

LETTER

Testing an intervention codesigned with stakeholders for altering wildlife consumption: Health messaging matters

Sifan Hu¹  | Kaiwen Zhou² | Zhijian Liang²  | Tien Ming Lee^{1,3} |
Diogo Veríssimo^{3,4}  | Xiangdong Ruan⁵ | Amy Hinsley^{3,4} 

¹School of Ecology and State Key Laboratory of Biological Control, Sun Yat-sen University, Shenzhen, Guangdong, People's Republic of China

²School of Life Sciences, Sun Yat-sen University, Guangzhou, Guangdong, People's Republic of China

³Oxford Martin School, University of Oxford, Oxford, UK

⁴Department of Biology, University of Oxford, Oxford, UK

⁵Academy of Inventory and Planning, National Forestry and Grassland Administration, Beijing, People's Republic of China

Correspondence

Sifan Hu and Tien Ming Lee, School of Ecology, Sun Yat-sen University, Shenzhen, Guangdong 518107, People's Republic of China.

Email: huf3@mail.sysu.edu.cn and leetm@mail.sysu.edu.cn

Amy Hinsley, Department of Biology, University of Oxford, 11a Mansfield Road, Oxford, OX1 3SZ, UK.

Email: amy.hinsley@biology.ox.ac.uk

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Abstract

Consumer behavior change is a key priority to address the illegal wildlife trade, but evaluation of these interventions is lacking. We used surveys and randomized controlled trials to assess the effectiveness of three types of messages, which were codesigned with key stakeholders, with 2496 potential consumers and nontarget consumers in China. We found a 23% decrease in intention among potential consumers to use wild animal medicinal products by health-related messages, and a 14% decrease by legality-related messages, compared with the control group, though the effect size was small. Furthermore, we revealed that the effect of health-related messages occurred indirectly by increasing health risk perceptions associated with improper utilization of wild animals. Yet, we did not find a clear effect pathway of the legality-related messages. Regarding the nontarget consumers, information of whistleblowing platforms and incentives improved willingness to report illegal wildlife use directly, as well as indirectly through adding messages to increase perceived legality risk of using wild products and improve self-efficacy in identifying legal products. Our findings can inform future larger scale efforts to influence wildlife consumption.

KEYWORDS

conservation behavior, effectiveness evaluation, legality, mediation analysis, randomized controlled trial, traditional chinese medicine

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1 | INTRODUCTION

Annually, numerous species of fauna, flora, and fungi species are traded worldwide for a variety of purposes, including food, traditional medicines, and pets (Prasad et al., 2022). However, overexploitation linked to illegal and unsustainable trade pose significant threats to biodiversity globally (Morton et al., 2021), making sustainable trade a priority and a challenge (Sas-Rolfes et al., 2019). As the trade is often demand driven, understanding and influencing consumers' behavior to reduce illegal wildlife trade has become critical in conservation efforts (Hinsley et al., 2021; Nielsen et al., 2021; Reddy et al., 2017; Veríssimo et al., 2020).

To change human attitudes and behaviors, interventions such as informational campaigns have gained increasing attention from both practitioners and policy makers (Hall & Madsen, 2022). Strategic message framing can enhance intervention effectiveness while reducing costs (Kidd et al., 2019; Kusmanoff et al., 2020). Identifying the target audience and emphasizing things that matter to them is pivotal (Kusmanoff et al., 2016). In the context of conservation behavior, health risk communication has been used in consumer behavior research, such as increasing the perception of disease-related health risks associated with keeping or using wild and/or illegal wildlife (MacFarlane et al., 2022; Moorhouse et al., 2017). Moreover, research has also concentrated on emphasizing the legality of products and related punishments to influence the demand for wildlife products (e.g., Rizzolo, 2021). However, despite certain messaging intervention attempts aiming at influencing consumption behavior, there is still a lack of sufficient evidence to evaluate the effectiveness of different message strategies for wildlife consumption and conservation behavior in general (Kidd et al., 2019; Olmedo et al., 2020).

Furthermore, recognizing the complexity of consumer behavior and the involvement of multiple stakeholders in wildlife trade chains, researchers are placing greater emphasis on integrating a range of experiences and ideas when designing behavioral interventions (Bowie et al., 2020). Among these approaches, codesign, a method that involves various stakeholders collaboratively designing inclusive intervention prototypes (Dietrich et al., 2017; Trischler et al., 2019), has been explored for its potential application in the context of wildlife consumption (Hu et al., 2023). This audience-oriented approach could better tailor message framing to audience's needs (David et al., 2019). Yet, there remains a lack of research to assess the effectiveness of these codesign prototypes in influencing wildlife consumption intention and informing future larger scale interventions.

Here, we test the effectiveness of an intervention for altering wildlife consumption intention, using intervention messages based on a previous codesign process that produced prototype messaging for reducing illegal wildlife use among traditional medicine consumers in China (Hu et al., 2023). We focused on exploring the effectiveness of three codesigned messaging types, some of which have not been applied to these trade contexts before, namely, health-related messages, legality-related messages, and whistleblowing-related messages. We conducted empirical research by questionnaire-based randomized controlled trials (RCTs). We then evaluated the outcomes and analyzed the pathways likely to reduce intention to use wild animals for different intervention prototypes.








2 | METHODS

2.1 | Messaging types

Our message themes were derived from a broader suite of intervention prototypes designed in 2021 in Guangzhou, south of China, involving three stakeholder groups: doctors, pharmacy workers, and consumers of bear bile, a key traditional Chinese medicine (TCM) ingredient that is used both legally and illegally in China (see Hu et al., 2023 for details). We used the outputs to develop distinct messages for further testing. The first message was health related, emphasizing the health risks associated with the illegal use of wildlife products and improper TCM use. The second was legality related, conveying information about relevant regulations and penalties for illegal wildlife consumption, as well as guidelines for identifying if the product is legal under China's certification labeling system for wildlife products (NFGA, 2004). The third was whistleblowing related, providing information about whistleblowing platforms and the incentives, using the whistleblowing incentives regulation in Guangdong province of China as an example. Additionally, we designed a control message unrelated to illegal product use but relevant to TCM (i.e., proper disposal of TCM waste). For each intervention message, we designed a set of three images, embedding an interactive trivia question or a game of spot-the-difference to increase the interactivity and engagement of the audiences. The message set was implemented in the Chinese language (Figures 1 and S1 for English language materials). Each intervention incorporated a theory of change (see Hu et al., 2023), with health-related and legality-related messages targeting potential consumers of TCM products, while whistleblowing-related message was aimed at a broader target audience. Specifically, our study focused


(a)

Compare:
Which of the following animal ingredients do you think will bring greater health risks?

	Wild 	Farmed 
Source	? Unclear	 Legal farm
Health quarantine	 Undo	 Qualified
Production chain	 Unknown	 Qualified

I think there are greater risks to health with:
A. Medicine A on the left
B. Medicine B on the right

Choose:
Are you aware of the health risk shown in the former picture?
Not enough! Please read further:

Sick.....
 I heard that a legal animal-based medicine could help to treat my illness.

The doctor said I had a "cold" nature. Is this medicine suitable for me with my illness type?
Thinking...

What should I do?
Go to a doctor
Buy it to eat directly by myself

After thinking of it, I decide to:
A. Go for doctors' advice
B. Buy it to eat directly by myself

Read:
Are you aware of this information?
Did you choose the right answers before?

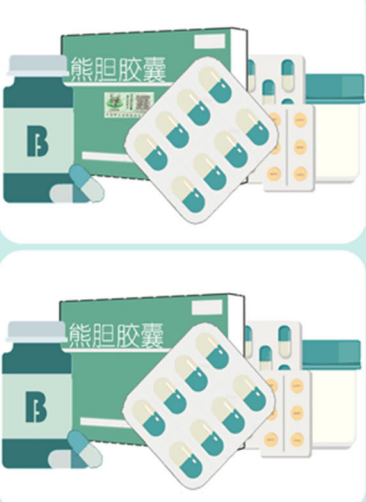
Key points! ! !
For animal-based medicines:
Unclear source, or,
From illegal wild-captured,
May be both with high Health risk!

Notice!
For animal-based medicines:
Even if it is legal, it may not be suitable for all illness types and recipients' characteristics.
Need to properly use it with doctors' advice.
Don't misuse or overuse.

After reading the information above, do you remember them?
A. Yes. I remembered.
B. No. I don't understand.


(b)

Find the difference:
How many differences are there between the following two pictures?



I found ___ difference between these two pictures
A. 0 place
B. 1 place

Recognize:
For the former two pictures, there is only one place different.
Have you found it?



What is this?

I think this labeling is:
A. Trademark of goods
B. Certain legality identification of product

Read:
Are you aware of this information?
Did you choose the right answers before?

Key points! ! !
Identification label for wildlife management and utilization
Animal-based medicines must show this label if it is legal (legal source and got the legality approve)
Those without it may be illegal.

Notice!
For animal-based medicines:
Buying or using the illegal one (e.g., from illegal wild-captured) are illegal behaviors.
There is server punishment for it.

After reading the information above, do you remember them?
A. Yes. I remembered.
B. No. I don't understand.

FIGURE 1 An example of strategic message design for the series of messages focusing on (a) health-related message, emphasizing the health risks associated with the illegal use of wildlife products and improper traditional Chinese medicine (TCM) use; and (b) legality-related message, conveying guidelines for identifying if the product is legal and information about relevant regulations and penalties for illegal wildlife consumption. Each of those images with questions embedded was shown in turn. Other two messaging designs are provided in Figure S1.

on testing: (1) whether health-related and legality-related messaging can reduce the intention of potential consumers to use wild animal ingredients, respectively; (2) whether whistleblowing-related messaging can encourage nontarget consumers to report illegal wildlife use.

2.2 | Design of survey and target audiences

For targeted audience segmentation, we used two survey questions regarding TCM use and awareness of bear bile products. Based on their responses, we divided the audiences into two distinct groups (Table S1): (1) Potential consumers, those who may use TCM when they are unwell, and who have heard of bear bile products; (2) Nontarget consumers, those who use only Western medicine when they get sick or who have never heard of bear bile products. We then embedded the intervention messages into the survey and conducted RCTs. The potential consumer group was randomly exposed to either health-related, legality-related, or control messages. On the other hand, the nontarget consumer group was randomly assigned legality-related, whistleblowing-related, whistleblowing with legality-related, or control messages (Figure 2).

We collected demographic information and experience, such as gender, age, and education level, whether they worked in ecological or environmental-related professions, use of bear bile, and the value of wildlife conservation. We also assessed health risk perception of different situations, perceived enforcement intensity, legality risk perceptions of using illegal or farmed sources, self-efficacy and actual ability on legality identification of medicines, and the behavior intention of using wild animal ingredients or intention of whistleblowing on illegal wildlife use (see Tables S2 and S3). We also inquired whether participants had noticed these legality labels before our survey.

2.3 | Study site and samplings

Given Guangzhou's significant role in the wildlife market of southern China and the presence of bear farms for bear bile medical consumption (Hinsley et al., 2021), we selected it as our study site for the previous codesign research and for testing the messaging derived from that work in this study.

We piloted our survey in March 2022 and proceeded with the formal survey in May–June 2022 among the city residents (>18 years old) through the online survey platform Wen Juan Xing (WJX, <https://www.wjx.cn/>) in Guangzhou city, China. We obtained a total of 3258 participants, but

after data filtering and quality control (excluding those <18 years, $n = 112$; incomplete responses, $n = 33$; failed attention test or exhibited logical inconsistencies, $n = 617$), we retained 2496 valid surveys, comprising 1170 potential consumers (46.9%) and 1326 nontarget consumers (53.1%; Table S4). All research was approved by the Central University Research Ethics Committee at the University of Oxford (R73067/RE003).

2.4 | Data analyses

To assess the effectiveness of each message, we conducted a Mann–Whitney U -test on each outcome variable as ordinal variables with treatment and control groups. We also calculated rank biserial correlation to quantify the effect size of the difference between two groups. This helps us assess whether the observed difference is large enough to have practical significance in real-world terms. We further conducted two ordinal logistic regression models: one with the groups as independent variables and another with all demographic and experience variables as covariates alongside the groups, as these factors might influence the intention to wildlife use (Table S5). All analyses were performed in R version 4.2.0 (R Core Team, 2022).

Furthermore, to explore the effectiveness pathways of each messaging intervention, we utilized mediation analysis (Igartua & Hayes, 2021; Preacher & Hayes, 2008; see Supporting Information Methods), which has been widely applied to RCTs in the health sciences literature (Cashin et al., 2023). We created three primary multiple mediation models (Figures 3 and S3): Mediation Model 1 and Model 2 focused on health-related and legality-related messages aimed at potential consumers; Model 3 investigated the effects of whistleblowing with legality-related messages on nontarget consumers. We also constructed two supplementary mediation models, which examined the effects of whistleblowing-related and legality-related messaging, respectively, on nontarget consumers. The key independent variable in all mediation models was the experimental group (coded as 1) and the control group (coded as 0). The dependent variable in all models was the behavior intention and the mediators were the proposed perception outcomes. Again, we included all demographic and experience variables as covariates in the models. The sample size of each model corresponds to the sum of a specific experimental group and its corresponding control group. Bootstrap method ($n = 5000$) was employed to test effect values in all multiple mediation models. Model construction, testing, and other analytical procedures were carried out using the PROCESS command package (version 4.1) in SPSS 25.0 (Hayes, 2022).

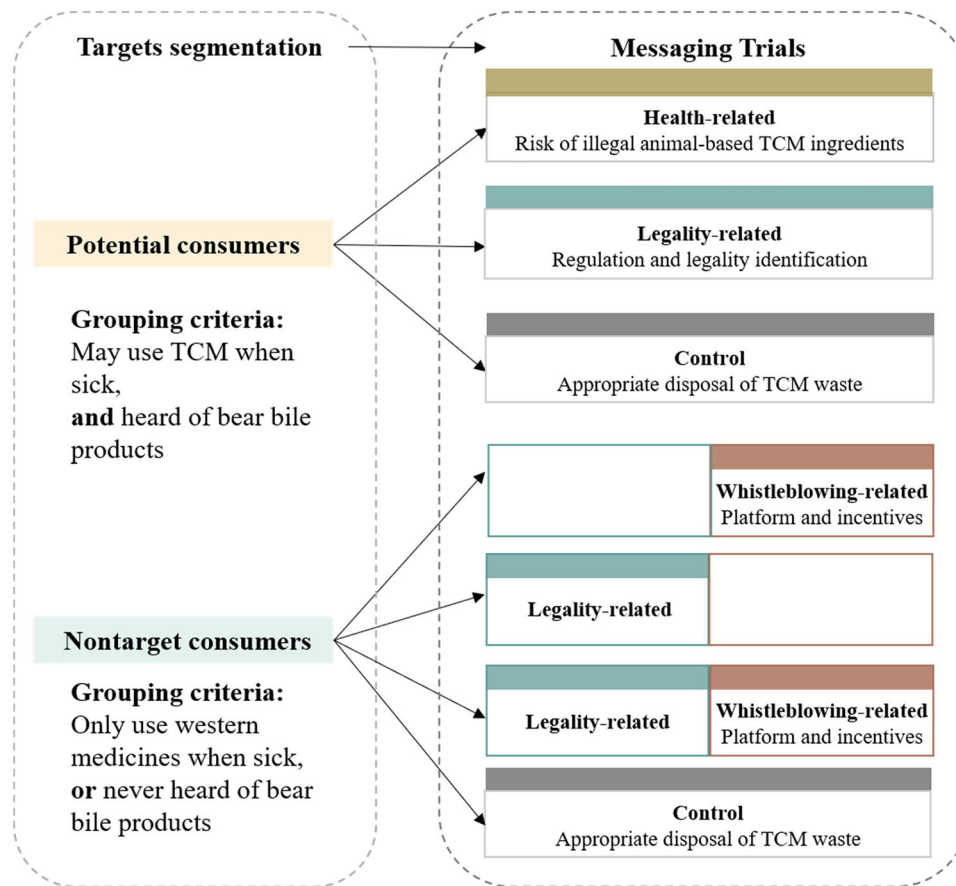


FIGURE 2 The randomized controlled trials (RCTs) design of the interventions. TCM, traditional Chinese medicine.

3 | RESULTS

Compared with the control group, our results demonstrated that the health-related message targeting potential consumers could significantly influence their health risk perceptions across various dimensions (Table 1). Specifically, health-related message significantly increased health risks associated with using animal-based medicine from wild sources by 16% ($p < 0.001$), from unknown source by 5% ($p < 0.001$), and from improper usage (e.g., overuse) by 7% ($p < 0.001$). It also significantly heightened their perception of safety when using animal-based medicine with doctors' advice by 5% ($p < 0.001$). Importantly, the health-related message led to a 23% decrease in the intention among potential consumers to use wild animals ($p < 0.001$). Although most were with small effect size (Table 1), these effects persisted even after accounting for all sociodemographic factors (Model 2 in Table S6).

Furthermore, our Mediation Model 1 revealed the pathway of effectiveness that the health-related message effectively reduced potential consumers' intention to consume wild animal-based products through the mediating factor rather than a direct effect, when controlling for all demographic covariates (standardized total effect, $c = -0.24$, $p < 0.001$; direct effect, $c' = -0.13$, $p > 0.05$ $R^2 = 0.14$;

Figure 4a). In detail, the health-related message exerted an indirect effect by increasing consumers' perception of the health risks associated with improper utilization of wild animal ingredients ($a = 0.26$, $p < 0.001$; $b = -0.24$, $p < 0.001$). Although the health-related message also improved other health risk perceptions, it did not transfer the influence to further change the intention to consume wild animal products.

The comparison showed legality-related message regarding regulation and legality identification significantly enhanced potential consumers' self-efficacy by 8% ($p < 0.001$) and ability in identifying the legality of animal-based products by 148% ($p < 0.001$; Table 1), even when controlling for all sociodemographic covariates ($\beta = 0.55$, $\beta = 1.63$, $p < 0.001$, respectively; Model 2 in Table S7). However, it had no discernible impact on consumers' perceptions of legality risks across various dimensions (i.e., perceived enforcement intensity, legality risk of using illegal-sourced or farm-sourced animals; $p = 0.068$, $p = 0.129$, $p = 0.203$, respectively; Table 1). Moreover, the legality-related message resulted in a slight decrease in intention among potential consumers to use wild animals by 14% ($p = 0.007$) with a small effect size (Table 1). This effect persisted after accounting for all sociodemographic factors ($\beta = -0.34$, $p = 0.008$; Model 2

TABLE 1 Differences of outcomes and effect size between the treatment group and the control group.

Health-related message								
Outcomes	Group	Description			Mann–Whitney <i>U</i> -test			
		Mean	SD	SE	Changes of mean (%)	<i>W</i>	<i>p</i> value	Effect size (<i> r </i>)
Health risk of wild source	Control	3.59	0.88	0.04	16	46,192	0.000	0.35
	Health	4.18	0.87	0.04				
Health risk of unknown source	Control	4.24	0.79	0.04	5	61,788	0.000	0.16
	Health	4.47	0.72	0.04				
Safety with doctors' advice	Control	4.36	0.66	0.03	5	61,530	0.000	0.17
	Health	4.56	0.66	0.03				
Health risk of improper use	Control	4.07	0.94	0.05	7	60,820	0.000	0.17
	Health	4.35	0.86	0.04				
Intention of using wild animal	Control	3.11	2.64	0.13	−23	87,314	0.000	0.15
	Health	2.40	2.50	0.13				
Legality-related message								
Outcomes	Group	Description			Mann–Whitney <i>U</i> -test			
		Mean	SD	SE	Changes of mean (%)	<i>W</i>	<i>p</i> value	Effect size (<i> r </i>)
Identification efficacy	Control	3.05	0.93	0.05	8	66,389	0.000	0.14
	Legality	3.30	0.96	0.05				
Identification capacity	Control	0.73	1.06	0.05	148	43,055	0.000	0.41
	Legality	1.81	1.34	0.07				
Risk of illegal	Control	7.54	1.96	0.10	3	72,531	0.068	0.07
	Legality	7.79	1.92	0.10				
Risk of farmed	Control	3.74	2.76	0.14	−7	83,285	0.129	0.05
	Legality	3.49	2.80	0.14				
Enforcement intensity	Control	3.98	0.64	0.03	2	74,373	0.203	0.05
	Legality	4.05	0.62	0.03				
Intention of using wild animal	Control	3.11	2.64	0.13	−14	86,939	0.007	0.10
	Legality	2.68	2.65	0.13				

Note: Sample size: Control group, *n* = 390; Health group, *n* = 374; Legality group, *n* = 393. *p* value is based on a two-tailed independent sample *t*-test. The effect size interpretation: <0.30 (small effect), 0.30–0.50 (moderate effect), and ≥0.50 (large effect).

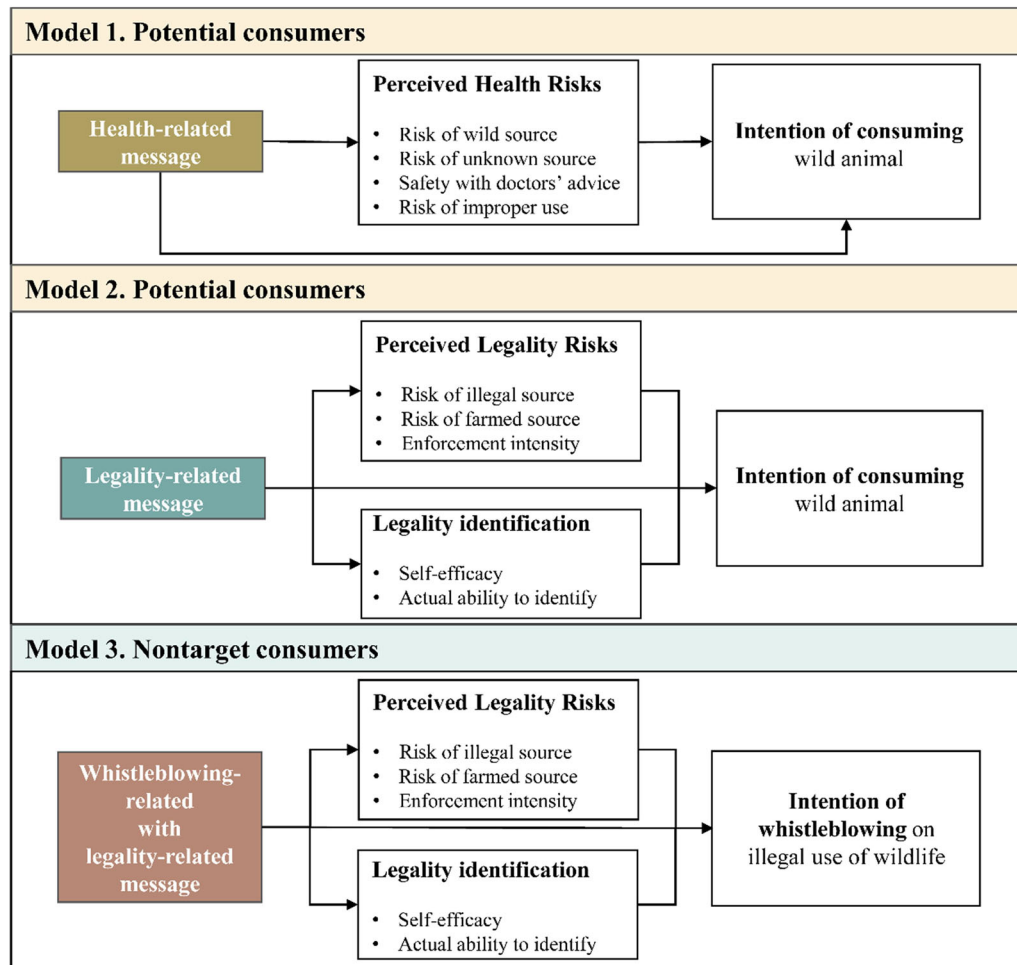


FIGURE 3 The model framework of mediation analysis in our study showing: (a) Illustration of Mediation Model 1 (Health-related message on potential consumers). (b) Illustration of Mediation Model 2 (Legality-related message on potential consumers). (c) Illustration of Mediation Model 3 (Whistleblowing and legality-related message on nontarget consumers). The arrows illustrate the proposed pathways with specific hypothesis of outcome.

in Table S7). Nevertheless, our Mediation Model 2 revealed that there was no significant pathway of effectiveness from the legality-related message to intention, neither direct effect nor indirect effect through the improvements of efficacy or capacity of identification, when considering the relationships among perception outcomes and controlling for all demographic covariates (standardized total effect, $c = -0.08$, $p = 0.021$; direct effect, $c' = -0.04$, $p > 0.05$, $R^2 = 0.13$; Figure S4).

Regarding nontarget consumers, our results revealed that the whistleblowing-related message about platforms and incentives with legality-related message of “regulation and legality identification” could effectively improve the nontarget consumers’ willingness to report illegal wildlife use by 14% ($p < 0.001$; Table S8). Moreover, our mediation models revealed that whistleblowing-related message could not only have direct effect on willingness to report by itself (Mediation Model S2, standardized direct effect, $c' = 0.24$, $p < 0.001$, $R^2 = 0.20$; Figure S5), but also have

two additional indirect pathways to encourage whistleblowing by adding the legality-related message (Mediation Model 3, Figure 4b). These pathways involve the message initially improving nontarget consumers’ self-efficacy in identifying the legality of products ($a = 0.59$, $p < 0.001$; $b = 0.14$, $p < 0.001$), as well as increasing their perceived legal risk of illegal products ($a = 0.19$, $p = 0.014$; $b = 0.33$, $p < 0.001$). Subsequently, these enhancements transfer into an increased intention of whistleblowing (standardized total effect, $c = 0.35$, $p < 0.001$, $R^2 = 0.26$).

4 | DISCUSSION

We assessed the effectiveness of three messaging types in reducing the intention to illegally use wildlife through randomized controlled messaging trials. These trials were tailored to both potential consumers and nontarget consumers. The effectiveness evaluation of interventions

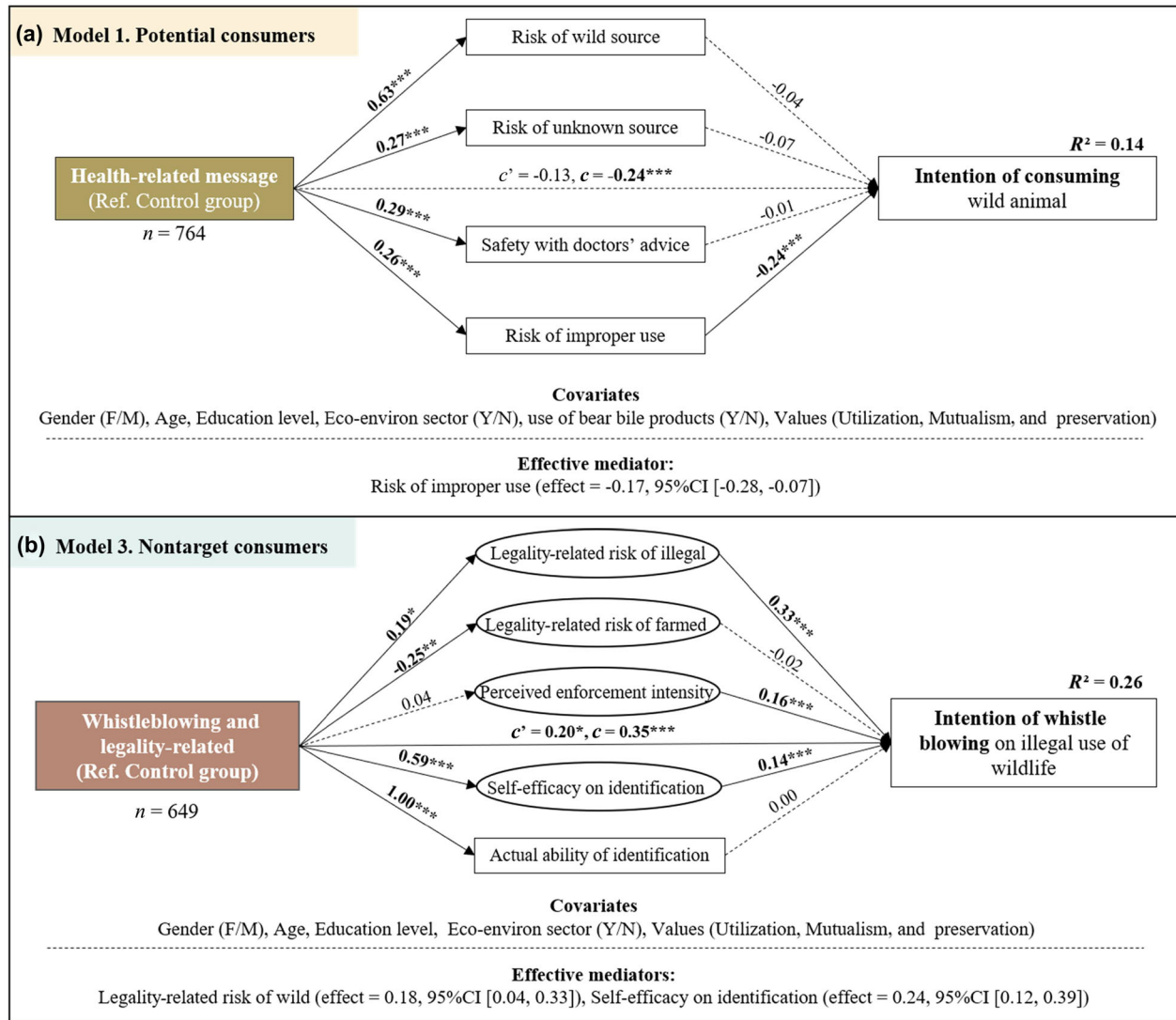


FIGURE 4 The effective pathways of messages on target audience. *Notes:* Model 1 in (a) is targeting potential consumers, and the dependent variable was the intention to use wild animal ingredients in the scenario. Model 3 in (b) is targeting the nontarget consumers, and the dependent variable was the intention to whistleblow on illegal use of wild animal ingredients. The independent variable in each model was the target treatment group and the control group (1/0). The effect testing for models was based on the Bootstrap test ($n = 5000$) with 95% confidence intervals (CIs), and all values presented are the standardized effect. The solid arrow indicated that the path relationship was significant, and the dashed arrow indicated that the path relationship is not significant. The significant levels: * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

could serve as a cost-effective basis for implementing intervention programs at large scale in the conservation context (Duthie et al., 2017; Kidd et al., 2019; Thomas-Walters et al., 2020).

We observed that health-related messaging could reduce potential consumers' willingness to use medicinal products sourced from wild animals. Importantly, we revealed the pathways to illustrate further how this effectiveness was achieved through enhancing the perception of health risks associated with the illegal use of wildlife initially. Previous research found that health risk communication could reduce intention of keeping exotic pets (Moorhouse

et al., 2017). We add to this by showing that health risk communication could reduce the intention for improper use of wildlife-based medicines. Compared to low-carbon proenvironmental behaviors such as energy use, conservation behaviors often have fewer personal connections to daily life, making behavior change more challenging (Kidd et al., 2019). Nevertheless, health-related messaging helps to strengthen the relevance of wildlife utilization to personal well-being, offering strong value in interventions for conservation behaviors (Grundy et al., 2022).

Moreover, in line with the codesigned interventions, utilizing health professionals like doctors for conveying

health-related messages in interventions might ensure the effectiveness, given their role in influencing treatment decisions in China (Hinsley et al., 2021; Hu et al., 2023). However, this may be limited in the social or cultural contexts in China, and future interventions need to consider the other context for choosing the right communicators. Furthermore, focusing on health risks from improper TCM use, especially on animal ingredients, is rooted in the key philosophies of TCM about the relationship between illness type and recipients' characteristics on selection of the right treatment (Cheung et al., 2021). This might have wider application to sustainable use of other TCM or food products. While health-related messaging matters, tailoring it to specific use of wildlife will be crucial for its effectiveness in other contexts.

We found that legality-related messages focused on regulations and the identification of legal products failed to significantly improve consumers' perception of the legal risks associated with the use. While it did reduce consumers' intentions to use wild animal products in comparison to the control group, this effect weakened when considering other outcome variables in the pathway of effectiveness. This may be due to the growing public awareness of wildlife legality and conservation in China (Hu et al., 2022; Zhang & Yin, 2014), resulting in a social norm that surpasses the effect of the intervention message. This is also partly reflected in our study, with a potential ceiling effect observed on perceived legality and enforcement. Nevertheless, the information related to legality identification significantly improved consumers' capacity to discern legal animal-based products. This ability could prove crucial in reducing inadvertent illegal use, which is a known problem (Hinsley et al., 2021). Furthermore, despite the presence of a labeling system for wildlife products, our study revealed that only approximately 22% of survey participants noticed these labels before our intervention. This underscores the necessity for legality outreach communication in future endeavors (Xie, 2020).

For the nontarget consumers, legality-related messages could significantly and indirectly encourage their intention of whistleblowing on illegal use by improving the perceived legality risk of using illegal animal products and their self-efficacy on identifying the legality of products. It is likely that the message enhances the role of self-efficacy in behavior change interventions (Lauren et al., 2016; Maki et al., 2019), which might also reflect the positive role of perceived enforcements and social norms in promoting active public engagement in wildlife conservation (Acemoglu & Jackson, 2017). This also highlights the importance of ensuring effective audience targeting both in implementing and evaluating interventions (Bostrom et al., 2013; Kidd et al., 2019). Meanwhile, making available

whistleblowing information with platforms and incentives could significantly increase the willingness to report illegal wildlife use. This suggests that future interventions could pay greater attention to this role in shaping social norms of wildlife conservation by encouraging wider non-consumer engagements rather than targeting consumers only (Bergquist et al., 2019; Byerly et al., 2018; Mengak et al., 2019).

Although the importance of changing human behavior related to wildlife consumption is increasingly recognized, the effectiveness of interventions still requires further evidence. This evidence is crucial to validate the application of interventions and to provide insights for future large-scale campaigns. Our study provides empirical insights into the effectiveness of various message types and the pathways for reducing the use of illegal wildlife products, underscoring the importance of behavioral interventions and their evaluation in a conservation context. While our study lacks a preregistration analysis plan, our findings suggest that a focus on health-related interventions appears promising for consumers of medicinal products, and broader nontarget consumers' engagement in combating illegal wildlife use can be improved using information on whistleblowing and legality. It is also worth noting that the measurement of the effectiveness in our study is limited to perceptual level or behavioral intention and we acknowledge that this may lead to some desirability bias. We employed an RCT to partly mitigate this bias, as it would likely affect both the control and treatment group. However, we also acknowledge that the treatments may have induced additional social desirability bias, which could further explain some of our observed outcomes, and we could not measure the extent of this. Nevertheless, it is important to recognize that behavioral intentions may not always translate into actual behavior (Webb & Sheeran, 2006). Future research could explore ways to monitor actual consumption or whistleblowing behavior. Moreover, our survey and message testing were conducted exclusively online, whereas consumption or whistleblowing behavior may also occur offline. We recommend further testing messages in diverse contexts, especially in real-world settings. We stress the necessity to assess the potential effectiveness of interventions before large-scale implementation. In terms of assessing effectiveness, while our study represents a key initial step, there is much work to be done to assess interventions in diverse contexts to achieve the desired conservation outcomes.

AUTHOR CONTRIBUTIONS

Sifan Hu, Tien Ming Lee, and Amy Hinsley designed research; Sifan Hu, Zhijian Liang, and Kaiwen Zhou performed research; Sifan Hu analyzed data and wrote the paper; and all the coauthors revised the paper.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in the Oxford Research Archive at <http://dx.doi.org/10.5287/ora-keo2mzdkr>.

ORCID

Sifan Hu  <https://orcid.org/0000-0002-7445-6284>

Zhijian Liang  <https://orcid.org/0000-0002-7654-8801>

Diogo Veríssimo  <https://orcid.org/0000-0002-3519-6782>

Amy Hinsley  <https://orcid.org/0000-0002-5590-7617>

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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