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01 Introduction

Message framing is among the most widely studied strategies in health communication, yet empirical evidence remains mixed. Meta-analyses show small, inconsistent, and context-dependent effects. Most studies ask: Which frame works better—gain or loss? We argue this framing of the question overlooks a more fundamental issue. Framing effects may depend on where in the decision process they operate—on the decision to participate at all (the participation margin), or on how service attributes are valued (service-attribute margins). This location may vary by disease context and audience characteristics. Understanding when, for whom, and in what contexts framing matters is therefore critical for translating communication science into practice. This study moves beyond asking which frame works better to ask: **When, for whom, and in what contexts can message framing meaningfully alter cancer screening decisions?**

• Where do framed messages operate—on the participation margin, service-attribute margins, or both?

• Does this differ between cervical and breast cancer screening—two contexts that differ in screening-target concreteness, disease-course intelligibility, social sensitivity, and follow-up complexity?

• Are framing effects moderated by perceived risk, self-rated screening familiarity, or prior screening experience?

02 Method

- Design:** Three-arm randomised message-framing experiment embedded in a best-worst discrete choice experiment (BWS-DCE), conducted in parallel as two independent cancer-specific modules (cervical and breast). Women in Shanghai were randomly assigned 1:1:1 to gain-, loss-, or mixed-framed messages, then completed DCE choice tasks.
- Framing Conditions:** Core clinical content stayed constant; only framing emphasis changed.

Gain frame	Highlighted the benefits of regular screening, including early detection, higher early-stage five-year survival, organ preservation, and lower treatment cost.
Loss frame	Emphasised the consequences of not screening, including late-stage detection, lower survival, mastectomy or hysterectomy risk, and higher treatment cost.
Mixed frame	Presented both gain- and loss-framed content.

- DCE Attributes and Choice Tasks:** Seven attributes with cancer-specific levels: screening location, pain/discomfort, provider gender, screening interval, false-negative rate, false-positive rate, and out-of-pocket cost. Each participant completed six experimental tasks plus one dominance check.

Table 1. Example best-worst choice task

	A	B	C
Screening interval	1 year	3 years	
Screening location	Private hospital	Public hospital	
Pain or discomfort	No pain or discomfort	Mild pain or discomfort	Not attending screening
Provider gender	Female	Male	
False-negative rate	20%	20%	
False-positive rate	20%	5%	
Out-of-pocket cost	100 RMB	300 RMB	
Which program do you think is best ? ☒ A ☐ B ☐ C			
Which of the two remaining options do you think is the worst ? ☐ B ☒ C			

- Analysis:** We estimated **heteroscedastic conditional logit** models with clustered standard errors, allowing decision scale to vary across best/worst choices and framing groups. A **forward stepwise selection** procedure (entry criterion $p < 0.10$) identified the focal attributes most sensitive to framing: opt-out utility for cervical cancer and false-positive rate for breast cancer. Following this identification, we examined whether the framing effect on each focal attribute was moderated by three theoretically motivated variables: perceived risk, self-rated screening familiarity, and prior screening experience. Inter-group comparison and moderation was assessed via joint Wald tests.

03 Results: Framing Effects on Focal Attributes

The forward selection procedure identified different focal attributes across the two cancer contexts. In cervical cancer, opt-out utility was identified as the focal attribute — meaning the participation margin was the decision node most sensitive to framing. In breast cancer, the false-positive rate was identified — a service-attribute margin — indicating that any framing sensitivity, if present, operated on how women weighed service features rather than the participation decision itself. However, pairwise contrasts did not reach statistical significance (gain vs. loss: $p = 0.101$). This is an exploratory signal that requires replication.

Table 2. Cervical Cancer Final Model Results — Attribute × Information Group

Inter-group comparison	β (SE)	P -value
Gain vs. Loss	0.694 (0.248)	0.005
Mixed vs. Loss	1.013 (0.245)	<0.001
Gain vs. Mixed	−0.319 (0.223)	0.153

Table 3. Breast Cancer Final Model Results — Attribute × Information Group

Inter-group comparison	β (SE)	p -value
Gain vs. Loss	−0.014 (0.009)	0.101
Mixed vs. Loss	−0.009 (0.008)	0.307
Gain vs. Mixed	−0.006 (0.008)	0.461

Cervical Cancer: Clear Effect on Participation Margin

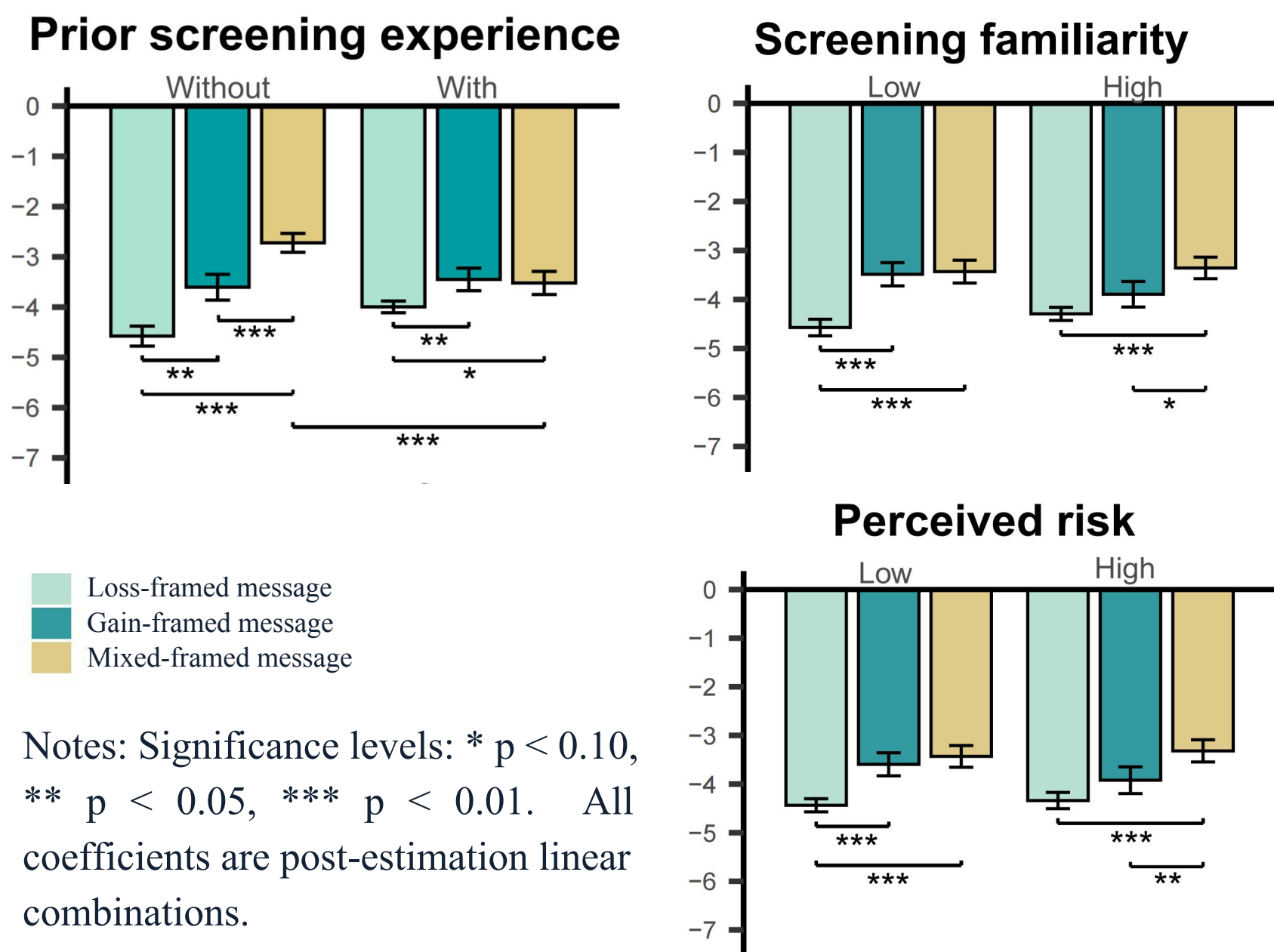
Loss-framed information significantly reduced opt-out utility relative to both gain- and mixed-framed messages.

Breast Cancer: Focal Attribute on Service-Attribute Margin

The breast-cancer main-effect contrast was an exploratory signal, not a statistically significant pairwise difference.

04 Results: Moderation Effects

- Cervical Cancer: Only Prior Screening Experience Was a Significant Moderator**
- We tested three moderators via joint Wald tests (framing × moderator × focal attribute). Only prior screening experience was statistically significant ($\chi^2 = 10.74$, $p = 0.0047$).



For prior screening experience, among women without prior cervical screening experience, loss framing outperformed gain and mixed framing. Among women with prior experience, these contrasts weakened — consistent with direct-experience theories: firsthand experience reduces persuasion.

Neither perceived risk nor familiarity was a significant moderator. Descriptively, the loss-frame advantage appeared in lower-risk and lower-familiarity groups but disappeared in higher-risk and higher-familiarity groups — patterns consistent with EPPM and ELM. However, formal tests did not confirm moderation; these patterns are hypothesis-generating, not confirmatory.

- Breast Cancer — No Moderation by Any Variable**
- In the breast cancer module, formal tests for all three moderators were not significant. Descriptively, among women with lower self-rated familiarity, gain framing showed a marginal advantage over loss framing in reducing false-positive risk preference ($\Delta\beta = -0.022$, $p < 0.10$). Among women with prior screening experience, gain framing also outperformed loss framing ($\Delta\beta = -0.022$, $p < 0.05$). However, given the non-significant formal interaction tests, these isolated signals should be interpreted with caution and require replication.

05 Conclusions & Implications

Conclusions

- Same message, different margins. The same framing strategy operates on different decision margins across cancer contexts — on the participation margin in cervical cancer (loss framing reduced opt-out utility), but no robust effect emerged in breast cancer.
- Only prior experience moderates. Among three psychological moderators, only prior screening experience significantly moderated the framing effect. Perceived risk and familiarity showed descriptive patterns consistent with EPPM and ELM, but formal tests did not confirm moderation.
- Context dependence. Framing effects are not simply stronger or weaker across contexts — they may operate on entirely different decision margins, or not at all, depending on the disease environment.

Implications for Practice

- Do not uncritically transfer framing strategies across screening contexts. Calibrate to the decision margin most likely to be movable in each context.
- Pair threat-based cervical messages with efficacy information and clear follow-up support, especially for women with prior unresolved findings.
- For breast cancer, where participation is already familiar for most urban women, message design may need to focus less on convincing women to screen and more on making service options acceptable, trustworthy, and manageable.

The relevant question is not simply “which frame works better?” — it is where in the decision process framing exerts its influence, and whether that location varies by screening context.