The Effects of Information Framing on Health Risk Perception and Behavior Change Decision-Making: Postprint

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Abstract

[Purpose/Significance] Through a combined approach of questionnaires and experiments, this study investigates differences in health risk perception and corresponding behavioral change decision-making among individuals at various stages of the health behavior change process after receiving differently framed messages, identifies which types of information more effectively enhance risk perception and facilitate behavioral change decision formation among individuals at different stages, and provides a foundation for subsequent longitudinal information interventions aimed at unhealthy behavior change. [Methods/Process] Based on a comprehensive theoretical model proposed in prior research, this study selects regular breakfast consumption as a specific case study and conducts a cross-sectional investigation of participants using a self-designed questionnaire. Through statistical analysis of the obtained data, statistically significant results are further discussed to derive feasible intervention recommendations. [Results/Conclusion] In the early stages of health behavior change (pre-contemplation and contemplation stages), negatively framed messages are more effective in enhancing individuals' risk perception and thereby facilitating behavioral change decision formation; however, in the middle and later stages (preparation and action stages), message framing no longer produces differential effects on the degree of risk perception enhancement, while positively framed messages can promote behavioral change decisions through significant enhancement of self-efficacy. Message framing did not exert significant effects on individuals in the final stage of health behavior change (maintenance stage).

Full Text

The Influence of Message Framing on Health Risk Perception and Decision-Making in Health Behavior Change

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Abstract:
[**Purpose/Significance**] Through a combined survey and experimental approach, this study investigates how individuals at different stages of the health behavior change process respond to differently framed information, examining variations in health risk perception and corresponding behavior change decisions. The aim is to identify which types of information most effectively enhance risk awareness and facilitate decision-making for individuals at various change stages, providing a basis for longitudinal information interventions targeting adverse behavior change. [**Method/Process**] Based on a comprehensive theoretical model developed in prior research, we selected regular breakfast consumption as a specific case study and conducted a cross-sectional investigation using a self-designed questionnaire. Statistical analysis of the collected data was performed, with statistically significant results further discussed to derive feasible intervention recommendations. [**Result/Conclusion**] In the early stages of health behavior change (precontemplation and contemplation), negatively framed information is more effective in enhancing risk perception and promoting behavior change decisions. In the middle-to-late stages (preparation and action), message framing no longer produces differential effects on risk perception enhancement; however, positively framed information significantly promotes self-efficacy, thereby facilitating behavior change decisions. Message framing showed no significant effect on individuals in the final stage (maintenance) of health behavior change.

Keywords: information intervention; framing effect; health risk perception; health behavior change decision

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In recent years, societal and national healthcare departments have gradually shifted their focus from passive post-disease treatment to disease prevention through the promotion of healthy lifestyles. Effectively changing adverse behaviors and cultivating good habits has become a research hotspot due to its significant importance for improving quality of life. Concurrently, with the proliferation of information in modern society, external information increasingly influences individuals' cognition of relevant matters, thereby promoting corresponding decisions and behavior changes. Individuals' subjective perceptions and judgments regarding various factors, activities, and diseases that affect

physical and mental health constitute their health risk perception, which serves as a crucial metric in their decision-making calculus for behavior change.

Research on the relationship between information and health behavior has not only demonstrated that exposure to health information can promote corresponding health behaviors, but has also shown that attributes beyond content can influence individual health behavior. For instance, the frequency of obtaining physical activity information positively correlates with aerobic or sustained training behavior, and different message framings exert varying influences on the effort levels of college students' health behaviors. These findings indicate that current research has begun to examine how more nuanced aspects of information, beyond content, affect individual cognition during the health behavior change process.

Comprehensive reviews of existing research reveal that studies on message framing typically employ one-time cross-sectional surveys and treat attitude and intention changes as the ultimate impacts of message framing. Such approaches overlook the widely accepted view in academia that health behavior change constitutes a continuous process, failing to differentiate research subjects according to their longitudinal change stages. This may prevent the full manifestation of message framing's actual effects on health behavior change, thereby affecting researchers' evaluation of the effectiveness of applying message framing to health interventions. Building on existing research, this study attempts systematic theoretical exploration and cross-sectional investigation of message framing's influence on individual health behavior change, aiming to identify which framed information individuals at different change stages are more sensitive to, thereby providing guidance for subsequent longitudinal intervention studies.

2 Theoretical Foundation

2.1 Message Framing and Framing Effects

The concept of message framing in this study originates from the phenomenon of framing effects, which refers to cognitive biases and differential decision tendencies resulting from different descriptions of logically equivalent information. Framing effects have been confirmed across multiple domains and manifest in various types. Since health information typically emphasizes specific consequences of behaviors, target framing effects predominate in this context. Target framing describes the differential impacts of information emphasizing the benefits of performing (or abstaining from) a behavior (positive framing) versus information emphasizing the losses from not performing (or not abstaining from) a behavior (negative framing). Although both types can enhance individual awareness of an issue, they do so to different degrees, leading to different behavioral decisions. In specific contexts, one framing may be more effective than the other in prompting desired behavioral decisions. Using regular eating as an example, information describing the benefits of regular eating habits constitutes positive framing, while information describing the adverse consequences

of irregular eating constitutes negative framing.

While research shows that simple message framing can lead to behavioral changes lasting weeks or even months, existing health message framing studies have focused primarily on stable individual traits such as psychological characteristics and cultural backgrounds. The behaviors examined have mostly involved one-time medical actions such as disease screening, vaccination, and clinic appointments. Some studies have attempted to use message framing in doctor-patient communication to enhance breastfeeding mothers' self-efficacy or reduce patients' psychological burden regarding side effects. However, less attention has been paid to behaviors requiring long-term daily maintenance. Among the few studies on such behaviors, such as J.A. Updegraff's team examining flossing among Americans and G.J. Debruin's study on mouthwash use among Dutch populations, none have considered whether individual changes during the behavior change process affect framing effects. Moreover, most studies continue to use behavioral intention as the measure of decision differences caused by framing effects, with cross-sectional surveys remaining the dominant research method.

The authors have conducted preliminary explorations of message framing effects in the health behavior change process, particularly by integrating the Transtheoretical Model and Protection Motivation Theory to propose a conceptual model of message framing effects for different stages of health behavior change. This study empirically validates part of this model to clarify how message framing affects risk perception and decision-making among individuals at different stages of health behavior change, thereby providing specific and feasible recommendations for subsequent longitudinal health behavior change interventions.

2.2 Integration of Health Behavior Change Theories

This study posits that in the context of health behavior change, individuals continuously weigh pros and cons as the process unfolds. Since individuals at different stages possess varying levels of pre-existing cognition about behavioral outcomes, the impact of newly introduced framed information differs accordingly, leading to different decision tendencies. Consequently, we previously proposed a conceptual model of message framing effects during health behavior change, integrating core ideas from two mainstream models: the Transtheoretical Model and Protection Motivation Theory.

The Transtheoretical Model conceptualizes individual health behavior change as a complex, gradual, and dynamic process, typically divided into five stages: precontemplation, contemplation, preparation, action, and maintenance. This theory also posits that stage transitions and cognitive changes are continuously influenced by decision-making and self-efficacy, with behavior modification essentially representing a decision-making process.

Protection Motivation Theory suggests that during health behavior change, individuals evaluate both adverse behaviors and ongoing changes across seven

dimensions. Internal rewards (self-satisfaction or intrinsic positive feelings experienced when engaging in a specific activity) and external rewards (factors from peers, family, or other social groups that reinforce behavior), along with response costs (costs incurred to adopt protective behaviors or overcome adverse behaviors), negatively impact behavior change. Conversely, perceptions of threat severity (judgments about the degree of harm a behavior may cause), susceptibility (judgments about the likelihood of experiencing consequences from adverse behaviors), response efficacy (judgments about whether protective actions will be effective), and self-efficacy (subjective feelings about one's ability to adopt protective behaviors) positively influence behavior change.

The message framing effects model during health behavior change utilizes the Transtheoretical Model's stages to represent behavioral progression. While individuals may not necessarily develop through these stages sequentially, transitions between adjacent stages are most common. When in a specific stage, an individual's decisional balance remains relatively stable. When this balance changes, the individual essentially reconsiders whether to remain in the current stage or move forward or backward. The model employs Protection Motivation Theory to elaborate on the internal composition of decisional balance, yielding a generalized decisional balance. Compared to the original decisional balance containing only two dimensions (perceived pros and cons of behavior change), this generalized version includes Protection Motivation Theory's seven dimensions. Perceived threat severity and susceptibility overlap with two dimensions of health risk perception (severity and likelihood), suggesting that health risk perception partially influences the generalized decisional balance.

2.3 Research Hypotheses

This study proposes that external information disrupts the existing decisional balance. When an individual's cognition of risks associated with adverse behaviors and their own condition no longer aligns with their current behavior change stage, they develop a decision tendency to transition to the most appropriate stage, with adjacent stages typically being the most likely targets. The conceptual model of message framing effects during health behavior change serves as this study's theoretical foundation, guiding the research design. This study aims to use this model to clarify the relationships among factors related to framing effects and the mechanisms underlying these phenomena, helping to identify more effective interventions for different individuals.

As shown in Figure 1 [Figure 1: see original paper], this study proposes two hypotheses:

H1: Different framed messages exert different effects on various dimensions within individuals' decisional balance during health behavior change.

H2: The influence of message framing differs for individuals at different stages of health behavior change.

To test these hypotheses, this study sequentially analyzes: (1) the decisional balance of individuals at each change stage and differences between stages; and (2) how positive/negative framed information affects dimensions within individuals' decisional balance and whether these effects differ across change stages. Through this analysis, we can determine which framed information better promotes behavior change among individuals at specific stages.

3 Research Design

3.1 Participants

The participants were first-year undergraduate students without systematic medical education. This selection considered that participants' knowledge reserves might interfere with the degree of influence from framed information. Using college students as research subjects also allowed control of variables affecting personal health behavior change, such as education level, age, and daily schedule differences, thereby establishing a relatively simple analytical model and facilitating statistical analysis. The study employed convenience sampling to examine the common phenomenon of regular breakfast consumption among college students. Participants completed pre- and post-experimental self-administered questionnaires after reading experimental materials at designated times and locations. Incomplete questionnaires and those with obvious random responses were excluded. Ultimately, 695 participants completed the experiment, including 185 males (26.6%) and 510 females (73.4%), with a mean age of 18.71 years (SD = 0.855).

3.2 Experimental Materials

All participants received a set of experimental tools including a pre-questionnaire, framing information materials, and a post-questionnaire. Participants first completed the pre-questionnaire based on their own situations, then were given adequate time to read the framing information materials before completing the post-questionnaire. The pre-questionnaire included stage of change items and a decisional balance questionnaire. The framing information materials consisted of a reading passage that had been framed to emphasize either the benefits of eating breakfast on time (positive framing) or the harms of not eating breakfast on time (negative framing). The two versions contained no logical differences; participants were divided into positive and negative groups based on which version they read. The post-questionnaire included the decisional balance questionnaire to examine changes in decision tendencies after reading the relevant information.

The questionnaires were self-developed for the "eating breakfast on time" context and underwent pre-testing and reliability and validity testing as per convention.

(1) Stage of Change. Given that eating breakfast on time is a relatively distinguishable behavior, this section was simplified to a single item for par-

ticipants to subjectively identify their current stage. Stage classifications were adapted from Li Guiling's health behavior change stages: "I have no intention of trying to eat breakfast on time within the next 6 months" (precontemplation); "I intend to start trying to eat breakfast on time within the next 6 months" (contemplation); "I plan to start trying to eat breakfast on time within the next 30 days" (preparation); "I only started eating breakfast on time within the last 6 months" (action); and "I have been eating breakfast on time for more than 6 months" (maintenance).

(2) Decisional Balance Questionnaire. This self-developed questionnaire contained 20 items adapted from Protection Motivation Theory's dimensions for the breakfast-eating context. Each item used a 5-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). The initial questionnaire comprised seven dimensions based on Protection Motivation Theory: perceived "threat severity" (example: "Health problems caused by skipping breakfast will significantly negatively impact my studies and work"), "threat susceptibility" (example: "Skipping breakfast can easily cause health problems for me"), "intrinsic rewards" (example: "Skipping breakfast gives me more time for other things, which makes me happy"), "extrinsic rewards" (example: "Skipping breakfast saves more time in the morning, which others envy"), "response costs" (example: "The time needed for breakfast is an extra burden for me"), "response efficacy" (example: "Eating breakfast can make me more energetic for morning study and work"), and "self-efficacy" (example: "I can still persist in eating breakfast on time even when I am very busy").

Pre-testing validity analysis showed a KMO value of 0.834 and Bartlett's sphericity test chi-square value of 1540.396 ($df = 190$), reaching significance at the 0.001 level. The rotated component matrix extracted four factors, with "threat severity" and "threat susceptibility" merging into a factor named "perceived threat," representing individuals' primary health risk cognition in the breakfast-skipping context. "Intrinsic rewards," "extrinsic rewards," and "response costs" also merged into a factor named "response resistance," representing various factors hindering regular breakfast consumption. The remaining dimensions retained their original names and meanings. Thus, the final decisional balance comprised four dimensions: "perceived threat," "response resistance," "response efficacy," and "self-efficacy." Among these, "perceived threat," "response efficacy," and "self-efficacy" are positive factors promoting decisions toward health behavior change, while "response resistance" is a negative factor inhibiting such decisions. Reliability analysis showed Cronbach's α values for each dimension and the overall scale as presented in Table 1 , all within acceptable ranges, indicating good internal consistency and measurement reliability.

The experimental materials were adapted from a blog post titled "What are the harms of skipping breakfast? How should a healthy breakfast be eaten?" on "Dingxiang Doctor" [26]. The content was reorganized to uniformly frame information describing the consequences of eating or not eating breakfast. For example, the original statement "Eating breakfast ensures morning study and

work" (positive framing) was changed in the negative framing version to "Skipping breakfast hinders morning study and work," while the original "Skipping breakfast may even lead to obesity" (negative framing) was changed in the positive framing version to "Eating breakfast may even help maintain a moderate figure." Other information remained unchanged. The final two versions of the promotional materials shared the same logical meaning but differed in framing type, with one emphasizing the benefits of eating breakfast on time and the other emphasizing the harms of not eating breakfast on time.

4 Research Results

4.1 Sample Distribution

The stage distribution of the sample was as follows: precontemplation (n = 94, 13.5%), contemplation (n = 45, 6.5%), preparation (n = 128, 18.4%), action (n = 109, 15.7%), and maintenance (n = 319, 45.9%), as shown in Table 2 .

Table 2 Distribution of Participants Across Stages and Framing Conditions (Unit: persons)

Framing Type	Precontemplation	Contemplation	Preparation	Action	Maintenance	Total

4.2 Decisional Balance Across Stages

4.2.1 Descriptive Statistics and ANOVA Descriptive statistics and ANOVA were conducted on pre-questionnaire data in the natural state without framing intervention. As shown in Table 3 , participants were grouped by stage of change for ANOVA on the pre-questionnaire. Results showed that for the four dependent variables—"perceived threat," "response resistance," "response efficacy," and "self-efficacy"—the overall F-values were 39.309 ($P = 0.000 < 0.05$), 93.046 ($P = 0.000 < 0.05$), 23.864 ($P = 0.000 < 0.05$), and 188.437 ($P = 0.000 < 0.05$), respectively, all reaching significance and rejecting the null hypothesis. This indicates that individuals at different change stages exhibit significant differences across these four decisional balance dimensions.

Table 3 Decisional Balance of Individuals at Different Change Stages

Decisional Balance Dimension	Stage	Mean ± SD	F-value	P-value
Perceived Threat	1	13.65 ± 3.68	39.309	0.000
	2	18.18 ± 3.88		
	3	18.85 ± 3.87		
	4	19.06 ± 3.38		
	5	18.66 ± 3.67		
Response Resistance	1	18.05 ± 4.07	93.046	0.000

Decisional Balance Dimension	Stage	Mean ± SD	F-value	P-value
	2	14.14 ± 4.18		
	3	13.31 ± 3.72		
	4	11.20 ± 3.18		
	5	9.55 ± 2.74		
Response Efficacy	1	7.81 ± 2.96	23.864	0.000
	2	9.92 ± 3.98		
	3	6.64 ± 1.83		
	4	7.20 ± 2.04		
	5	7.83 ± 1.34		
Self-Efficacy	1	8.02 ± 1.35	188.437	0.000
	2	8.35 ± 1.58		
	3	7.89 ± 1.68		
	4	17.01 ± 6.01		
	5	19.00 ± 5.29		

4.2.2 Post-hoc Test Results To further identify which paired groups exhibited significant differences, Scheffe's method was used for post-hoc multiple comparisons. After removing duplicate entries with identical meanings, the results are presented in Table 4 . Since transitions between adjacent stages are most common, dimensions showing significant changes between adjacent stages were summarized as follows: precontemplation to contemplation—perceived threat; contemplation to preparation—response resistance; preparation to action—response resistance and self-efficacy; action to maintenance—response resistance and self-efficacy.

Table 4 Comparison of Decisional Balance Differences Between Change Stages

Decisional Balance Dimension	Stage Pair (I-J)	Mean Difference (I-J)	Std. Error	P-value
Perceived Threat	1-2	-4.529*	0.500	0.000
	1-3	-5.203*	0.518	0.000
	1-4	-5.406*	0.432	0.000
	1-5	-5.006*	0.638	0.000
Response Resistance	2-3	2.935*	0.582	0.000
	2-4	4.588*	0.436	0.000
	2-5	6.333*	0.377	0.000
	3-4	2.108*	0.557	0.007
	3-5	3.761*	0.569	0.000
	4-5	1.653*	0.512	0.004
Self-Efficacy	3-4	-11.017*	0.892	0.000
	3-5	-14.877*	0.771	0.000
	4-5	-2.547*	0.956	0.043

*Mean difference is significant at the 0.05 level.

Additionally, plotting the mean values of each decisional balance factor across stages more clearly illustrates differences in the generalized decisional balance across the behavior change process, as shown in Figure 2 [Figure 2: see original paper]. The figure reveals that from precontemplation through action stages, the average level of perceived threat is higher than in earlier stages, though it slightly decreases in the maintenance stage. Average response resistance decreases sequentially across stages, while response efficacy and self-efficacy increase sequentially. However, which specific stage transitions show significant differences requires statistical testing.

4.3 Effects of Message Framing on Decisional Balance Across Stages

Differences in decision change between groups receiving positive versus negative framing were analyzed by comparing mean differences between post- and pre-questionnaire scores.

4.3.1 Effects on Precontemplation Stage Individuals As shown in Table 5 , although the negative framing group showed greater changes than the positive framing group in perceived threat and response resistance, while the positive framing group showed greater changes in response efficacy and self-efficacy, independent samples t-tests revealed that only the difference in perceived threat reached statistical significance (t = -3.826, P = 0.000 < 0.001). This indicates that differently framed messages had significantly different effects on perceived threat changes among precontemplation individuals, with negative framing producing significantly greater increases in perceived threat than positive framing. The effect size was 0.126, indicating a moderate association strength between message framing and perceived threat change.

Table 5 Comparison of Decisional Balance Changes in Precontemplation Stage Individuals Exposed to Different Framing Conditions

Decisional Balance Dimension	Framing	Mean ± SD	t-value	P-value	Effect Size
Perceived Threat Change	Negative	2.08 ± 3.02	-3.826	0.000	0.126
	Positive	-1.33 ± 2.61			
Response Resistance Change	Negative	0.58 ± 1.65	0.733	0.466	0.006
	Positive	-1.81 ± 3.58			
Response Efficacy Change	Negative	1.80 ± 4.02	1.175	0.243	0.015
	Positive	0.13 ± 1.93			
Self-Efficacy Change	Negative	1.76 ± 4.19	0.047	0.962	0.000
	Positive	1.17 ± 3.50			

4.3.2 Effects on Contemplation Stage Individuals As shown in Table 6 , although the pattern of differences between framing conditions was similar

to that observed in the precontemplation stage, independent samples t-tests revealed that only perceived threat differences reached statistical significance (t = -2.504, P = 0.016 < 0.05). This indicates that differently framed messages had significantly different effects on perceived threat changes among contemplation individuals, with negative framing producing significantly greater increases in perceived threat than positive framing. The effect size was 0.127, indicating a moderate association strength.

Table 6 Comparison of Decisional Balance Changes in Contemplation Stage Individuals Exposed to Different Framing Conditions

Decisional Balance Dimension	Framing	Mean ± SD	t-value	P-value	Effect Size
Perceived Threat Change	Negative	1.50 ± 3.16	-2.504	0.016	0.127
	Positive	-0.67 ± 2.56			
Response Resistance Change	Negative	-2.04 ± 3.67	0.609	0.546	0.009
	Positive	-1.43 ± 2.99			
Response Efficacy Change	Negative	0.14 ± 1.49	-0.611	0.545	0.009
	Positive	0.46 ± 1.91			
Self-Efficacy Change	Negative	0.90 ± 6.62	-0.184	0.855	0.001
	Positive	1.21 ± 4.36			

4.3.3 Effects on Preparation Stage Individuals As shown in Table 7 , independent samples t-tests revealed that only self-efficacy differences reached statistical significance (t = 3.944, P = 0.000 < 0.001). This indicates that differently framed messages had significantly different effects on self-efficacy changes among preparation stage individuals, with positive framing producing significantly greater increases in self-efficacy than negative framing. The effect size was 0.110, indicating a moderate association strength.

Table 7 Comparison of Decisional Balance Changes in Preparation Stage Individuals Exposed to Different Framing Conditions

Decisional Balance Dimension	Framing	Mean ± SD	t-value	P-value	Effect Size
Perceived Threat Change	Negative	0.33 ± 2.76	-0.742	0.459	0.004
	Positive	0.72 ± 3.13			
Response Resistance Change	Negative	-0.85 ± 3.41	0.357	0.722	0.001
	Positive	-1.06 ± 3.17			
Response Efficacy Change	Negative	0.36 ± 1.38	0.920	0.359	0.007
	Positive	0.15 ± 1.22			
Self-Efficacy Change	Negative	2.49 ± 3.37	3.944	0.000	0.110
	Positive	1.19 ± 2.88			

4.3.4 Effects on Action Stage Individuals As shown in Table 8 , independent samples t-tests revealed that only self-efficacy differences reached statistical

significance ($t = 2.173$, $P = 0.032 < 0.05$). This indicates that differently framed messages had significantly different effects on self-efficacy changes among action stage individuals, with positive framing producing significantly greater increases in self-efficacy than negative framing. The effect size was 0.042, indicating a low association strength.

Table 8 Comparison of Decisional Balance Changes in Action Stage Individuals Exposed to Different Framing Conditions

Decisional Balance Dimension	Framing	Mean ± SD	t-value	P-value	Effect Size
Perceived Threat Change	Negative	0.08 ± 2.05	-0.017	0.987	0.000
	Positive	0.09 ± 2.75			
Response Resistance Change	Negative	-0.40 ± 1.96	-1.812	0.073	0.029
	Positive	-0.02 ± 1.05			
Response Efficacy Change	Negative	0.36 ± 1.15	2.173	0.032	0.042
	Positive	1.19 ± 2.88			
Self-Efficacy Change	Negative	1.17 ± 3.50	2.173	0.032	0.042
	Positive	2.49 ± 3.37			

4.3.5 Effects on Maintenance Stage Individuals As shown in Table 9 , independent samples t-tests revealed that none of the differences reached statistical significance, indicating that differently framed messages did not significantly affect decisional balance changes among maintenance stage individuals. Effect sizes were not calculated.

Table 9 Comparison of Decisional Balance Changes in Maintenance Stage Individuals Exposed to Different Framing Conditions

Decisional Balance Dimension	Framing	N	Mean ± SD	t-value	P-value
Perceived Threat Change	Negative	159	0.76 ± 2.81	-1.195	0.233
	Positive	160	1.17 ± 3.21		
Response Resistance Change	Negative	159	-0.05 ± 2.41	-0.529	0.597
	Positive	160	0.09 ± 2.17		
Response Efficacy Change	Negative	159	0.03 ± 1.15	-0.336	0.737
	Positive	160	0.08 ± 1.48		
Self-Efficacy Change	Negative	159	0.40 ± 2.78	0.467	0.641
	Positive	160	0.62 ± 2.35		

5 Discussion

The results demonstrate that individuals at different stages of the health behavior change process exhibit significant differences in decisional balance dimension scores, and that differently framed messages exert differential effects on decision

tendencies among individuals at specific change stages. Moreover, framing effects vary significantly across individuals at different change stages.

For individuals in the health behavior change process, the general pattern of decisional balance shows that positive factors—response efficacy and self-efficacy—continuously increase as stages progress, while perceived threat initially increases, stabilizes in middle stages, and even slightly decreases in the final stage. The negative factor, response resistance, decreases sequentially. When positive factors increase and negative factors decrease in the decisional balance, individuals' decisions tend toward continuing health behavior change, increasing the likelihood of advancing to the next stage. Conversely, individuals may remain in their current stage for extended periods or even regress to earlier stages.

Comparing adjacent stages reveals patterns in the behavior change process. In earlier transition stages (precontemplation to contemplation), only perceived threat shows significant differences, with other factors changing minimally without statistical significance. This suggests that interventions targeting precontemplation individuals should focus on enhancing perceived threat to help their decisional balance approach that of contemplation stage individuals, thereby promoting stage progression. Similarly, the significant difference between contemplation and preparation stages lies in decreased response resistance, with other factors showing minimal differences, suggesting interventions for contemplation individuals should focus on reducing response resistance. For preparation-to-action and action-to-maintenance transitions, self-efficacy shows significant changes while other factors remain relatively stable, indicating that interventions for preparation and action stage individuals should focus on enhancing self-efficacy.

Comparing pre- and post-questionnaire scores across stages reveals that in early stages (precontemplation and contemplation), the negative framing group showed greater increases in perceived threat than the positive framing group. With no statistically significant differences in the other three factors, negative framing appears to have a greater impact on behavior change decisions in these stages, better facilitating positive behavior change. In middle-to-late stages (preparation and action), the positive framing group showed greater increases in self-efficacy than the negative framing group. With no statistically significant differences in other factors, positive framing appears more influential for behavior change decisions in these stages, better promoting positive behavior change. In the final maintenance stage, no statistically significant differences were observed between framing conditions across all factors, suggesting message framing no longer significantly affects behavior change decisions.

These findings validate the two proposed hypotheses: differently framed messages exert different effects on dimensions within individuals' decisional balance during health behavior change, and these effects differ across change stages. Specifically, negative framing is more effective than positive framing for enhancing health risk perception (primarily perceived threat) among precontemplation and contemplation stage individuals, thereby more effectively influencing deci-

sions. Positive framing is more effective than negative framing for influencing decisions among preparation and action stage individuals, primarily through enhancing self-efficacy. Maintenance stage individuals show no significant differences in response to different framing conditions.

This study demonstrates that different message framings differentially affect health risk perception and decision tendencies across stages of health behavior change. We recommend that health behavior change intervention communication plans provide appropriately framed information tailored to individuals' specific stages: for individuals in early stages, interventions should emphasize negative framing by highlighting adverse consequences of unhealthy behaviors to enhance perceived threat and promote positive behavior change decisions; for individuals in middle-to-late stages, interventions should emphasize positive framing by highlighting benefits of maintaining healthy behaviors to enhance self-efficacy and promote positive behavior change decisions; for individuals in the final maintenance stage, framing differences no longer produce significantly different effects, so communication need not emphasize message framing.

This study has limitations. First, using a relatively homogeneous college student sample effectively controlled variables and avoided uncertainties from excessive individual differences, facilitating data analysis. However, this also prevented examination of how factors such as age and education level influence framing effects. Second, because specific health behavior change information was required, the study could only examine one common behavior among college students (regular breakfast consumption), making it impossible to avoid potential influences from the specific behavior's uniqueness. Therefore, further research incorporating more diverse populations and various types of health behavior changes is needed to generalize these conclusions more broadly.

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Research on the Influence of Message Frame on Health Risk Perception and Decision-Making of Health Behavior Change

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Abstract: [Purpose/significance] We adopted experiment and questionnaire to investigate the difference in the change of health risk perception and health be-

havior change decision of individuals at different stages of the health behavior change process after receiving different framed information, in order to determine which information can more effectively improve their awareness of risks and promote the formation of change decisions, and to provide a basis for the longitudinal information intervention of adverse behavior change in the next step. [Method/process] Based on the theoretical model proposed in the previous study, we selected eating breakfast on time as the special case of the study, and conducted cross-sectional investigation and study on the subjects by using the self-made questionnaire. Finally, through statistical analysis of the obtained data, we further discussed the results with statistical differences and obtained feasible intervention opinions. [Result/conclusion] In the early stages of health behavior change (i.e., the precontemplation and the contemplation), negative frame information more helps individuals to increase risk perception and promote the formation of behavior change decision, and positive framework information more helps individuals to feel tendency of decision-making of entering to the next stage in the mid-late in health behavior change while there is no difference in the impact of the frame on health risk perception (i.e., the preparation and the action). But the individual is not susceptible to the influence of the framed information at end-stage phase of health behavior change (the maintenance).

Keywords: information intervention; framing effect; health risk perception; health behavior change decision

Note: Figure translations are in progress. See original paper for figures.