*	*Outcome*	*Sample Features*			*Other Message Features*				
					Sample Composition	**Sample Type**	**Sample Region**	**Topic**	**Topic Type**	**Behavior Advocated**	**Experimental environment**	**Modality**
1	Jeong et al. (2020)	journal article	406	attitude	students	homogeneous group	USA	anti-piracy educational campaign	self-benefit	prevention	online	text
2	Yu et al. (2010)	journal article	213	behavioral intention	students	homogeneous group	USA	health	self-benefit	prevention	offline	text
3	Sipes (2010)	thesis	193	attitude	students	convenience sample	USA	safety	self-benefit	cessation	offline	text
4	Xu et al. (2021)	journal article	300	behavioral intention	students	convenience sample	China	health	self-benefit	prevention	online	text
5	Kirkpatrick et al. (2021)	journal article	400	behavioral intention	general	mixed sample	USA	health	self-benefit	prevention	online	video
6	Das et al. (2008)	journal article	160	attitude	students	convenience sample	Netherlands	charity	altruistic	donation	offline	text
7	Ma & Nan (2018)	journal article	101	belief	students	homogeneous group	USA	health	self-benefit	cessation	online	text
8	Vafeiadis & Shen (2021)	journal article	415	attitude	general	mixed sample	NA	health	self-benefit	prevention	online	text
9	Kang & Lee (2017)	journal article	156	behavioral intention	students	convenience sample	USA	health	self-benefit	prevention	online	text
10	Delehanty et al. (2020)	journal article	282	involvement/attitude	general	homogeneous group	USA	health	self-benefit	detection	online	text
11	Lammers (2019)	thesis	131	behavioral intention	general	convenience sample	Netherlands	charity	altruistic	donation	online	text
12	Chien & Chang (2015)	journal_article	189	behavioral intention	students	convenience sample	Taiwan	charity	altruistic	donation	offline	text
13	Gray & Harrington (2010)	journal_article	345	attitude	students	convenience sample	USA	health	self-benefit	prevention	offline	text
14	Dardis & Shen (2008)	journal_article	196	behavioral intention	students	convenience sample	USA	adv	consumer	consumer	offline	text
15	Coenders (2014)	thesis	248	attitude	general	mixed sample	Netherlands	charity_donate	altruistic	donation	offline	text
16	Liu & Yang (2020)	journal article	439	involvement	students	convenience sample	USA	health	self-benefit	cessation	online	text
17	Braun (2018)	thesis	402	belief	general	mixed sample	Netherlands	Retirement	self-benefit	pension information	offline	video
18	Ye et al. (2021)	journal article	298	behavioral intention	students	homogeneous group	China	health	self-benefit	prevention	online	text
19	Wirtz & Kulpavaropas (2014)	journal article	72	involvement	general	homogeneous group	USA	health	self-benefit	prevention	offline	text
20	Vafeiadis (2017)	thesis	433	attitude	general	mixed sample	USA	health	self-benefit	prevention	online	text
21	Hong (2011)	thesis	130	involvement	students	homogeneous group	USA	health	self-benefit	detection	online	text
22	Zhao et al. (2023)	journal article	1084	attitude	students	homogeneous group	USA	health	self-benefit	cessation	online	text
23	Kim & Chon (2022)	journal article	472	belief	general	mixed sample	USA	environmental	altruistic	Conservation	online	text

Intercoder Reliability

The coding of study characteristics was completed by the author and a student assistant who familiar with the field. After the coding training, the two coder independently coded all studies. The inter-coder reliability was assessed using the Krippendorff's alpha estimate from the "irr" package in R 4.0, with the reliability results of all variables ranges from 0.99 to 1. After comparing the coding results, two coders discussed the areas of inconsistency and resolved the disagreements.

Table 2

The results of inter-coder reliability test

Type	Variable Name	Krippendorff's alpha
Moderators	sample type	0.996
	study region	1
	sample edu	1
	white ratio	1
	sample female ratio	1
	age mean	1
	experimental environment	1
	modality	1
	kernel state	0.996
	framing_ ype	0.992
	behavior advocated	1
	Outcome variable type	0.997
Statistics	group sample (reference)	1
	mean (reference)	1
	standard deviation (reference)	1
	beta (reference)	1
	standard errors (reference)	1
	group sample (comparison)	1
	mean (comparison)	0.995
	standard deviation (comparison)	0.993
	beta (comparison)	1
	standard errors (comparison)	1
	degree of freedom (between)	1
	degree of freedom (within error)	1
	f statistics	1

Analytical Approach

Analytical Model

Many of the study samples we included measured multiple outcomes related to persuasion, resulting in multiple effect sizes per study that are dependent on each other. The dependencies arise from several layers. On one hand, the same operationalization of variables, study population and other sharing factors in research methodologies can make the effect sizes across studies more similar. On the other hand, the same sampling method, experimental interventions also contribute to higher correlation among effect sizes within the same study. This correlation is particularly notable when there is an overlap in the samples used to calculate effect sizes, indicating significant within-study dependency (Van Den Noortgate et al., 2013). In this study, the main effects of gain-loss framing and evidence type, as well as their interaction, are of our interest. However, these effect sizes all stem from group comparisons in between-subjects factor analysis. When multiple experimental groups are compared with the same reference, this implies overlap in the samples used to calculate these effect sizes (Van Den Noortgate et al., 2013). Furthermore, given that persuasion is constructed by multiple dimensions (e.g., attitudes, behavioral intention, perception, belief), the various dependent variables that contribute to the overall persuasion outcomes reported in the same study are inherently related, even when different measurement methods are employed.

However, the dependency characteristics among effect sizes make traditional meta-analysis unsuitable for such data, which assumes independence among effect

sizes (Lipsey & Wilson, 2001). Using traditional meta-analysis methods to combine effect sizes results in the repeated consideration of overlapping information among correlated outcome variables, causing this overlapping information to be inflated (Van Den Noortgate et al., 2013). It can also lead to biased estimates because it assigns more weights to studies that contribute more effect sizes, overly emphasizing the results of these studies (Van Den Noortgate et al., 2013).

Compared to other strategies, the three-level meta-analysis method is the best alternative because it considered a hierarchical structure, that is, effect sizes nested within studies (Cheung, 2014). It assigns weights based on the dependency among effect sizes within the same study, with less dependency resulting in greater weight assigned (Van Den Noortgate et al., 2013). Thus, the sources of variance are distinguished in three levels, sampling variance of individual effect sizes on Level 1, the variance within each study on Level 2, and the variance between different studies on Level 3.

Analytical Procedure

Heterogeneity between studies can be caused by one or more effect sizes with extreme values, which Viechtbauer and Cheung (2010) define as influential cases. These cases significantly impact the robustness of the pooled effect size. Thus, we first conducted an influence analysis to identify and remove outliers, and then repeated the analysis (Harrer et al., 2021). The dmetar package in R was used, which facilitates Influence Analysis by measuring each study's contribution to the pooled effect size. The influence diagnostics plots provided by this package help us visually

identify studies that do not fit well into our model that influential studies are marked in red.

We used the R package metafor (Viechtbauer, 2010) to construct all three-level models. Following the tutorial of Assink & Wibbelink (2016), we assessed the heterogeneity at the within-study and between-study levels using two independent log-likelihood tests. Thus, the sources of variance are distinguished across three levels: sampling variance of individual effect sizes on Level 1, the variance within each study on Level 2, and the variance between different studies on Level 3. The presence of significant heterogeneity at any level indicates the need for an analysis of moderating variables.

In a multilevel meta-regression framework, we further explored potential moderating factors through omnibus tests. This method's advantage lies in its ability to calculate the average effects at each level of the moderating variables, facilitating intuitive comparisons (Van den Noortgate et al., 2013). Thus, beyond theoretical moderators we also considered different types of message design and outcomes of persuasion as predictors. A significant F-value indicates that among the three types of message design, at least one type (compared to the reference) is more effective; or that different outcome variables vary in their sensitivity to the intervention. Such steps in analysis enhance the efficiency of group comparisons and provide essential information for adjusting the analysis plans left. According to previous research practices, in tests of moderators, predictors are converted into dummy variables, and the moderator is only included in the analysis if each level of has at least one effect

size, and at has least three effect sizes in total (van Loon et al., 2020). To better determine the effect sizes of four message design interventions on specific outcomes, we conducted subgroup analyses for each intervention.

Publication Bias

When published research does not systematically represent the entirety of completed studies in a field, it is considered to indicate publication bias (Rothstein et al., 2005), which may result in effect sizes that are higher than the true values (Kuppens et al., 2013). To assess publication bias, we employed Egger's linear regression test (Egger et al., 1997). If the Egger's intercept is not significant ($p > 0.05$), it indicates an absence of publication bias (Sterne & Egger, 2006). It is noteworthy that to align with the two-level model data characteristics of the Egger regression, we adjusted the traditional steps of Egger's test based on prior practices (Ratcliff & Sun, 2020; Wang, Chu & Huang, 2023). We set the standard error as a predictor and used a new dataset for regression testing, randomly selecting one effect size from each study to form a new two-level dataset.

Funnel plots and Egger regression tests are commonly used to assess publication bias (Vevea et al., 2019). Funnel plots provide a visual preliminary check for publication bias. If Egger's test suggests potential publication bias, the trim and fill method can be further applied for bias correction (Duval & Tweedie, 2000). If the effect size remains after trimming and filling, then publication bias is considered absent. However, the asymmetry in funnel plots does not always indicate publication bias. Contour-enhanced funnel plots with statistically significant contours can provide

additional information to interpret the asymmetry. If the studies filled are in areas of high statistical significance, it is more likely that the asymmetry is not caused by publication bias (Palmer et al., 2008; Peters et al., 2008).

Results

Test for H1 - Frame Effect

After deleting an outlier through influence analysis, a total of 19 studies with 56 effect sizes were examined in this study (N=17941). The results of the three-level meta-analysis showed that gain frame had a small but positive relative effectiveness than loss frame strategy ($d = 0.116$, $t = 2.346$, 95% CI = [0.017, 0.216], $p = 0.023$). Contrary to our prediction, there is a significant difference between the strategies within the framing effect. Please see the complete results in supplement files.

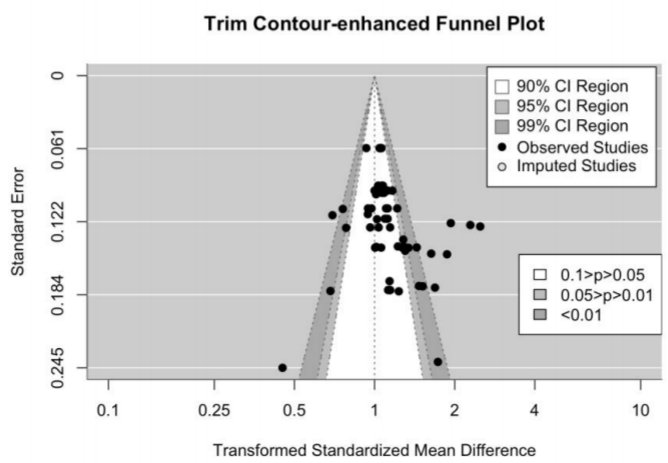
There was a significant heterogeneity in effect sizes of the included studies, $Q(55) = 218.33$, $p < .001$. This indicates that the existence of potential moderators in the effect of message frame on persuasion. Specifically, a significant heterogeneity was observed at both within the studies in Level 2 ($\sigma^2 = 0.016$, $\chi^2 = 11.12$, $p = 0.0009$) and between the studies in Level 3 ($\sigma^2 = 0.032$, $\chi^2 = 10.04$, $p = 0.0015$). It shows that the full model is superior to the simplified model, so we further determine the variance contribution of the three levels. The variance proportions across the different levels of our multi-level meta-analysis are as follows: 20.67% attributed to Level 1 (sampling error), 26.78% to Level 2 (within-study variance, EID), and 52.55% to Level 3 (between-study variance, SID).

Subgroup analysis showed that gain frames are more effective especially on attitudes ($d = 0.125$, 95% CI [0.0030, 0.2478], se = 0.062, k = 23, $t = 2.01$, $p = 0.045$). However, their relative effectiveness did not differ significantly on belief ($d = 0.222$, 95% CI [-0.0429, 0.4884], se = 0.1355, k = 9, $t = 1.64$, $p = 0.100$). and behavioral intention ($d = 0.114$, 95% CI [-0.0148, 0.2431], se = 0.07, k = 24, $t = 1.74$, $p = 0.083$). Additionally, the omnibus test showed there was no significant difference in the effect sizes across the types of outcomes: $F(2,53) = 0.251$, $p = 0.779$.

The trim contour-enhanced funnel plot and Egger's test result indicated that there was no publication bias. One effect size was randomly selected from each sample to form a two-level dataset (Ratcliff & Sun, 2020), including the sampling error and the errors between studies (k = 19, $d = 0.020$, se = 0.047, $t = 0.41$, 95% CI = [-0.0730, 0.1121], $p = 0.68$) . The Egger's test intercept was also not significant (intercept= 0.23, $t = 1.33$, $p = 0.18$).

Figure 2

The trim contour-enhanced funnel plot for H1



----------one sample from "Method"----------

indicated that mean age ($d = 0.195$, $\beta = -0.021$, se = -0.009, $t(30) = -2.229$, $p = 0.033$) was a significant moderator, $F(1, 30) = 4.968$, $p = 0.030$. In the omnibus test of categorical moderators, we did not found any variable is significant.

Discussion

Although scholars are actively exploring the effects of message styles, structures and contents, particularly seeking optimal strategies within single feature category or potential moderating variables, there remains a lack of perspective across theres message features, especially in studying the combined impact on the persuasion process and outcomes. This study conducted a meta-analys to quantify the persuasive effects of messages characterized by both framing (gain & loss) and evidence type (narrative & non-narrative), and attempts to identify potential moderating factors.

The results indicated that, for individual message features, the gain frame has a relatively greater effect and positively influences behavioral intentions; narrative evidence has a greater relative impact, positively affecting both behavioral intentions and attitudes. Regarding the combined effects of the two features, the combination of a gain frame with non-narrative evidence appears to be the most effective. Moreover, omnibus test suggested that loss-framed messages with narratives are most likely to engage information processing, while gain-framed messages with non-narratives are slightly behind. Beyond identifying sample type as a marginally significant moderating variable in the meta-analysis of framing effects (with gain frames being more effective for convenience samples), this study did not find any other

Limitations and Future Research Agendas

In today's era of scarce attention, only those messages that capture the audience's attention in an extremely short time and allow them to quickly perceive effectiveness are more likely to have persuasive opportunities. This also means that persuading them requires less time. In summary, different audiences, due to the impact of psychological mechanisms and emotional responses, have different needs, and only precisely designed messages are more likely to be effective. Therefore, we recommend establishing more empirical studies in the future to explore the potential persuasive paths mentioned above.

This study still has many shortcomings. First, due to the limited number of available studies and the very inconsistent methods of manipulating emotional responses, our results lack an important dimension of emotion. We suggest that future researchers continue to explore the effects of different statistical evidence combined with frameworks, explaining more detailed impact relationships. Secondly, we were also unable to further explore the effects of transportation and involvement on the persuasive process of such information through meta-analysis. It is recommended that future empirical studies increase the variable control of individual participation, or focus on the differences in the degree of audience involvement before and after reading the information. Changes in the level of information processing during the persuasion process and the effect of transportation as a mediator. Finally, distinguish between different characteristics of information recipients and explore more personal