Avoiding Harm Now, Seeking Benefits in the Future: The Interactive Effect of Goal Framing and Temporal Distance on Vaccine Persuasion Effectiveness

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Abstract

Against the backdrop of the COVID-19 pandemic, how to persuade individuals to receive COVID-19 vaccination has garnered attention from policymakers and researchers. This study investigates, from an approach-avoidance motivation perspective, the effects of different goal frames (positive vs. negative) and temporal distance (present vs. future) on vaccine persuasion effectiveness. Results demonstrate that when messages focus on the present, the 'present-negative' goal frame proves more effective for persuading vaccination; conversely, when messages focus on the future, the 'future-positive' goal frame is more persuasive. The underlying mechanism resides in the stronger avoidance motivation activated by the 'present-negative' goal frame and the stronger approach motivation activated by the 'future-positive' goal frame. Furthermore, pandemic risk additionally moderates the effectiveness of goal frames and temporal distance on vaccine persuasion. This research elucidates the theoretical mechanisms and application boundaries of framing effects from an approach-avoidance motivation perspective, while providing practical guidance for nudging COVID-19 vaccination and future vaccination campaigns, thereby bearing significant scientific value and practical implications.

Full Text

Preamble

Framing effect refers to the phenomenon where different descriptions of identical information influence decision outcomes (Kahneman & Tversky, 1979). Levin et al. (1998) defined three distinct types of framing effects: risky framing, attribute framing, and goal framing. Goal framing, which begins by describing

behavioral consequences, emphasizes how either the positive outcomes of adopting a behavior or the negative outcomes of failing to adopt it influence decision-making. Positive goal framing focuses on potential benefits or gains from a behavior, whereas negative goal framing highlights potential losses (Levin et al., 1998). Regardless of whether the framing is positive or negative, the fundamental purpose is to persuade individuals to act in a particular direction. Consequently, existing research has primarily focused on determining whether positive or negative goal framing proves more persuasive.

As a common non-monetary nudge intervention, framing effects can effectively promote target behaviors while minimizing intervention costs (He et al., 2018), leading to widespread application in communication and behavioral persuasion domains (Gerend & Cullen, 2008). In vaccine persuasion, researchers have examined the impact of goal framing on vaccination uptake (O' Keefe & Nan, 2012), though consensus remains elusive regarding whether positive or negative goal framing proves more effective (Penţa & Băban, 2018).

Some studies suggest that negative goal framing (vs. positive) more effectively persuades vaccination: research has found negative framing more persuasive for COVID-19 vaccination (Peng et al., 2021), MMR vaccination (Abhyankar et al., 2008), and HPV vaccination (Gerend & Cullen, 2008). Conversely, other research indicates that positive goal framing (vs. negative) proves more effective, such as studies showing positive framing better persuades HPV vaccination (Liu et al., 2019) and preventive viral infection vaccines (Broemer, 2004).

Moreover, current research lacks investigation into the underlying mechanisms through which goal framing influences behavioral persuasion. The theoretical explanation for negative framing' s superior persuasiveness primarily draws on loss aversion from Prospect Theory: individuals perceive losses as far more valuable than equivalent gains, making losses more behaviorally persuasive (Kahneman & Tversky, 1979). However, this mechanism cannot explain findings where positive goal framing proves more persuasive for vaccination, necessitating a theoretical integration of these inconsistent results. In this study, we propose that the temporal distance of vaccination consequences influences goal framing effectiveness and further explore the underlying mechanism from an approach-avoidance motivation perspective.

1.2 Temporal Distance in Vaccine Messaging

Vaccine advertisements often involve descriptions of vaccination consequences at different temporal distances—that is, individuals' perceived temporal distance from vaccination consequences (Jiga-Boy et al., 2010). Temporal distance represents a crucial factor affecting how individuals perceive and evaluate events, as people tend to perceive future events more abstractly and present events more concretely (Trope & Liberman, 2010). Additionally, individuals discount the value of future events (temporal discounting), such that present events exert greater influence on behavioral decisions than future events of equal inten-

sity (Chapman, 1996). Therefore, advertisements describing immediate consequences may prove more persuasive than those describing future consequences. Gerend and Cullen (2008) supported this claim, finding that messages emphasizing the "immediate consequences" of alcohol abuse more effectively persuaded adolescents to reduce drinking than those describing "future consequences." However, research also shows that near temporal distance does not always outperform far temporal distance: one study found that when using non-narrative messages, vaccine advertisements emphasizing "future outcomes" proved more persuasive than those emphasizing "present outcomes" (Kim & Nan, 2019).

More relevantly, temporal distance influences evaluations of positive/negative events (e.g., Trope & Liberman, 2010). Although people are more sensitive to negative events (Gal & Rucker, 2018), the emotional pain from negative events diminishes when thinking from a future temporal perspective (Bruehlman-Senecal & Ayduk, 2015). Furthermore, when considering distant future events, individuals focus more on positive aspects such as pros and desirability, whereas when considering near-term events, they focus more on negative aspects such as cons and feasibility (Eyal et al., 2004; Trope & Liberman, 2010). Therefore, we propose that different goal framings (positive vs. negative) and temporal distances (present vs. future) interactively influence vaccine advertisement effectiveness, with negative goal framing better matching near temporal distance and positive goal framing better matching far temporal distance.

H1: In the "present" temporal dimension, negative (vs. positive) goal framing more effectively persuades vaccination; in the "future" temporal dimension, positive (vs. negative) goal framing more effectively persuades vaccination.

1.3 Approach-Avoidance Motivation

Approach and avoidance motivation represent two fundamental forms of motivation, constituting the core mechanism through which humans seek benefits and avoid harm to adapt to their environment (Liu & Gao, 2012). This principle traces back to the ancient Greek philosopher Democritus (460–370 BCE), who proposed the pleasure principle: pursuing pleasure and avoiding pain constitute the core intrinsic drivers of human behavior, with the combination of both motivations ensuring successful environmental adaptation (Elliot, 2013).

The distinction between approach and avoidance motivation lies primarily in stimulus valence and motivational direction (Elliot, 1999). Approach motivation refers to behavioral energy elicited by or directed toward positive stimuli, whereas avoidance motivation refers to behavioral energy elicited by or directed away from negative stimuli (Zhang et al., 2012; Elliot, 2013).

Both approach and avoidance motivation can be triggered directly by environmental stimuli (e.g., automatic eye-closing in response to danger) or by stimuli containing positive/negative valence (Elliot, 1999). Positive-valence stimuli trigger approach motivation, while negative-valence stimuli trigger avoidance motivation (Krieglmeyer et al., 2013). Re-examining the definition of goal framing

reveals that it inherently contains positive and negative valence: emphasizing either positive consequences of adopting a behavior or negative consequences of failing to adopt it. Therefore, positive goal framing may persuade behavior by reinforcing the positive consequences of "action,"thereby eliciting approach toward that action; negative goal framing may persuade by reinforcing the negative consequences of "inaction," thereby eliciting avoidance of inaction. In this study, to persuade vaccination, positive goal framing emphasizes vaccination benefits, potentially triggering approach toward vaccination and biasing behavior toward vaccination; negative goal framing emphasizes the harms of not vaccinating, potentially triggering avoidance of non-vaccination and similarly biasing behavior toward vaccination. Thus, people may "approach vaccination for benefits" or "avoid vaccination to prevent harm."

Figure 1 Motivational and behavioral explanations of positive/negative goal framing in vaccine persuasion

However, the degree to which positive and negative stimuli can activate approach/avoidance motivation may depend on contextual factors (Krieglmeyer et al., 2010). This study proposes that positive/negative goal framing may elicit different intensities of approach-avoidance motivation across temporal distances. Loss aversion theory suggests that negative stimuli elicit stronger physiological and psychological responses than positive stimuli (Taylor, 1991), meaning equivalent negative goal framing may trigger stronger avoidance motivation than positive goal framing triggers approach motivation. However, research shows loss aversion exists only in the "present" temporal dimension and disappears in the "future" dimension (Cheng & He, 2017), reflecting insensitivity to future losses. Additionally, studies show individuals avoid future negative events (preferring to pay more to delay learning about them) and approach future positive events (preferring to pay to learn about positive future information sooner) (Ganguly & Tasoff, 2017). Meanwhile, positive future expectations often better motivate individuals and promote behavior (Oettingen & Mayer, 2002), as captured by the phrase "painting a rosy picture." Based on this, we propose:

H2: Negative goal framing elicits stronger avoidance motivation in the present (vs. future) temporal dimension; positive goal framing elicits stronger approach motivation in the future (vs. present) temporal dimension—i.e., "avoid harm now, approach benefits later."

Motivation represents the psychological tendency or internal drive that initiates and maintains organismic action while directing it toward a goal, with motivational intensity predicting corresponding behavioral likelihood (Elliot, 2013). Therefore, the asymmetrical intensity of approach-avoidance motivation across temporal dimensions may underlie differences in positive/negative goal framing effectiveness at different temporal distances.

H3: In the present (future) temporal dimension, avoidance (approach) motivation mediates the effect of different goal framings on vaccine persuasion effectiveness.

1.4 Perceived Risk

Infection risk represents an important factor influencing individual health behaviors, with increased risk promoting preventive health behaviors (Chapman & Coups, 2006). COVID-19 vaccine research also shows that during severe outbreak periods with lockdowns, individuals exhibit higher vaccination intentions (Caserotti et al., 2021). More relevantly, risk influences goal framing effectiveness: Park (2012) found that when perceived risk was high (vs. low), negative (vs. positive) goal framing proved more persuasive; however, other research found that high (vs. low) perceived risk made positive (vs. negative) goal framing more persuasive for vaccination (Nan et al., 2016). Thus, perceived pandemic risk may affect goal framing effectiveness across temporal distances.

When pandemic risk increases, individuals perceive it as a substantial external and psychological threat (Ye et al., 2020). As core mechanisms for environmental adaptation (Elliot, 2013), approach and avoidance motivation may be automatically triggered by high pandemic threat to ensure adaptation, with both protection-seeking and infection-avoidance motivations potentially increasing during high-risk periods. Such adaptive motivations are often automatic, rapid, and focused on addressing immediate challenges (Neumann et al., 2003), meaning individuals under high pandemic risk likely possess stronger present-focused approach and harm-avoidance motivations.

According to the compatibility hypothesis, approach motivation aligns with positive stimuli and more readily triggers approach behavior, while avoidance motivation aligns with negative stimuli and more readily triggers avoidance behavior (Krpan & Schnall, 2014). For example, individuals primed with avoidance motivation can more quickly push negative (vs. positive) stimuli away (Neumann et al., 2003), while those primed with approach motivation consume more delicious cookies (Förster, 2003). Therefore, under high pandemic risk, when present approach and harm-avoidance motivations increase, both present-positive and present-negative goal framings become compatible with these motivations and equally persuasive, eliminating differences in their effectiveness. In contrast, future-oriented positive/negative goal framings show poorer compatibility with pandemic-induced present approach-avoidance motivations, maintaining the superior persuasiveness of positive over negative future framing.

H4: High pandemic risk changes goal framing effectiveness across temporal distances. In the present temporal dimension, positive and negative goal framings show no difference in vaccine persuasion; in the future temporal dimension, positive (vs. negative) goal framing remains more persuasive.

Study 1

2.1 Purpose

Study 1 primarily aimed to preliminarily test the effects of goal framing (positive vs. negative) and temporal distance (present vs. future) on vaccine persuasion.

Specifically, we hypothesized that negative goal framing would prove more persuasive in the present temporal dimension, whereas positive goal framing would be more effective in the future temporal dimension.

2.2 Method

2.2.1 Design and Participants The study employed a 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) between-subjects design. Using G*Power 3.1, we calculated the required sample size for detecting a medium effect size (f = 0.25) for the 2$×$2 interaction at 80% power, which yielded a minimum of 128 participants (Faul et al., 2007). We recruited 302 participants through Wenjuanxing, each receiving 2 RMB compensation. Seven participants failed attention checks and were excluded, leaving a final sample of 295 participants (48.8% female,* M*age = 25.92 ± 5.35). All participants provided informed consent and could refuse participation or withdraw at any time.

2.2.2 Procedure Participants first answered a screening question: "Have you already received the COVID-19 vaccine?" Those who answered "already vaccinated" were automatically terminated. Unvaccinated participants were randomly assigned to one of four experimental conditions (present-positive: $n = 74$; present-negative: $n = 73$; future-positive: $n = 77$; future-negative: $n = 71$). Participants first read a brief popular science article about COVID-19 vaccines, then viewed vaccination messages under their assigned condition and reported their vaccination intention. Finally, control variables and demographic information were measured.

2.2.3 Measures Goal Framing and Temporal Distance Manipulation: We collected common COVID-19 vaccine slogans and adapted them to our positive/negative and present/future dimensions, pairing them with images (e.g., present-positive: "Get vaccinated to build immunity barriers, resume previous life, and regain hope of embracing loved ones"; future-negative: "If you don't get vaccinated, in the near future, lack of immunity will expose you to COVID-19 infection and travel restrictions").

A pretest with 95 participants (74.1% female, *M*age = 24.00 ± 6.42) evaluated the positive/negative valence ("Do you think the scenario described in this slogan is 'positive' or 'negative' ?" 1 = very negative, 7 = very positive) and present/future dimension ("Do you think the temporal distance of the scenario described is 'near' or 'far' ?" 1 = very near, 7 = very far). Results showed that positive framing was rated significantly higher than negative framing (*M*positive = 5.75; *M*negative = 2.77, $F(1, 94) = 418.51$, $p < 0.001$, $p^2 = 0.817$, 90% CI [0.761, 0.851]). For temporal distance, "present" scenarios were perceived as significantly nearer than "future" scenarios (*M*present = 2.57, *M*future = 4.57; $F(1, 94) = 183.18$, $p < 0.001$, $p^2 = 0.66$, 90% CI [0.566, 0.723]).

Vaccination Intention: Participants responded to "Assuming vaccination services are available in your community, how willing are you to get vaccinated?" (1 = very unwilling, 7 = very willing), with higher scores indicating stronger vaccination intention.

Control Variables: We measured individual approach-avoidance trait motivation using the Behavioral Activation & Inhibition System Scale (BAS & BIS Scale; Carver & White, 1994). The 20-item scale includes 7 items measuring avoidance motivation (BIS scale, $\alpha = 0.74$) and 13 items measuring approach motivation (BAS scale, $\alpha = 0.79$). Participants rated each item on a 1–7 scale (1 = very uncharacteristic, 7 = very characteristic).

2.3 Results

A 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) ANOVA on vaccination intention revealed non-significant main effects of temporal distance and goal framing (Fs < 0.28, ps > 0.600). However, the interaction was significant ($F(1, 291) = 12.25$, $p = 0.001$, $p^2 = 0.040$, 90% CI [0.011, 0.083]). Simple effects analysis showed that in the present temporal dimension, vaccination intention was significantly lower under positive than negative framing (Mpositive = 5.41, Mnegative = 5.85, $F(1, 291) = 4.42$, $p = 0.036$, $p^2 = 0.015$, 90% CI [0.001, 0.046]). In contrast, in the future temporal dimension, vaccination intention was significantly higher under positive than negative framing (Mpositive = 5.90, Mnegative = 5.30, $F(1, 291) = 8.12$, $p = 0.005$, $p^2 = 0.027$, 90% CI [0.005, 0.065]) (see Figure 2).

Figure 2 Vaccination intention across experimental conditions

2.4 Discussion

Study 1 preliminarily supported our main hypothesis: positive/negative goal framing effectiveness is moderated by temporal distance (H1). In the "present" temporal dimension, negative goal framing proved more persuasive for vaccination, whereas in the "future" dimension, positive goal framing showed higher persuasiveness.

Study 2

3.1 Purpose

Study 2 aimed to: (1) provide robustness tests using different vaccine messages to replicate the framing × temporal distance effect and add behavioral measures to verify robustness across both intention and behavior; (2) test the mediating roles of approach and avoidance motivation (H2 & H3); and (3) rule out alternative mechanisms. Research suggests positive emotions increase future focus while negative emotions increase present focus (Gardner et al., 2014), making differential emotions evoked by positive/negative framing a potential alternative explanation. Additionally, the effect might arise because positive framing

matches high-level construal in future conditions while negative framing matches low-level construal in present conditions (White et al., 2011). Therefore, Study 2 measured positive/negative emotions and construal level to rule out these alternatives.

3.2 Method

3.2.1 Design and Participants The study used a 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) between-subjects design. We recruited 300 participants through Wenjuanxing, each receiving 2 RMB compensation. Eight participants failed attention checks, leaving 292 participants (49.2% female, Mage = 26.45 ± 6.65) for analysis.

3.2.2 Procedure Participants first answered the vaccination screening question, then were randomly assigned to experimental conditions. They read a brief COVID-19 vaccine article and promotional message, then reported their approach-avoidance motivation, positive/negative emotions, and construal level, followed by vaccination intention and appointment behavior, and finally control variables and demographics.

3.2.3 Measures Goal Framing and Temporal Distance Manipulation: The manipulation logic (creating different vaccination scenarios) mirrored Study 1 but used different message content (e.g., present-positive: "Get vaccinated to gain protection and immunity now, enjoy unrestricted travel" ; future-negative: "If you don' t get vaccinated, when borders open in the future, lack of immunity will expose you to travel restrictions and COVID-19 infection").

A pretest with 95 participants (74.1% female, Mage = 24.00 ± 6.42) evaluated the positive/negative valence and temporal distance (same measures as Study 1). Results showed significant differences in both valence (Mpositive = 5.88; Mnegative = 2.73, $F(1, 94) = 446.91$, $p < 0.001$, $p^2 = 0.83$, 90% CI [0.773, 0.858]) and temporal distance (Mpresent = 2.70, Mfuture = 4.43; $F(1, 94) = 98.66$, $p < 0.001$, $p^2 = 0.512$, 90% CI [0.393, 0.597]).

Mediators: Approach-Avoidance Motivation: Adapted from Anderson and Berdahl (2002), we used a 7-point scale to measure participants' focus on "gaining positive consequences" (to what extent do you focus on positive aspects of vaccination, such as peace of mind?) and "preventing negative consequences" (to what extent do you focus on negative aspects of not vaccinating, such as COVID-19 infection?) (1 = not at all focused, 7 = very focused). Higher scores indicated stronger approach/avoidance motivation.

Alternative Mediators: We measured positive/negative emotions using the Emotion Report Form (Li et al., 2020). Participants rated the intensity of six emotions on a 1-7 scale (1 = not at all intense, 7 = very intense). Positive emotions included "happy" and "pleased" ($\alpha = 0.94$); negative emotions included "sad," "anxious," "annoyed," and "afraid" ($\alpha = 0.93$).

Construal level was measured using an adapted Behavioral Identification Form (Aggarwal & Zhao, 2015; Van Kerckhove et al., 2015). Participants answered "Please select the first words that come to mind when thinking about 'getting vaccinated' " and chose from words representing different construal levels. Low-level words included "vaccine packaging, manufacturer, injection site, appointment," while high-level words included "risk, gaining immunity, peace of mind, eliminating COVID-19."High-level choices were scored as "1"and low-level as "0," with final scores calculated as low-level minus high-level (0–4 points).

Vaccination Intention and Behavior: Vaccination intention was measured identically to Study 1. For behavior, participants were told: "Our research team provides vaccination appointment information with available time slots. You can directly browse available times and schedule an appointment based on your preference." They then chose whether to browse available times (Option 1: Not now, Option 2: Browse available times). Selecting "browse" presented a list of available time slots (e.g., tomorrow 08:30–12:00) to enhance realism. We reasoned that choosing to browse appointment times reflected actual vaccination willingness. Participants were later informed that the appointment was virtual and to contact their community or hospital for real vaccination.

Control Variables: Same as Study 1, measuring trait approach-avoidance motivation (avoidance: $\alpha = 0.74$; approach: $\alpha = 0.71$).

3.3 Results

A 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) ANOVA on vaccination intention revealed non-significant main effects (Fs < 0.04, ps > 0.878) but a significant interaction ($F(1, 288) = 9.53$, $p = 0.002$, $\mathrm{p}^2 = 0.032$, 90% CI [0.007, 0.072]). Simple effects analysis (Figure 3) showed that in the present dimension, negative framing produced higher intention than positive framing ($F(1, 288) = 4.22$, $p = 0.041$, $\mathrm{p}^2 = 0.014$, 90% CI [0.000, 0.045]), whereas in the future dimension, positive framing produced higher intention than negative framing ($F(1, 288) = 5.39$, $p = 0.021$, $\mathrm{p}^2 = 0.018$, 90% CI [0.002, 0.052]).

Figure 3 Effects of temporal distance and goal framing on vaccination intention in Study 2

For vaccination behavior, "not now" was coded as "0" and "browse appointment times" as "1." Logistic regression showed a significant interaction between goal framing and temporal distance ($b = -1.73$, $p = 0.002$). Specifically (Table 1), in the present dimension, negative framing yielded significantly more appointments than positive framing ($^2(1, 139) = 4.48$, $p = 0.034$); in the future dimension, positive framing yielded significantly more appointments than negative framing ($^2(1, 153) = 5.25$, $p = 0.022$).

Table 1 Vaccination numbers, intention, and approach-avoidance motivation across conditions (N = 292)

Condition	Vaccination Intention (M±SD)	Appointment Rate	Approach Motivation (M±SD)	Avoidance Motivation (M±SD)
Present-Positive	74	5.79$±1.32	42(67.74±1.20	6.13±0.78
Present−Negative	73	6.18±0.88	64(83.12±1.08	6.17±0.86
Future−Positive	77	6.12±0.84	64(83.12±0.89	5.75±1.22
Future−Negative	71	5.70±1.37	51(67.11±1.08	5.99±$1.08

To test the mediating role of approach-avoidance motivation, we conducted separate 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) ANOVAs on avoidance and approach motivation. For approach motivation, main effects were non-significant (Fs < 0.22, ps > 0.722), but the interaction was significant ($F(1, 288) = 4.12$, $p = 0.043$, $p^2 = 0.014$, 90% CI [0.000, 0.045]). Simple effects showed no difference between present-positive and present-negative conditions ($F(1, 288) = 0.56$, $p = 0.457$), but future-positive showed significantly higher approach motivation than future-negative ($F(1, 288) = 4.68$, $p = 0.031$, $p^2 = 0.016$, 90% CI [0.001, 0.048]).

For avoidance motivation, main effects were non-significant (Fs < 0.18, ps > 0.745), but the interaction was significant ($F(1, 288) = 5.32$, $p = 0.022$, $p^2 = 0.018$, 90% CI [0.001, 0.051]). Present-negative showed significantly higher avoidance motivation than future-positive ($F(1, 288) = 4.35$, $p = 0.038$, $p^2 = 0.015$, 90% CI [0.000, 0.046]), with no difference between future-positive and future-negative ($F(1, 288) = 1.33$, $p = 0.250$) (see Figure 4). These results indicate that negative framing activated stronger avoidance motivation in present conditions, while positive framing activated stronger approach motivation in future conditions.

Figure 4 Approach (a) and avoidance (b) motivation across temporal distance and goal framing conditions

We coded "present dimension" as "0" and "future dimension" as "1," and "positive goal framing" as "0" and "negative goal framing" as "1." Using PROCESS macro (Model 8, 5000 bootstrap samples), we tested mediated moderation (Hayes, 2017). Avoidance motivation mediated the interaction effect on vaccination intention (β = -0.23, SE = 0.11, Bootstrap 95% CI: [-0.492, -0.049]). Specifically, the indirect effect was significant in the present dimension ($\beta = 0.15$, SE = 0.07, Bootstrap 95% CI: [0.021, 0.322]) but not in the future dimension (β = -0.08, SE = 0.07, Bootstrap 95% CI: [-0.254, 0.047]). Approach motivation also mediated the interaction (β = -0.28, SE = 0.15, Bootstrap 95% CI: [-0.597, -0.013]), but only in the future dimension (β = -0.21, SE = 0.10, Bootstrap 95% CI: [-0.428, -0.042]), not the present ($\beta = 0.08$, SE = 0.11, Bootstrap 95% CI: [-0.130, 0.292]) (see Figure 5). These mediation models remained significant after controlling for trait approach-avoidance motivation and demographics.

Figure 5 Indirect effects of goal framing and temporal distance on vaccination

intention through approach (a) and avoidance (b) motivation

Finally, to rule out alternative mediation by construal level and emotions, we conducted 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) ANOVAs on construal level and positive/negative emotions. No significant main effects or interactions emerged (Fs < 0.67, ps > 0.42). Moreover, positive emotion (β = -0.040, SE = 0.06, Bootstrap 95% CI: [-0.180, 0.073]), negative emotion (β = 0.002, SE = 0.02, Bootstrap 95% CI: [-0.027, 0.058]), and construal level (β = 0.05, SE = 0.05, Bootstrap 95% CI: [-0.037, 0.175]) did not significantly mediate the interaction effect on vaccination intention (Model 8, 5000 bootstrap samples), ruling out these alternative explanations.

3.4 Discussion

Using different materials and adding behavioral measures, Study 2 replicated Study 1' s findings: negative (positive) goal framing proved more persuasive in the present (future) temporal dimension (H1). It also confirmed the underlying mechanism: negative (positive) framing elicited stronger avoidance (approach) motivation in the present (future) dimension—the "avoid harm now, approach benefits later" effect—with approach-avoidance motivation mediating the effects of goal framing and temporal distance on vaccination persuasion (H2 & H3). Study 2 further ruled out competing explanations based on emotions and construal level.

Study 3

4.1 Purpose

Study 2 provided correlational evidence for the mediating role of approach-avoidance motivation. If the effects of goal framing and temporal distance on vaccine persuasion indeed stem from differences in approach and avoidance motivation, experimentally manipulating these motivations should alter the original effects. Therefore, Study 3 manipulated approach-avoidance motivation to provide further causal evidence for the mediation hypothesis.

4.2 Method

4.2.1 Design and Participants Study 3 employed a 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) × 2 (motivation priming: approach vs. avoidance) between-subjects design. Using G*Power, *we calculated a required sample of 237 participants for 80% power to detect a medium effect. We recruited 352 participants through Wenjuanxing, each receiving 5 RMB compensation. Five participants failed attention checks, leaving 347 participants (61% female,* M*age = 29.63 ± 7.98) for analysis.

4.2.2 Procedure Participants were first randomly assigned to approach or avoidance motivation priming conditions and completed manipulation checks. They then read vaccine-related materials, reported vaccination intention and behavior, and finally completed approach-avoidance temperament scales and demographic measures.

4.2.3 Measures **Approach-Avoidance Motivation Priming**: Adapted from Stephan et al. (2014). Approach priming: participants imagined positive consequences of vaccination ("What positive consequences do you expect from getting vaccinated?"). Avoidance priming: participants imagined negative consequences of not vaccinating ("What negative consequences do you want to avoid by not getting vaccinated?"). Participants wrote down three imagined consequences.

Manipulation Check: Adapted from Stephan et al. (2014) using four items: two measuring focus on vaccination' s positive effects ($\alpha = 0.94$; e.g., "I am very concerned about the positive impact vaccination may have on my life") and two measuring focus on non-vaccination' s negative effects ($\alpha = 0.95$; e.g., "I am very concerned about the negative impact not vaccinating may have on my life").

Vaccine Messages: Used the same materials as Study 1, including four conditions: present-positive, present-negative, future-positive, and future-negative.

Vaccination Intention and Behavior: Same as Study 1.

Control Variables: Measured using the Approach & Avoidance Temperament Scale (Elliot & Thrash, 2010), with 12 items: 6 measuring approach motivation ($\alpha = 0.72$) and 6 measuring avoidance motivation ($\alpha = 0.82$).

4.3 Results

Manipulation checks confirmed priming effectiveness. Independent samples t-tests showed that in the approach priming condition, approach motivation was significantly higher than avoidance motivation (Mapproach = 6.13, Mavoidance = 3.63, $t(345) = 25.62$, $p < 0.001$, Cohen' s $d = 2.75$, 95% CI [2.455, 3.044]). In the avoidance priming condition, approach motivation was significantly lower than avoidance motivation (Mapproach = 3.83, Mavoidance = 6.12, $t(345) = -24.14$, $p < 0.001$, Cohen's $d = -2.59$, 95% CI [2.304, 2.876]), confirming successful priming.

A 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) × 2 (motivation priming: approach vs. avoidance) ANOVA on vaccination intention revealed non-significant main effects and three-way interaction (Fs < 0.64, ps > 0.42). However, the two-way interaction between motivation priming and goal framing was significant ($F(1, 339) = 19.87$, $p < 0.001$, $\mathrm{p}^2 = 0.055$, 90% CI [0.022, 0.099]), as was the interaction between temporal distance and goal framing ($F(1, 339) = 12.10$, $p = 0.001$, $\mathrm{p}^2 = 0.035$, 90% CI [0.010, 0.071]).

Simple effects analysis (Figure 6) showed that under approach priming, present-positive and present-negative conditions did not differ ($F(1, 339) = 0.49$, $p = 0.493$), but future-positive yielded significantly higher intention than future-negative ($F(1, 339) = 11.12$, $p = 0.001$, $p^2 = 0.032$, 90% CI [0.008, 0.068]). Under avoidance priming, present-positive yielded significantly lower intention than present-negative (Mpositive = 5.64, Mnegative = 6.37, $F(1, 339) = 20.93$, $p < 0.001$, $p^2 = 0.058$, 90% CI [0.024, 0.103]), but future-positive and future-negative did not differ ($F(1, 339) = 0.08$, $p = 0.780$).

Figure 6 Effects of temporal distance and goal framing on vaccination intention under approach priming (a) and avoidance priming (b)

Table 2 Vaccination intention and behavior across conditions (N = 347)

Condition	Vaccination Intention (M±SD)	Appointment Rate
Approach Priming		
Present-Positive	6.11$±0.71|33(73.33±0.87|33(75.00±0.83|35(81.40%)	0.72|27(64.29±0.69|29(65.91±0.69|36(83.7

For vaccination behavior, chi-square tests showed that under approach priming, appointment rates did not differ between present-positive and present-negative ($^2(1, 89) = 0.03$, $p = 0.857$), but future-positive marginally exceeded future-negative ($^2(1, 85) = 3.15$, $p = 0.076$). Under avoidance priming, present-negative marginally exceeded present-positive ($^2(1, 87) = 3.65$, $p = 0.056$), but future-positive and future-negative did not differ ($^2(1, 86) = 0.28$, $p = 0.596$).

4.4 Discussion

Study 3 demonstrated that approach priming eliminated the difference between present-positive and present-negative framing, while maintaining future-positive superiority. Conversely, avoidance priming eliminated the difference between future-positive and future-negative framing, while maintaining present-negative superiority. This suggests that stronger avoidance motivation in the present dimension underlies negative framing' s persuasiveness, while stronger approach motivation in the future dimension underlies positive framing' s effectiveness.

Study 4

5.1 Purpose

Study 4 aimed to: (1) examine the impact of high pandemic risk on the "avoid harm now, approach benefits later" effect by collecting data in a high-risk region (Guangzhou outbreak, June 2021); and (2) simultaneously collect data in a low-risk region as a control group, using this quasi-experimental design to explore boundary conditions of pandemic risk.

5.2 Method

5.2.1 Design and Participants The study used a 2 (goal framing: positive vs. negative) × 2 (temporal distance: present vs. future) × 2 (perceived risk: high vs. low) between-subjects design. We recruited 430 unvaccinated participants: 230 from Guangdong (high-risk) via Wenjuanxing links and 200 from other regions (low-risk) via IP verification, each receiving 5 RMB compensation. Seven participants failed attention checks, leaving 423 participants (49.4% female, Mage = 29.15 ± 6.53) for analysis.

5.2.2 Procedure After screening, participants were randomly assigned to conditions. The procedure mirrored Study 2: reading vaccine slogans (framing and temporal distance manipulation), reporting approach-avoidance motivation, vaccination intention and behavior, and finally trait motivation and demographics.

5.2.3 Measures Pandemic risk served as a quasi-experimental factor, manipulated by recruiting participants from Guangdong (high-risk) versus other regions (low-risk) during the June 2021 outbreak. As a manipulation check, participants rated: "How likely do you think you are to get COVID-19 if you don' t get vaccinated?" (1 = very unlikely, 7 = very likely).

Goal framing, temporal distance, approach-avoidance motivation, vaccination intention, and behavior measures were identical to Study 2.

5.3 Results

An independent samples t-test on perceived risk confirmed that high-risk region participants reported significantly higher pandemic risk than low-risk region participants (Mhigh-risk = 4.88, Mlow-risk = 4.34, $t(421)$ = -3.42, p = 0.001, Cohen' s d = 0.33, 95% CI [-0.852, -0.229]).

A 2$×2×2$ $ANOVA on vaccination intention revealed a non-significant three-way interaction (*F* = 2.37, *p* = 0.124) and non-significant main effects of temporal distance and goal fram$ $s < 0.67, *p*s > 0.415). However, the main effect of pandemic risk was significant, with high-risk participants showing higher intention than low-risk participants (*M* < sub > high − risk < /sub >= 6.35, *M* < sub > low − risk < /sub >= 5.75, *F* (1, 415) = 35.00, *p* < 0.001, η < sub > p < /sub >^{2}$ = 0.078, 90% CI [0.041, 0.121]). The interaction between temporal distance and goal framing was significant (F(1, 415) = 15.84, p < 0.001, p^2 = 0.037, 90% CI [0.013, 0.071]).

Simple effects analysis (Table 3, Figure 7) showed that in low-risk conditions, present-positive intention was significantly lower than present-negative (F(1, 415) = 6.45, p = 0.011, p^2 = 0.015, 90% CI [0.002, 0.040]), while future-positive intention was significantly higher than future-negative (F(1, 415) = 7.62, p = 0.006, p^2 = 0.018, 90% CI [0.003, 0.044]), replicating Studies 1-2. In high-risk conditions, present-positive and present-negative did not differ (F(1, 415)

= 0.31, p = 0.579), but future-positive intention remained significantly higher than future-negative (F(1, 415) = 3.93, p = 0.048, p^2 = 0.009, 90% CI [0.000, 0.031]).

Figure 7 Effects of temporal distance and goal framing on vaccination intention under low-risk (a) and high-risk (b) conditions

Table 3 Vaccination intention, appointments, and approach-avoidance motivation across conditions (N = 423)

Condition	Vaccination Intention (M±SD)	Appointment Rate	Approach Motivation (M±SD)	Avoidance Motivation (M±SD)
Low-Risk				
Present-Positive	5.44$±1.41	33(68.75±1.27	5.58±1.53	
	Present−Negative	5.98±1.22	41(83.67±1.34	6.29±0.98
	Future−Positive	6.08±1.27	40(81.63±1.09	5.86±1.50
	Future−Negative	5.49±1.34	30(63.83±1.02	5.64±1.37
	∗∗*High − Risk* ∗∗			
	Present − Positive	6.41±0.67	60(98.36±0.88	5.89±1.17
	Present−Negative	6.52±0.54	54(96.43±0.76	5.88±1.05
	Future−Positive	6.44±0.67	51(98.08±0.78	5.58±1.18
	Future−Negative	6.05±1.06	52(85.24±1.06	5.64±$1.02

Vaccination appointment behavior showed similar patterns (Table 3). In low-risk conditions, present-negative marginally exceeded present-positive (^{2}(1, 97) = 2.99, p = 0.084), and future-positive significantly exceeded future-negative (^{2}(1, 96) = 3.85, p = 0.050). In high-risk conditions, present-positive and present-negative did not differ (^{2}(1, 117) = 0.44, p = 0.509), but future-positive exceeded future-negative (^{2}(1, 113) = 5.72, p = 0.017).

Separate 2$×2×2*ANOVAsonapproachandavoidancemotivationrevealedasignificantthree−wayinteractionforavoidancemotivation*($∗F∗(1, 415) = 4.29, ∗p∗ = 0.039, \eta <$ *sub* $> p <$ */sub* $>^{2} = 0.010, 90% CI [0.000, 0.0321]). In low-risk conditions, present-positive showed lower avoidance motivation than present-negative (F(1, 415) = 7.94, p = 0.005, p^2 = 0.019, 90% CI [0.003, 0.046]), with no difference in the future dimension (F(1, 415) = 0.76, p = 0.383), replicating Study 2. In high-risk conditions, no differences emerged in either temporal dimension (Fs < 0.073, ps > 0.788) (see Figures 8 and 9).

Figure 8 Approach (a) and avoidance (b) motivation under low-risk conditions

Figure 9 Approach (a) and avoidance (b) motivation under high-risk conditions

5.4 Discussion

Using a natural risk manipulation (high-risk vs. low-risk regions), Study 4 examined how perceived pandemic risk moderates the temporal framing effect. Results showed that in low-risk regions, the "avoid harm now, approach benefits later" effect replicated. In high-risk regions, the difference between present-positive and present-negative framing disappeared, but future-positive framing remained more persuasive than future-negative, confirming pandemic risk as a boundary condition.

Under high risk, approach-avoidance motivation did not differ between positive and negative framing in either temporal dimension, yet both motivations were elevated. This suggests that present-positive and present-negative framings were equally persuasive because each aligned with high present-focused approach and avoidance motivations. Additionally, high risk increased overall vaccination rates, possibly because pandemic-induced present motivations also showed some compatibility with future framings, raising future vaccination rates, though future-positive remained superior to future-negative due to weaker compatibility.

General Discussion

Against the backdrop of widespread COVID-19 vaccination promotion, this research examined how different goal framings (positive vs. negative) and temporal distances (present vs. future) influence vaccine persuasion effectiveness. Across four sequential studies, we found that in the "present" temporal dimension, negative (vs. positive) goal framing proved more persuasive, whereas in the "future" dimension, positive (vs. negative) goal framing proved more persuasive. This effect replicated across different materials (Studies 1 & 2) and outcome measures (intention & behavior). Furthermore, we identified the underlying mechanism: negative (positive) framing elicited stronger avoidance (approach) motivation in the present (future) dimension—the "avoid harm now, approach benefits later" effect—with approach-avoidance motivation mediating these effects (Study 2 measurement, Study 3 manipulation). Finally, Study 4' s quasi-experimental design in high- and low-risk regions demonstrated that high pandemic risk eliminated the difference between present-positive and present-negative framing, while future-positive remained superior to future-negative.

6.1 Theoretical Contributions

This research offers several theoretical contributions. First, it enriches goal framing research. Previous studies have reached inconsistent conclusions about whether positive or negative goal framing better persuades vaccination (e.g., Peng et al., 2021 vs. Liu et al., 2019). Our findings provide a framework for integrating these inconsistencies: framing effectiveness depends not only on valence but also on temporal distance—negative framing works better in the present, positive framing in the future.

Second, we supplement the internal mechanisms of goal framing effects. Previous explanations for negative framing' s superiority relied on loss aversion (Gal & Rucker, 2018), while positive framing' s advantages were attributed to positive emotions (Nabi et al., 2018) or processing fluency (White et al., 2011). Our research offers a novel approach-avoidance motivation perspective, proposing that asymmetrical motivational intensity across temporal dimensions underlies differential framing effectiveness, providing a new lens for future research.

Third, we contribute to temporal distance research. While temporal discounting theory suggests present consequences are more influential (Gerend & Cullen, 2008), we found interactive effects of framing and temporal distance. Additionally, contrary to previous findings that individuals are more sensitive to future losses than gains (Nikitin & Freund, 2010), we found future gains more motivating, aligning with research showing future positive stimuli better motivate behavior (Oettingen & Mayer, 2002).

Fourth, we extend approach-avoidance motivation theory. While previous research shows motivational intensity varies by factors like gender (Gable & Gosnell, 2013), we are the first to demonstrate that equivalent stimuli elicit stronger avoidance (approach) motivation in the present (future), influencing behavior. We also extend compatibility theory (Krpan & Schnall, 2014): Study 3 showed priming approach (avoidance) increased persuasiveness of corresponding positive (negative) framing. Study 4 further revealed compatibility differences across temporal dimensions—high risk elevated present motivations that were compatible with both present framings but less so with future framings, though future vaccination rates still increased.

Finally, we contribute to nudge research. Following the nudge literature (He et al., 2018), numerous studies have examined vaccination promotion through various nudges (Rao & Nyquist, 2018; Dai et al., 2021). While framing effects have been applied to vaccine advertising (Li & Chapman, 2009; Milkman et al., 2021), consensus on positive vs. negative framing effectiveness remains elusive (Penţa & Băban, 2018). Our research combines framing effects with temporal distance, demonstrating that appropriate choice architecture (positive vs. negative) in specific contexts (present vs. future) can cost-effectively guide behavior.

6.2 Practical Implications

Effectively persuading vaccination has important practical significance for policymakers and researchers. Increasing vaccination rates prevents disease and reduces healthcare burdens, benefiting society. Traditional incentives like monetary rewards and mandates have been used (Hughes et al., 2021) but show drawbacks (Schmelz & Bowles, 2021). Our research explores an economical, efficient non-monetary intervention—goal framing effects. From a temporal distance perspective, we found negative framing works better for immediate consequences, while positive framing works better for future consequences. These findings offer insights not only for current COVID-19 vaccination promotion but

also for future applications to other vaccines (influenza, HPV). Additionally, experimentally manipulating approach-avoidance motivations and external factors (e.g., pandemic risk) can alter framing effectiveness across temporal distances, providing guidance for tailoring interventions to specific contexts.

6.3 Limitations and Future Directions

Despite these contributions, limitations remain. First, Study 4 used a quasi-experimental design with regional risk differences. Future research should employ more rigorous experimental designs to verify pandemic risk' s moderating role.

Second, future studies should test additional boundary conditions. For instance, insensitivity to future negative events may stem from uncertainty about future event probability (Harris & Hahn, 2011). Experimentally manipulating certainty about future events might alter our effects. Additionally, while this research focused on persuading "doing something" (vaccination), goal framing can also persuade "not doing something" (e.g., drinking, drug use). Whether corresponding framings (positive consequences of not acting/negative consequences of acting) show the same temporal pattern warrants investigation. Individual differences like baseline vaccine acceptance may also moderate effects—whether our findings hold among hard-to-persuade groups requires further examination.

Finally, although we expect the "avoid harm now, approach benefits later" effect to generalize across vaccines, differences in vaccine familiarity and acceptance (Caserotti et al., 2021) and perceived temporal distance of vaccine effects (e.g., influenza vaccines seen as immediate vs. HPV vaccines as future) may influence our effect. Therefore, applications should carefully select negative stimuli that trigger present avoidance motivation and positive stimuli that trigger future approach motivation for each vaccine. Moreover, as vaccine perceptions evolve over time, future research should conduct longitudinal studies examining how changing perceptions affect our temporal framing effect.

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Liu Nan, Li Aimei, Sun Hailong: Conceptualization, study design; Liu Nan, Li Aimei, Liu Pei: Experiment implementation; Liu Nan, An Xinru: Data collection, cleaning, and analysis; Liu Nan, An Xinru, Sun Hailong: Manuscript drafting; Liu Nan, An Xinru, Sun Hailong, Li Aimei, Liu Pei: Manuscript revision and final approval.

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