The Effects and Mechanisms of Refutation Texts on Patient Trust and Moral Judgment

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Abstract

This study employs the refutation text paradigm to correct patients' knowledge and enhance their trust in and moral judgment of medical professionals. A preliminary experiment was conducted to develop refutation texts and verify their effectiveness. Experiment 1 confirmed that refutation texts can significantly improve patients' trust in doctors and moral judgment, and identified medical outcomes as an important factor influencing patients' trust and moral judgment of medical professionals. Experiments 2 and 3 investigated the underlying mechanism and general applicability of refutation text effectiveness, revealing that tolerance for uncertainty and leniency serve as chain mediators between refutation texts and patients' trust and moral judgment, and that refutation texts can enhance general patient trust independent of medical contexts.

Full Text

The Effect and Mechanism of Refutation Texts on Patient Trust and Moral Judgment

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Abstract

This study employed a refutation text paradigm to revise patients' knowledge, aiming to enhance their trust in physicians and moral judgments toward medical decisions. A pilot study developed and validated the refutation text materials. Experiment 1 demonstrated that refutation texts significantly improved

patients' trust in physicians and moral judgments, revealing that medical outcomes constitute a crucial factor influencing patient trust and moral evaluations. Experiments 2 and 3 explored the underlying mechanisms and generalizability of refutation text effectiveness, finding that intolerance of uncertainty and tolerance toward physicians mediated the relationship between refutation texts and both patient trust and moral judgment in a chain-like fashion. Moreover, refutation texts proved effective in enhancing general patient trust independent of specific medical contexts.

Keywords: refutation texts; doctor-patient relationship; patient trust; moral judgment; intolerance of uncertainty

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Introduction

The crisis of trust between doctors and patients represents a challenge that is both globally pervasive and particularly acute within Chinese society. While patients may express confidence in modern medicine' s therapeutic capabilities, they frequently harbor generalized skepticism toward individual physicians' moral character and diagnostic competence (Rosenberg, 2007/2016, p. 7). When receiving medical information, patients simultaneously engage in dual evaluative processes: technical trust (assessing professional competence) and moral trust (evaluating whether non-therapeutic motives, such as overtreatment (Heather et al., 2017) or defensive medicine, might compromise their interests). Defensive medicine—characterized by ordering unnecessary tests and medications, performing unwarranted procedures, or avoiding high-risk patients to mitigate legal liability (He, 2014; Tan, 2011)—reflects this trust deficit. However, due to the inherent knowledge gap and cognitive disparities between medical professionals and laypeople, patients' assessments of physicians' credibility tend to prioritize moral character over technical expertise. Technical judgments often exceed patients' medical knowledge, whereas moral evaluations can be derived from observable interactional cues such as facial expressions and tone of voice. For instance, during clinical communication, physicians typically employ logical reasoning and emphasize objective evidence, whereas patients favor affective judgments and prioritize subjective feelings and harmonious atmosphere (Clack, Allen, Cooper, & Head, 2004). Patients frequently interpret physicians' neutral statements negatively (Lyu & Zhao, 2019) and attribute defensive medical behaviors to individual greed, while physicians view these same behaviors as necessary responses to diagnostic uncertainty and disease variability (Lyu, 2019). These divergent perspectives create deep-seated 隔阂 that obstruct effective doctor-patient communication.

Current psychological interventions aimed at improving doctor-patient communication predominantly focus on enhancing physicians' moral standards, service attitudes, and communication skills (Dang, Westbrook, Njue, & Giordano, 2017; Wang, Lan, & Zhao, 2015; Wang, Yan, Lv, Yan, & Lin, 2016). This "physician-

oriented" strategy emphasizes improving how doctors communicate information to patients and strengthening medical ethics training. However, exclusively demanding skill enhancement or moral improvement from physicians may paradoxically elevate patients' expectations, fostering a "unlimited liability consciousness" among patients who believe physicians bear absolute responsibility for health outcomes, while physicians maintain a "limited liability consciousness" focused on self-protection (Sun & Dong, 2015). This cognitive divergence may ultimately deteriorate doctor-patient relationships. Consequently, complementary patient-oriented research and practice are essential for more effectively addressing cognitive biases and behavioral differences between the two parties.

Physicians' cognitive patterns are not innate but rather products of extensive professional training. Rigorous licensing examinations and clinical exposure provide physicians with knowledge of counterintuitive medical facts and rare cases that remain unfamiliar to laypeople. Additionally, the risk of medical disputes compels physicians to adhere strictly to clinical protocols, avoiding individualized or emotionally-driven decisions. Consequently, physicians typically exhibit highly rationalized cognitive patterns characterized by evidence-based reasoning, familiarity with esoteric medical knowledge, tolerance of diagnostic uncertainty, and proactive risk mitigation (Kim & Lee, 2018; Wang, Shang, & Zeng, 2018). If effective patient education could align patients' cognitive patterns with those of physicians, combining patient-oriented strategies with physician-oriented approaches would create synergistic effects for enhancing doctor-patient trust.

Early research demonstrated that prompting individuals to consider "alternative possibilities" or plausible counterfactual outcomes effectively reduces cognitive biases (Lord, Lepper, & Preston, 1984; Hirt & Markman, 1995). Recent studies indicate that brief interventions can attenuate cognitive biases and produce attitude change—for example, Broockman and Kalla (2016) found that a ten-minute supportive conversation durably reduced transphobia. This suggests a promising approach for reducing patients' cognitive biases: Could reminding patients that their prior knowledge and intuitive judgments might be erroneous promote self-reflection and monitoring, thereby reducing cognitive biases during knowledge acquisition and increasing trust in medical recommendations? Knowledge revision research has addressed this question by employing refutation texts, which explicitly state that previously acquired knowledge is incorrect, directly refute it, and simultaneously provide accurate information (Kendeou, Walsh, Smith, & O' Brien, 2014). Effective refutation texts contain three core components: (1) explicit identification of erroneous knowledge or beliefs, (2) explicit refutation of such knowledge or beliefs (Guzzetti, 2000), and (3) explanation of correct knowledge or beliefs (Kendeou, Smith, & O' Brien, 2013). Refutation texts facilitate learning of counterintuitive information and promote critical thinking (Hynd, 2001), while spontaneously activating previously learned correct knowledge in new contexts (Beker, Kim, Boeke, van den Broeka, & Kendeoub, 2019).

Although laypeople widely attend to medical and health knowledge, they can-

not guarantee its accuracy. Refutation texts could make individuals aware that their existing medical knowledge may be incorrect or deficient, stimulating interest in relevant information and encouraging more positive evaluations of physicians' professional judgments and medical exceptions. However, accepting intuition-defying concepts requires a subtle and persuasive process (Pyysiäinen, 2003); overt value-laden messaging may prove counterproductive. Therefore, knowledge revision should initially avoid emotionally and value-laden content, focusing instead on relatively objective yet underappreciated medical and health knowledge to reduce psychological resistance to belief revision and accelerate cognitive transformation.

Based on these considerations, the pilot study developed refutation text intervention materials comprising medical and health knowledge that is typically unfamiliar to patients, frequently misunderstood, yet unrelated to core value systems or medical beliefs. The texts employed a question-and-answer format, presenting questions followed by correct answers and explanations to facilitate knowledge revision. By analyzing error rates and feedback, we estimated the general rate of incorrect responses and the effectiveness of knowledge revision. Successful validation would enable further investigation of whether refutation texts could alter moral judgment patterns in contexts reflecting doctor-patient cognitive differences while enhancing trust in medical decisions.

Experiment 1

Experiment 1 tested the hypothesis that refutation texts would promote alignment with physicians' decisions and enhance patient trust. Using the scenario "whether bone marrow puncture is necessary for a child with recurrent fever" — a common clinical situation where parents may suspect financial motives while physicians consider diagnostic necessity for potentially serious conditions like leukemia (Miu et al., 2017)—participants were randomly assigned to refutation text or control conditions. After reading the scenario, participants predicted whether the patient would follow medical advice and evaluated the physician' s moral intentions. We then manipulated the patient' s compliance (following vs. not following advice) and medical outcomes (no abnormal findings vs. leukemia detection) to test whether refutation texts enhanced trust across these conditions.

Experiment 2

Building on Experiment 1, Experiment 2 investigated the mediating mechanisms underlying refutation text effectiveness. Medical practice outcomes are inherently uncertain, requiring both parties to make judgments under ambiguity (Luther & Crandall, 2011). Individuals with low tolerance for uncertainty tend to evaluate stimuli negatively (Koerner & Dugas, 2008). Most patients, lacking medical education, may have limited insight into their knowledge limitations, making them intolerant of uncertainty and expectant of idealized outcomes. We hypothesized that refutation texts, by prompting cognitive reflection and aware-

ness of counterintuitive medical facts, would increase tolerance for unexpected outcomes. This enhanced tolerance might enable patients to view physicians' imperfect judgments in uncertain situations more charitably, preserving trust. Experiment 2 therefore examined intolerance of uncertainty and tolerance toward physicians as chain mediators between refutation texts and both trust and moral judgment, clarifying the mechanism through which refutation texts promote harmonious doctor-patient relationships.

Experiment 3

Experiment 3 assessed whether refutation text effectiveness generalized beyond specific medical contexts by using the same patient trust questionnaire but asking participants to respond based on their personal medical experiences.

Pilot Study

Participants

Using convenience sampling, 103 non-biology/medical college students (56 male, 47 female; mean age = 21 years, SD = 1.13) participated. Questionnaires were administered and collected during class breaks; all completed questionnaires were deemed valid.

Materials

Medical textbooks and literature were reviewed to select items meeting these criteria: brief and comprehensible questions from physiology, medicine, or health domains that could be answered through intuition or common sense. For example: "Kidney transplantation involves replacing a diseased kidney with a healthy one" (False: the diseased kidney typically remains, leaving transplant recipients with three kidneys), and "Direct relatives should not donate blood to each other" (True: risk of fatal graft-versus-host disease is significantly higher). The intended effect was for participants to feel confident in their intuitive answers, then realize their errors upon seeing correct answers, prompting reflection on the inaccuracy of intuitive judgment.

Ten items were initially compiled and evaluated by one internal medicine attending physician, one surgery attending physician, and two clinical medicine graduate students. Based on their recommendations, five items were retained for the pilot study. The final refutation text materials consisted of four sections: question, answer with explanation, self-assessment of intervention effectiveness, and answer source. Questions used true/false format; intervention effectiveness was measured via a 5-point Likert scale rating of agreement with the statement "Through answering and reading, I realized my previous understanding might not be correct." Complete materials appear in Appendix 1.

Procedure

Collective classroom administration was conducted. After participants completed the questions, correct answers and explanations were distributed. Participants then completed the intervention effectiveness self-assessment. Upon collection, answer sources were disclosed to all participants.

Results and Discussion

Pilot study results are described in Table 1 . Overall, 94.2% of participants answered at least one question incorrectly, indicating effective item selection. While error rates demonstrated that participants' prior and intuitive knowledge was incorrect, the binary nature of the questions meant random guessing could produce correct answers. The crucial outcome was whether participants recognized that their previous views might be wrong after completing the task. Intervention effectiveness, measured on a 5-point Likert scale from "strongly disagree" to "strongly agree," showed 78.6% of participants selecting "agree" or "strongly agree," indicating effective intervention. This suggested that over 70% of participants in subsequent experiments would successfully engage with the refutation texts.

Experiment 1

Experiment 1 employed a 2 (refutation text: intervention vs. control) × 2 (compliance: following vs. not following medical advice) × 2 (check result: common fever vs. lymphocytic leukemia) between-subjects design. The control group received no intervention. Dependent variables included moral judgment of the physician and patient trust levels at different experimental stages. Control variables were gender, age, marital status (married/unmarried), and parental status (with/without children).

Participants

Participants aged 18+ without medical backgrounds were recruited from hospitals and communities in Shanghai, Xi' an, Ningbo, Changchun, and Tianjin. Testing occurred in hospital waiting areas, inpatient wards, and community leisure spaces under the guise of a "health knowledge quiz." The scenario contained critical medical information and manipulation check questions; data from participants failing manipulation checks were excluded. Targeting 35 valid participants per cell and accounting for the 78.6% intervention success rate from the pilot study plus an estimated 20% invalid response rate, we aimed for 45 participants per cell. A total of 360 questionnaires were distributed and collected. Fifty-one participants failed manipulation checks, yielding 309 valid participants (85.83% validity rate; 137 male, 172 female; mean age = 31 years, SD = 8.91).

Materials

Materials comprised two parts: (1) the validated refutation texts from the pilot study, and (2) a self-designed doctor-patient interaction scenario measuring moral judgment and trust.

The scenario, titled "Child with Fever: Doctor Recommends Bone Marrow Puncture," was presented in simplified comic form to enhance readability [Figure 1: see original paper]. The narrative described Mr. Wang bringing his six-year-old child, who had experienced recurrent fever for two weeks, to a general clinic. After blood work proved inconclusive, the physician recommended bone marrow puncture. When Mr. Wang questioned this recommendation, the physician provided a brief response. Clinically, this recommendation is justified: blood tests cannot confirm diagnosis, abnormal blood counts in a child with recurrent fever necessitate ruling out malignant disease. The materials used neutral, concise language. For example, the physician' s statement "It' s difficult to explain clearly in a few words" could be interpreted as either calm or impatient, leaving subjective interpretation to participants. This ambiguity was designed to elicit varying moral judgments and trust evaluations.

After initial material development, experts from the pilot study evaluated the design' s rationality and medical accuracy before finalizing the version.

Measurement Tools

Moral Judgment Measurement: Given intention inference' s central role in moral judgment (Young et al., 2007), Experiment 1 operationally defined moral judgment through intention assessment. Participants rated two statements on 5-point Likert scales: "The doctor recommended bone marrow puncture to make more money"(reverse-scored) and "The doctor recommended bone marrow puncture for clearer diagnosis." Higher scores indicated more positive moral judgments.

Patient Trust Measurement: We used Section B of the Chinese Doctor-Patient Trust Scale (Lyu et al., in press), comprising 13 items measuring interpersonal trust in individual physicians using 5-point Likert scales (item 8 reverse-scored). Higher total scores indicated greater trust. This scale demonstrated strong relevance to the experimental scenario (expert-rated Kendall' s concordance coefficient = 0.81), high internal consistency (= 0.95), and 2-week test-retest reliability = 0.91 (see Appendix 3).

Procedure

To ensure geographic diversity, psychology graduate students were trained as research assistants and dispatched to five cities (Shanghai, Xi' an, Ningbo, Changchun, Tianjin). At each location, two tertiary hospitals and two communities were selected as survey sites. Using one-on-one questionnaire administration, participants provided informed consent before random assignment to

intervention or control groups. Intervention group participants completed refutation text questions, received correct answers and explanations, then read the scenario and answered follow-up questions. Control participants proceeded directly to the scenario.

Step 1: Scenario description and doctor-patient dialogue were presented. The dialogue used a comic-text combination to enhance immersion and reduce reading burden [Figure 1: see original paper].

Step 2: Manipulation check questions required participants to identify the recommended test and its cost. Both questions had to be answered correctly for data validity; any error resulted in exclusion.

Step 3: Participants predicted whether Mr. Wang would follow the doctor' s advice (yes/no) and rated the doctor's intentions (pre-outcome moral judgment).

Step 4: Participants randomly selected one of four identical neutral pens marked with codes (a, b, c, d) on the bottom. Based on the selected code, they received one of four outcome scenarios: (a) complied/test normal, (b) complied/test revealed leukemia, (c) non-compliance/recovered, (d) non-compliance/leukemia diagnosed later.

Step 5: Participants rated the doctor' s intentions again (post-outcome moral judgment) and completed the patient trust scale.

Step 6: Demographic information was collected, questionnaires checked for completeness, and participants received compensation.

Results

Refutation Text Intervention Effectiveness Consistent with the pilot study, error rates were 97.4% and intervention effectiveness was 80.6%, confirming the refutation text intervention' s effectiveness.

Control Variables Separate regression analyses with gender, age, marital status, and parental status as predictors of pre-outcome moral judgment, post-outcome moral judgment, and patient trust revealed no significant effects (see Appendix 6, Table 1). These variables were excluded from subsequent analyses.

Effect on Pre-Outcome Moral Judgment Intervention group participants ($n = 155$) scored significantly higher on pre-outcome moral judgment ($M = 7.52$, $SD = 1.69$) than control participants ($n = 154$; $M = 6.32$, $SD = 1.99$), $t(307) = 5.74$, $p < 0.001$, $d = 0.65$. Intervention participants were more likely to attribute the bone marrow puncture recommendation to diagnostic clarity rather than profit motives.

Effect on Behavioral Prediction Intervention participants predicted compliance at a significantly higher rate (104/155, 67.1%) than controls (83/154,

53.9%), with a two-proportion difference test yielding p = 0.012 (one-tailed). This suggests refutation texts increase predicted adherence to medical advice.

Effects on Post-Outcome Moral Judgment and Trust Descriptive statistics for post-outcome moral judgment and patient trust across conditions appear in Table 2 .

A three-way ANOVA on post-outcome moral judgment revealed significant main effects for refutation text intervention, F(1, 301) = 54.51, p < 0.001, ^{2} = 0.15, and check result, F(1, 301) = 69.55, p < 0.001, ^{2} = 0.19. A significant compliance × check result interaction emerged, F(1, 301) = 10.76, p = 0.001, ^{2} = 0.04 [Figure 2: see original paper]. Simple effects analysis showed that when the result was common fever, participants in the compliance condition viewed the doctor' s intentions more positively than those in the non-compliance condition, F(1, 154) = 7.18, p = 0.008, ^{2} = 0.02. Conversely, when leukemia was diagnosed, non-compliant participants showed marginally more positive moral judgments, F(1, 151) = 3.69, p = 0.051, ^{2} = 0.01.

For patient trust, significant main effects emerged for refutation text intervention, F(1, 301) = 50.08, p < 0.001, ^{2} = 0.14, and check result, F(1, 301) = 40.99, p < 0.001, ^{2} = 0.12. A significant intervention × check result interaction was found, F(1, 301) = 4.82, p = 0.029, ^{2} = 0.02 [Figure 3: see original paper]. Simple effects indicated that refutation text intervention had a stronger effect on trust when the diagnosis was common fever versus leukemia, suggesting that medical outcomes themselves are key trust determinants. When leukemia was diagnosed, even control participants viewed the doctor' s recommendation as reasonable and expressed relatively high trust.

Experiment 2

Experiment 2 investigated the mediating mechanism of refutation text effects. Medical practice involves inherent uncertainty requiring collaborative navigation of imperfect realities (Luther & Crandall, 2011). Individuals intolerant of uncertainty tend toward negative evaluations (Koerner & Dugas, 2008). Most patients, lacking medical education, may have limited insight into their knowledge limitations, making them intolerant of uncertainty and expectant of idealized outcomes. We hypothesized that refutation texts, by promoting cognitive reflection and awareness of counterintuitive medical facts, would increase tolerance for unexpected outcomes. This enhanced tolerance might enable more charitable views of physicians' imperfect judgments under uncertainty, thereby preserving trust. Experiment 2 therefore examined intolerance of uncertainty and tolerance toward physicians as chain mediators between refutation texts and both trust and moral judgment.

Design

Experiment 2 used a 2 (refutation text: intervention vs. control) × 2 (check result: common fever vs. lymphocytic leukemia) between-subjects design. The control group received no intervention. Dependent variables were moral judgment and trust. Mediators were intolerance of uncertainty and tolerance toward physicians. Control variables were gender, age, marital status, and parental status.

Participants

Using the same recruitment criteria as Experiment 1, 180 questionnaires were distributed (45 × 4). Fifteen participants failed manipulation checks, yielding 165 valid participants (91.67% validity; 86 male, 79 female; mean age = 33 years, SD = 9.08).

Materials

Materials included: (1) the validated refutation texts, after which intervention participants completed measures of intolerance of uncertainty and tolerance toward physicians while control participants completed these measures directly; and (2) the same doctor-patient interaction scenario as Experiment 1, but with check results presented immediately after the dialogue. Participants randomly received one of two outcome scenarios (common fever vs. leukemia) before rating moral judgment and trust.

Measurement Tools

Intolerance of Uncertainty: The short form of the Intolerance of Uncertainty Scale (Zhang et al., 2017) demonstrated adequate internal consistency (= 0.70–0.88) and test-retest reliability (r = 0.70–0.78) with good construct validity (see Appendix 4). The 12-item scale uses 5-point Likert scales (reverse-scored), with higher scores indicating greater tolerance.

Tolerance Toward Physicians: Six items from the Tolerance Toward Physicians subscale of the Chinese Doctor-Patient Social Mentality Questionnaire (Lyu et al., 2019) were used. The subscale shows strong internal consistency (= 0.757–0.932) and test-retest reliability (r = 0.632–0.759) with good expert-rated validity (see Appendix 5). Items use 5-point Likert scales (items 1, 2, 4, 5 reverse-scored), with higher scores indicating greater tolerance.

Moral judgment and patient trust measures were identical to Experiment 1.

Procedure

The sampling method, procedure, and random assignment paralleled Experiment 1, with participants randomly assigned to intervention or control groups, then further randomized to common fever or leukemia conditions. Steps were:

(1) measure intolerance of uncertainty and tolerance toward physicians; (2) present scenario and dialogue followed by random outcome assignment; (3) manipulation check questions on recommended test, cost, and final result (all three required correct answers for validity); (4) moral judgment and trust measures; (5) demographic collection and compensation.

Results

Intervention Effectiveness Error rates were 100% and intervention effectiveness was 72.3%, confirming effectiveness.

Control Variables Regression analyses showed only parental status significantly predicted moral judgment, $t(4, 154) = 2.01$, $p = 0.047$, $B = 0.79$. This variable was included as a covariate in subsequent moral judgment analyses (see Appendix 6, Table 2).

Two-Way ANOVA Results Descriptive statistics appear in Table 3 .

For moral judgment (with parental status as covariate), significant main effects emerged for refutation text intervention, $F(3, 161) = 7.04$, $p = 0.009$, $^{2} = 0.04$, and check result, $F(3, 161) = 31.47$, $p < 0.001$, $^{2} = 0.16$. The interaction was non-significant.

For patient trust, the intervention effect was non-significant, $F(1, 161) = 0.148$, $p = 0.70$, while check result was significant, $F(1, 161) = 10.68$, $p < 0.001$, $^{2} = 0.06$. The interaction was non-significant.

These results indicate that when outcomes are presented directly, refutation texts remain effective for moral judgment but not for trust. This suggests that while moral judgment and trust are correlated, they differ fundamentally: moral judgment is more susceptible to subjective intention inference, whereas trust is more strongly influenced by objective outcomes.

Mediation Analysis Using SPSS Process Plugin with Preacher and Hayes' s (2004) bootstrap method, we tested a chain mediation model with three paths: (1) refutation text → intolerance of uncertainty → moral judgment; (2) refutation text → intolerance of uncertainty → tolerance toward physicians → moral judgment; (3) refutation text → tolerance toward physicians → moral judgment. Following Zhao, Lynch, and Chen's (2010) procedures and Hayes's (2013) multistep mediation approach, we entered refutation text as X, moral judgment as Y1, and intolerance of uncertainty and tolerance as M1 and M2, controlling for check result and demographics.

Results appear in Table 4 . The model was significant, $F(4, 160) = 3.93$, $p = 0.005$, $R^2 = 0.089$. Path 2 was significant (confidence interval: -0.12, -0.01) with effect size = 0.06, while Paths 1 and 3 were non-significant [Figure 4: see original paper]. Consistent with hypotheses, refutation texts enhanced moral

judgment by first increasing intolerance of uncertainty, then tolerance toward physicians.

Since refutation texts did not significantly affect trust in Experiment 2, we could not determine whether the same mediation applied. Experiment 3 addressed this by removing the scenario and asking participants to respond based on personal medical experiences while including the same mediators.

Experiment 3

Experiment 3 used a single-factor between-subjects design (refutation text intervention vs. control). Dependent variable was patient trust. Mediators were intolerance of uncertainty and tolerance toward physicians. Control variables were gender, age, marital status, and parental status.

Participants

Using identical recruitment criteria, 90 questionnaires were distributed (45 × 2). Seven participants failed manipulation checks, yielding 83 valid participants (92.2% validity; 27 male, 56 female; mean age = 34 years, SD = 7.70).

Materials

Intolerance of uncertainty, tolerance toward physicians, and patient trust measures were identical to Experiment 2, with trust instructions modified to reference personal medical experiences.

Procedure

Sampling and random assignment followed previous experiments, with the sole modification being the removal of the doctor-patient scenario.

Results

Intervention Effectiveness Error rates were 100% and intervention effectiveness was 79.5%, confirming effectiveness.

Control Variables Independent t-tests with gender, marital status, and parental status as predictors of intolerance of uncertainty, tolerance, and trust were non-significant. Age significantly predicted tolerance, $t(81) = 3.31$, $p = 0.001$, $B = 0.16$, and was included as a covariate in subsequent mediation analyses (see Appendix 6, Table 3).

Effect on Patient Trust In the no-scenario condition, intervention participants ($n = 39$) reported significantly higher trust ($M = 45.08$, $SD = 7.23$) than controls ($n = 44$; $M = 38.61$, $SD = 6.19$), $t(81) = 4.39$, $p < 0.001$, $d = 0.96$.

Mediation Analysis The same analytic approach tested three paths: (1) refutation text → intolerance of uncertainty → trust; (2) refutation text → intolerance of uncertainty → tolerance → trust; (3) refutation text → tolerance → trust. Results appear in Table 5 .

The model was significant, $F(4, 78) = 14.09$, $p < 0.001$, $R^2 = 0.420$. Path 2 was significant (confidence interval: 0.034, 0.34) with effect size = 0.15, and Path 3 was also significant (confidence interval: 0.09, 0.59) with effect size = 0.31 [Figure 5: see original paper]. Unlike the moral judgment model, refutation texts directly increased tolerance toward physicians, which then enhanced trust.

General Discussion

Summary of Findings

Across conditions where outcomes were presented directly, refutation texts significantly improved moral judgment. However, trust was only significantly enhanced when participants had time to reflect before outcome presentation. This suggests that medical outcomes are primary determinants of trust, while moral judgment is more susceptible to intuitive influences. The interaction between refutation text and check result in Experiment 1 further supports this: when the diagnosis was common fever, refutation texts had a stronger effect on trust, whereas leukemia diagnoses elicited high trust even in controls. Participants primarily used final outcomes as their trust evaluation criterion.

Notably, comparison between Experiments 1 and 2 suggests reflection time may be a crucial moderator. Experiment 1 prompted participants to consider the patient' s compliance and doctor' s intentions before outcome presentation, potentially fostering more deliberative thinking. Research indicates that individuals in wise reasoning states become more cooperative with extended reflection, while those in unwise states become less trusting (Grossmann, Brienza, & Bobocel, 2017). Experiment 2' s non-significant trust effect may thus reflect both the absence of reflection time and the possibility that reflection time in Experiment 1' s control condition could have reduced trust, amplifying between-group differences.

Furthermore, Experiment 3 demonstrated that refutation text effectiveness generalizes beyond specific scenarios, suggesting its utility as a universal strategy for enhancing doctor-patient trust.

Theoretical Implications

Experiments 1 and 2 consistently showed that medical outcomes significantly influence moral judgment and trust. This implies that trust contingent upon treatment effectiveness is unstable—a phenomenon familiar in clinical practice. Patients typically exhibit "outcome-oriented" rather than "process-oriented"

thinking, judging medical recommendations by their results rather than acknowledging physicians' inability to 预知 outcomes beforehand. Conversely, physicians adopt "process-oriented" thinking, making standardized recommendations based on medical knowledge without guaranteeing patient satisfaction. This fundamental difference leaves doctor-patient trust vulnerable. Strengthening trust requires robust channels independent of specific outcomes.

Simple effects in Experiment 1 revealed that when the outcome was common fever, compliant participants viewed the doctor's intentions more positively than non-compliant participants, while the reverse pattern (marginally significant) occurred for leukemia outcomes. This may reflect social influence: Mr. Wang' s compliance or non-compliance shaped participants' judgments. In leukemia cases, non-compliance' s severe consequences may have triggered counterfactual thinking, which enhances regret and promotes more rational moral evaluation (Roese, 1997; Zeelenberg et al., 2002; Turman, 2005; Sevdalis & Kokkinaki, 2006).

Experiments 2 and 3 demonstrated that intolerance of uncertainty and tolerance toward physicians mediated the effects of refutation texts on both moral judgment and trust. Understanding and managing uncertainty constitutes a metacomponent of wisdom (Baltes & Staudinger, 2000; Chen & Wang, 2013). As a knowledge system, wisdom involves insight and judgment in complex, uncertain situations. Our mediation findings suggest refutation texts serve as an efficient method for promoting wiser, more scientific thinking. Intolerance of uncertainty and tolerance emerge as proximal factors influencing moral judgment and trust, offering new avenues for research on enhancing patients' uncertainty tolerance and fostering realistic expectations about medical limitations.

Innovations and Practical Recommendations

This study draws from cognitive debiasing strategies to demonstrate a novel pathway for improving patient moral judgment and trust through refutation texts. The integration of three independent variables within realistic scenarios using participants with genuine medical experiences enhances ecological validity.

Our findings suggest refutation texts represent an objective, effective, and easily implementable patient education method. Hospitals could develop disease-specific educational materials highlighting counterintuitive medical facts and display them via electronic devices in public areas to enhance patient knowledge and tolerance for exceptional cases. Additionally, recognizing patients' outcome-oriented thinking, both parties should acknowledge these cognitive differences and seek balance between subjective feelings and objective medical judgment. Physicians should understand laypeople' s help-seeking patterns and use questioning to guide patients toward more medical-professional thinking. Finally, hospitals should publicize knowledge about appropriate medical testing, helping the public understand that tests serve both diagnostic and exclusionary purposes, thereby reducing expectations of perfect accuracy and increasing

acceptance of false positives and error rates.

Limitations and Future Directions

First, our carefully crafted refutation texts used counterintuitive medical knowledge likely to evoke surprise and interest rather than cognitive load from "emotional taxation" (Thunström, 2019), potentially increasing acceptance. Whether similar effects occur with more mundane medical knowledge requires verification.

Second, to avoid conflicts with deeply held values, our materials deliberately avoided contentious topics (e.g., "postpartum bathing," "donkey-hide gelatin' s blood-enriching effects") that involve traditional vs. modern medical philosophy conflicts. Patients might reject such information, seeking support from existing beliefs and potentially experiencing negative emotions that produce backfire effects—strengthening original erroneous beliefs (Lewandowsky et al., 2012). Conversely, positive emotions like surprise facilitate belief change (Trevors, Kendeou, & Butterfuss, 2017). How refutation texts function when medical philosophy conflicts are involved requires further investigation.

Third, mediation mechanisms need deeper exploration. While we examined mediators of refutation text effects, the mechanisms underlying medical outcomes' powerful influence remain unclear. Outcomes likely affect emotions: leukemia diagnoses may induce sadness, while common fever may induce happiness. Sadness increases uncertainty acceptance and neutral attitudes compared to happiness (Baillon, Koellinger, & Treffers, 2014), suggesting emotion as a promising mediating variable. Additionally, intellectual humility—the ability to recognize one' s knowledge limitations (McElroy et al., 2014)—may influence uncertainty tolerance and extreme judgments, warranting investigation. Moreover, the smaller effect sizes for moral judgment mediation compared to trust mediation suggest the need for more robust empirical research on refutation texts' mechanisms.

Fourth, our goal of reducing cognitive differences by aligning patient thinking with medical professionals suggests future research should examine specific medical cognitive beliefs lacking in patients, such as multifactorial disease beliefs (Collins et al., 2003). Laypeople' s failure to recognize that common diseases result from genetic, behavioral, and environmental factors creates conceptual gaps that may undermine trust in health communicators (Levy et al., 2008).

Finally, our field experiment design precluded longitudinal follow-up. Whether single interventions produce durable effects or multiple sessions are required for stable attitude change remains an important question for future research.

Conclusion

Refutation text interventions significantly enhance patient trust and moral judgment toward physicians. Medical outcomes constitute a crucial factor influenc-

ing these evaluations. Intolerance of uncertainty and tolerance toward physicians serially mediate the relationship between refutation texts and both trust and moral judgment. These findings provide a novel, evidence-based approach to reducing cognitive biases and fostering more resilient doctor-patient trust.

Appendices

Appendix 1: Refutation Text Intervention Materials

Item 1: Kidney transplantation involves replacing a diseased kidney with a healthy one. (True/False)
Answer: False. Kidney transplantation involves transplanting a healthy kidney into the patient without removing the diseased kidney, so transplant recipients typically have three kidneys (Chen & Wang, 2013, p. 174).

Item 2: Direct relatives should not donate blood to each other. (True/False)
Answer: True. The probability of graft-versus-host disease is significantly higher and often fatal in direct relative transfusions (Ye, 2015).

Item 3: Repeatedly boiled drinking water affects health. (True/False)
Answer: False. While long-simmered broth (also repeatedly boiled) is often considered healthy despite high purine content, many suspect repeatedly boiled water is unhealthy. Experimental research shows repeated boiling does not affect water quality (Shen & Zhang, 2011).

Item 4: Anti-inflammatory drugs are antibiotics. (True/False)
Answer: False. Antibiotics inhibit or kill bacteria, fungi, and other pathogens, whereas anti-inflammatory drugs target symptoms like redness, swelling, heat, and pain without directly acting on disease-causing agents (Huang & Zhou, 2014).

Item 5: The human eye cannot sense temperature changes. (True/False)
Answer: True. The eye lacks temperature receptors, and the cornea and sclera have minimal heat dissipation. Continuous eye movement generates heat, making the eye insensitive to external temperature changes (Zhao & Yang, 2013, p. 5).

Appendix 2: Four Scenario Descriptions

a. Mr. Wang complied with the doctor' s recommendation. Bone marrow puncture results were normal. The doctor prescribed fever medication, and the child recovered within two days.

b. Mr. Wang complied. Bone marrow puncture revealed lymphocytic leukemia. Timely diagnosis and treatment prevented disease progression.

c. Mr. Wang refused the recommendation and insisted on fever medication. The child recovered within two days.

d. Mr. Wang refused. The child' s condition did not improve. Subsequent bone marrow puncture revealed lymphocytic leukemia. Delayed diagnosis worsened the condition.

Appendix 3: Chinese Doctor-Patient Trust Scale (Patient Version, Section B)

Rate from Strongly Disagree to Strongly Agree:
1. The doctor promptly inquires about the patient' s condition
2. I feel the doctor genuinely cares about patients
3. The treatment effect exceeded my expectations
4. This hospital' s procedures are efficient
5. I believe the doctor treats all patients equally
6. The doctor promptly answers my questions
7. I will see this doctor again in the future
8. I feel the doctor won' t communicate patiently even when having time
9. The treatment process matched my expectations
10. I will recommend this doctor to friends and family
11. I believe the doctor provides personalized service when needed
12. I am satisfied with the treating doctor
13. The doctor does their utmost for patient treatment

Appendix 4: Intolerance of Uncertainty Scale

Rate from Strongly Disagree to Strongly Agree:
1. Unpredictable events seriously upset me
2. I feel frustrated when I don' t have all the information I need
3. Uncertainty makes my life deficient
4. People should always plan ahead to avoid surprises
5. Even perfect plans can be ruined by small accidents
6. I hesitate to act because of uncertainty
7. I perform poorly when feeling uncertain
8. I always want to know what the future holds
9. I cannot handle surprises
10. Even small doubts prevent me from acting
11. I should be able to plan everything in advance
12. I must avoid all uncertain situations

Appendix 5: Tolerance Toward Physicians Subscale

Rate from Strongly Disagree to Strongly Agree:
1. Medical staff rarely understand patients' difficulties
2. Medical staff involved in accidents should receive the harshest punishment
3. Medical staff' s efforts remain commendable even when treatment fails
4. Harm caused by medical errors is unforgivable
5. Responsible doctors should apologize to patients and families after errors
6. Patients should be prepared for treatment outcomes not meeting expectations

Tables 1-3 in Appendix 6 present detailed statistical results for control variable analyses across all experiments.

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