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Article

Carrot or stick? The impact of reinforcement and government trust on persuading vaccine-hesitant parents during the pandemic

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Abstract: This study examined the effectiveness of different vaccination promotional strategies among parents of unvaccinated children aged 12–17 years during the COVID-19 pandemic. Using a 2 (reinforcement: positive vs. negative) × 2 (trust in government: high vs. low) between-subjects experimental design with 286 participants, we investigated how reinforcement strategies interact with government trust to influence parental attitudes and intentions toward child vaccination. Results revealed no significant main effect of reinforcement type on vaccination attitudes or intentions. However, trust in government emerged as a powerful predictor of both outcomes, with high-trust parents demonstrating substantially more positive attitudes and stronger intentions to vaccinate their children compared to low-trust parents. Importantly, significant interaction effects were observed—parents with low government trust responded more favorably to positive reinforcement (incentives) than negative reinforcement (restrictions), while parents with high government trust showed similar responses to both approaches. These findings highlight the critical role of trust in vaccine communication and suggest that tailored reinforcement strategies based on pre-existing trust levels may improve communication effectiveness. As declining vaccination rates for routine childhood immunizations create new public health vulnerabilities, these insights offer practical guidance for developing targeted vaccination campaigns that can effectively reach diverse populations, particularly those most resistant to standard public health messaging.

Keywords: vaccine hesitancy; COVID-19; parental decision-making; government trust; reinforcement theory; health communication; childhood vaccination; public health messaging; pandemic response

1. Introduction

As health experts warn of future infectious disease crises potentially more severe than COVID-19 [1,2], understanding effective vaccine promotion strategies has become increasingly urgent—particularly as pandemic-era hesitancy now affects routine childhood immunizations. Vaccination remains one of the most effective protective measures against infectious diseases [3], yet declining immunization rates for diseases like measles are creating new public health vulnerabilities, with some Texas counties reporting over 10% of kindergarteners have non-medical exemptions from school vaccination requirements [4]. The lessons learned from COVID-19 vaccination campaigns offer critical insights that could help reverse these concerning trends and better prepare public health systems for future outbreaks.

This need for effective vaccination strategies is particularly evident in the United States, which implemented the most diverse array of vaccine promotion policies during the COVID-19 pandemic. Specifically, strategies providing positive incentives (i.e., positive reinforcement) and those limiting access to public places for the unvaccinated (i.e., negative reinforcement) were extensively used in combination

throughout the country. Despite their widespread implementation, empirical evidence comparing the effectiveness of these different approaches remains scarce. Also, while researchers have extensively studied vaccination perceptions and behaviors [5,6], few have empirically tested which specific promotional messages effectively persuade parents of unvaccinated children—a critical population during public health emergencies when childhood vaccination is strongly encouraged. Therefore, this study focuses specifically on families with unvaccinated children to develop optimal communication strategies that might increase childhood vaccination rates by evaluating both positive and negative reinforcement approaches among this hesitant population.

A critical factor often overlooked in reinforcement strategy-related research, however, is the role of government trust in mediating message effectiveness. Vaccine hesitancy does not exist in a social vacuum but is frequently intertwined with broader attitudes toward institutions and authorities. During the COVID-19 pandemic, trust in government emerged as a significant predictor of vaccination willingness [7,8], with vaccination rates varying dramatically across political and ideological divides. This suggests that reinforcement strategies may not operate uniformly across different population segments. Parents with low government trust may interpret and respond to vaccination incentives or restrictions differently than those with high trust, potentially rendering some approaches counterproductive for certain groups. Hence, understanding these interaction effects between reinforcement type and government trust is essential for developing targeted, effective vaccination campaigns that can reach diverse populations—particularly those most resistant to standard public health messaging. This study addresses this crucial gap by examining how trust levels moderate the effectiveness of different reinforcement strategies.

Therefore, the purpose of this study is to examine the effectiveness of positive and negative reinforcement, which are commonly practiced vaccine-promotional strategies during the recent pandemic, among parents reluctant about vaccinating their children. Specifically, we explored how the effect of different messages varies between those with high versus low levels of trust in the government. This study may shed light on the ways in which vaccination-promotional messages can reach various groups of people and be better received, with implications for both emergency response during infectious disease outbreaks and ongoing efforts to maintain high vaccination coverage for routine childhood immunizations.

2. Literature review

2.1. COVID-19 vaccination rate and its impact on children's vaccine uptake

The COVID-19 pandemic has had profound effects on healthcare systems worldwide, extending beyond the direct impacts of the virus itself to influence broader health behaviors, including routine childhood immunizations. Recent evidence suggests a concerning relationship between COVID-19 vaccination hesitancy and reduced uptake of established childhood vaccines, creating what some researchers have termed a "spillover effect" of pandemic-era vaccine concerns [9].

Prior to the pandemic, global childhood vaccination rates had reached historic highs. However, data from the World Health Organization and UNICEF indicate that the pandemic triggered the largest sustained decline in childhood vaccinations in three decades [10]. In the United States specifically, the Center for Disease Control and Prevention (CDC) reported that for the 2021–2022 school year, kindergarten vaccination coverage decreased to approximately 93% for DTaP, MMR, and varicella vaccines—falling below the 95% target necessary for community protection against diseases like measles [11]. This troubling trend continues, with some states experiencing more dramatic declines. For example, Texas has reported counties where over 10% of kindergarteners now have non-medical exemptions from school vaccination requirements [4].

Research by Trujillo et al. [9] demonstrates that hesitancy about COVID-19 vaccines correlates strongly with hesitancy toward other childhood vaccines, suggesting that attitudes formed during the pandemic may generalize to other immunizations. This pattern appears most pronounced among parents who declined COVID-19 vaccination for their children, who subsequently became more skeptical of established vaccines they had previously accepted. Particularly concerning is evidence from Grills and Wagner [12] showing that parents who expressed the strongest resistance to COVID-19 vaccination were more likely to reconsider previously accepted routine immunizations for their children.

The consequences of this hesitancy are already becoming apparent. Measles outbreaks have occurred in multiple states, with the CDC [11] reporting more cases in 2023 than in the previous five years combined. Similarly, concerning patterns have emerged for pertussis and other vaccine-preventable diseases. These trends underscore the critical importance of developing effective persuasion strategies specifically targeting parents and guardians of unvaccinated children. Therefore, understanding which strategies—whether based on positive reinforcements or negative reinforcements—most effectively reach vaccine-hesitant parents is essential not only for preparing for future pandemics but also for reversing current declines in routine childhood immunization.

2.2. Vaccine promotion strategies: Positive and negative reinforcement

Among various vaccine promotional strategies, the most commonly employed approaches involve either providing incentives (positive reinforcement) or restricting access to public spaces for the unvaccinated (negative reinforcement). These approaches are grounded in reinforcement theory, which originated from B. F. Skinner's operant conditioning principles suggesting that behavior can be effectively modified through systematic consequences [13]. When applied to vaccination promotion, these distinct reinforcement strategies represent fundamentally different approaches to encouraging the same health behavior.

Positive reinforcement involves the addition of a rewarding stimulus following a desired behavior, thereby increasing the likelihood of that behavior recurring [13,14]. Operationally defined, positive reinforcement in vaccination contexts consists of tangible incentives (e.g., monetary rewards, gift cards, lottery entries) or social benefits (e.g., public recognition, social approval) provided contingent upon receiving

vaccination. For example, during the COVID-19 pandemic, numerous states implemented positive reinforcement strategies such as Ohio's "Vax-a-Million" lottery, which offered $1 million prizes and college scholarships to vaccinated residents [15]. Similarly, New York City offered $100 prepaid debit cards to residents receiving their first vaccine dose [16].

Negative reinforcement, in contrast, involves the removal of an aversive stimulus following the desired behavior, which similarly reinforces that behavior [17,18]. It is crucial to distinguish negative reinforcement from punishment; while punishment aims to decrease behavior through negative consequences, negative reinforcement increases behavior through the removal of restrictions or penalties [19]. In vaccination contexts, negative reinforcement is operationally defined as the lifting of restrictions or requirements (e.g., testing mandates, access limitations, quarantine requirements) contingent upon vaccination status [20]. During the COVID-19 pandemic, negative reinforcement strategies included allowing vaccinated individuals to forego mask requirements in certain settings, exemption from testing requirements, and permission to engage in activities otherwise restricted, such as international travel without quarantine.

Both positive and negative reinforcement strategies have demonstrated effectiveness in health promotion contexts. Positive reinforcement has shown efficacy in substance use treatment through contingency management [21], improved medication adherence through financial incentives [22], and increased participation in preventive health behaviors [23]. Similarly, negative reinforcement has proven effective in vaccination contexts through school entry requirements [24], activity-specific mandates [20], and emphasizing restriction removal following vaccination [25]. During the COVID-19 pandemic, workplace mandates and access restrictions increased vaccination intentions when perceived as legitimate rather than coercive [26].

Despite evidence supporting both approaches, research examining reinforcement strategies has yielded inconsistent findings with no clear consensus on their comparative effectiveness. Some studies highlight limitations of negative reinforcement, with Schmelz and Bowles [27] finding that mandatory approaches triggered psychological reactance among populations with pre-existing distrust in authorities, while Sprengholz et al. [26] discovered negative reinforcement strategies were sometimes counterproductive when targeting individuals with low institutional trust. Comparative studies have yielded particularly mixed results: Adams et al. [23] found insufficient evidence to determine whether financial incentives or quasi-mandatory interventions were more effective for increasing childhood vaccination acceptance; Thirumurthy et al. [28] observed no significant overall difference between incentive and mandate approaches during the COVID-19 pandemic, though they noted differential effects across subpopulations; and Naeim et al. [29] reported that both approaches increased vaccination intentions in some contexts, but their relative effectiveness varied substantially based on demographic and psychosocial factors.

This inconsistent evidence highlights the absence of clear guidelines regarding which reinforcement approach is superior for promoting childhood vaccinations. Therefore, the current study poses the following research question:

Research question 1a–b: How do positive versus negative reinforcement-based

vaccination-promotional messages affect (a) parental attitudes toward vaccination for children and (b) parental intentions to vaccinate their children?

2.3. A crucial factor in vaccine decision-making: Trust in government

The effectiveness of both positive and negative reinforcement appears highly contingent on contextual factors including pre-existing attitudes, trust levels, cultural context, and implementation approach. These mixed findings underscore the need for empirical research that directly compares reinforcement strategies while accounting for potential variables such as trust in government—precisely the gap that the current study addresses.

Trust in government is a foundational element of public health infrastructure, particularly crucial during large-scale infectious disease crises. When citizens trust their government, they are more likely to comply with public health measures, including vaccination [30]. This trust becomes essential during emergencies when governments must quickly mobilize resources, implement protective policies, and communicate effectively with the public [31,32].

The relationship between government trust and health behaviors is well-established in the literature. Quinn et al. [33] found that trust in government was a significant predictor of H1N1 vaccine acceptance during the 2009 pandemic, with higher trust associated with greater willingness to follow vaccination recommendations. Similarly, Jennings et al. [8] conducted a comprehensive analysis of COVID-19 vaccine hesitancy and identified trust in government as one of the strongest predictors of vaccination intention, alongside trust in science and healthcare systems. This finding has been corroborated by multiple studies during the COVID-19 pandemic [7,34,35].

The mechanisms through which government trust influences vaccination behavior are multifaceted. First, trust functions as a heuristic that reduces decision complexity; individuals with high trust are more likely to accept government recommendations without extensive personal research [36]. Second, trust mitigates perceived risks associated with vaccines; Larson et al. [37] demonstrated that individuals with higher trust perceive fewer risks and greater benefits from vaccines. Third, trust facilitates the acceptance of information from official sources, reducing susceptibility to misinformation [38].

Conversely, mistrust in government often precipitates adverse public health outcomes. Lee et al. [39] found that distrust in government was significantly associated with vaccine refusal in the United States, even after controlling for demographic and ideological factors. During the COVID-19 pandemic, this pattern intensified. Freeman et al. [40] demonstrated that individuals with low trust in government were not only less likely to accept vaccination but also more susceptible to conspiracy theories and misinformation about vaccines, creating a self-reinforcing cycle of hesitancy. Furthermore, when individuals distrust government, they may adopt maladaptive practices that exacerbate health crises, such as delaying care-seeking, using unproven remedies, or deliberately contravening public health recommendations [41,42].

Trust in government varies significantly across demographic and ideological

subgroups, creating disparities in health behavior compliance. In the United States, political polarization has significantly impacted trust patterns, with conservatives reporting lower trust in federal health agencies during Democratic administrations and vice versa [43,44]. This politicization of trust has concrete health consequences; Fridman et al. [45] found that during the COVID-19 pandemic, partisan gaps in trust translated directly into disparities in vaccination rates, with counties that voted predominantly Republican having significantly lower vaccination rates than predominantly Democratic counties.

This political dimension of trust is particularly relevant for childhood vaccination. Hamel et al. [46] reported that during the Republican parents expressed lower intentions to vaccinate their children against COVID-19, with distrust in government cited as a primary reason. A concerning extension of this phenomenon is the spillover effect on routine childhood immunizations. Based on the clear role of trust in government in vaccine communication, the study posited the following hypothesis:

Hypothesis 1a–b: People who trust government will show higher (a) parental attitudes toward vaccination for children and (b) parental intention to vaccinate their children than those who have low trust in government.

The intersection of trust in government and reinforcement strategies remains critically understudied despite theoretical frameworks suggesting their important interaction. Psychological reactance theory [47] predicts negative reinforcement from distrusted sources may trigger stronger resistance [20], while the Elaboration Likelihood Model indicates message processing varies with source credibility [48]. This interaction suggests public health officials should tailor approaches to community trust levels—using straightforward reinforcement in high-trust contexts while incorporating trust-building initiatives where trust is low [49,50]. Given the established importance of trust in government for vaccination behavior and the theoretical basis for expecting interactions with reinforcement strategies, this study addresses two critical research questions:

Research question 2a–b: How do the effects of positive versus negative reinforcement-based vaccination promotional messages on (a) parental attitudes toward vaccination for children and (b) parental intentions to vaccinate their children vary between parents high and low in their trust in the government?

By examining these questions, this study will contribute to understanding how public health officials can most effectively promote vaccination among diverse population segments, particularly those characterized by varying levels of government trust.

3. Method

A 2 (reinforcement: positive vs. negative) × 2 (trust in government: high vs. low) between-subjects experiment was conducted. A total number of 286 parents and guardians of unvaccinated children during the pandemic were recruited through Amazon Mechanical Turk. Most of the participants were fathers (57.7%), Caucasian (72.2%), and the average age was 41 years old (SD = 7.82). Participants received $1.00 compensation for completing the study and were qualified if they identified themselves as parents and guardians of unvaccinated children aged between 12 and 17,

and located in the U.S. **Table 1** illustrates the detailed demographic information of the participants.

Table 1. Demographic characteristics of study participants (N = 286).

Characteristic	*n*	%
Role		
Mother	116	40.6
Father	165	57.7
Other (e.g., grandparent, foster parent)	5	1.7
Race/Ethnicity		
White/Caucasian	207	72.2
African American/Black	25	8.7
Asian/Pacific Islander	22	7.7
Hispanic/Latino	22	7.7
Native American	8	2.8
Other	1	0.3
Age	M = 41.1	SD = 7.82

Note. Percentages may not sum to 100% due to rounding.

This study specifically targeted parents of unvaccinated children aged 12–17 years in the United States—a population of particular importance for public health interventions. This age group was intentionally chosen because adolescents represent a critical demographic for pandemic vaccination due to their extensive participation in group activities, yet they showed only a 39% COVID-19 vaccination rate during the pandemic [51]. Also, parents who chose not to vaccinate their children against COVID-19 were selected for several key reasons: their decision indicates pre-existing vaccine hesitancy, making them precisely the audience that public health campaigns need to persuade. Hence, understanding how to effectively communicate with this population is therefore crucial not only for COVID-19 vaccination but also for maintaining childhood immunization rates more broadly. By sampling this population, our study examines communication strategies with those who present the greatest challenge—and greatest opportunity—for increasing childhood vaccination rates.

Procedure. This study received approval from the institutional review board (IRB), with an informed consent form provided on the first page of the online survey. The study had no external funding sources and no conflicts of interest. Following consent, participants completed a screening questionnaire that identified eligible parents or guardians of unvaccinated children aged 12–17 years. Qualified participants (N = 286) were randomly assigned to either the positive reinforcement condition (n = 138) or negative reinforcement condition (n = 148).

Participants in each condition viewed two thematically consistent messages (e.g., gift card and scholarship topics in the positive reinforcement condition). After viewing each message, participants completed manipulation check items and measures of the dependent variables. Demographic information, including trust in government and political viewpoints, was collected at the survey's conclusion, followed by a debriefing page that disclosed the use of fictitious messages.

Stimulus messages. Fictitious Instagram posts promoting COVID-19 child vaccination by a state health department were created for each experimental condition. Instagram was selected as the experimental platform because approximately 85% of social media users who get news from social media receive vaccine-related news from Instagram [52]. This approach allowed realistic simulation of governmental vaccine communications while maintaining experimental control.

The messages operationalized reinforcement type through either incentives (i.e., positive reinforcement) or avoidable restrictions (i.e., negative reinforcement). To reduce potential topic-specific effects, two different scenarios were used for each reinforcement type. Positive reinforcement messages offered either (a) a chance to win one of five $100,000 college scholarships or (b) a $100 gift card upon vaccination. Negative reinforcement messages highlighted restrictions on (a) after-school extracurricular activities or (b) school sports participation for unvaccinated children. All messages contained identical information about COVID-19 vaccine availability for children 12–17 years old, with manipulated content specific to the reinforcement condition. All messages were pilot-tested with a separate sample (n = 45) to ensure they were perceived as intended.

Measures

Trust in government. Trust in government was measured using a single item: 'How much do you trust the federal government in terms of their COVID-19 pandemic management?' on a 7-point scale (1 = not at all trust, 7 = very much trust; M = 4.96; SD = 1.85) [53]. For analysis purposes, we created a dichotomous variable by splitting at the midpoint, with scores 4 or lower coded as low trust (0) and scores 5 or higher coded as high trust (1).

Attitudes toward child vaccination. Attitudes toward child vaccination were measured using nine semantic differential items adapted from Walsh [54]: bad/good, negative/positive, harmful/beneficial, unwise/wise, threatening/assuring, risky/safe, worrying/reassuring, unimportant/important, and worthless/worthwhile. Participants responded on 7-point scales, and the mean score was calculated with higher scores indicating more positive attitudes (Cronbach's α = 0.97, M = 5.17, SD = 1.60).

Intention to get child vaccinated. Intention to vaccinate was measured with the item, 'I will get my child vaccinated against COVID-19 within the next two months' using a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) (M = 4.94, SD = 1.73).

Control variable. Political viewpoint was assessed using a single item, 'How would you describe your political views?' on a 5-point scale (1 = very conservative, 5 = very liberal). It was controlled in analyses, as previous research has established that COVID-19 vaccination rates are lower among those with politically conservative viewpoints [55].

4. Results

4.1. Manipulation check

An independent-samples t-test was performed to verify the manipulation.

Participants were asked to indicate whether they perceived the given message as addressing a reward that could be attained by getting vaccinated or a restriction that could be avoided by getting vaccinated, using a semantic differential scale. Participants in the positive reinforcement condition (M = 5.86, SD = 1.25) perceived the messages significantly differently than those in the negative reinforcement condition (M = 4.12, SD = 2.25), $t(284) = -7.99$, $p < 0.001$, confirming the successful manipulation of reinforcement type.

4.2. Research questions and hypothesis testing

A series of one-way ANCOVAs was performed to examine the main effects of reinforcement type on parental attitudes (RQ1a) and intentions toward child vaccination (RQ1b). The results showed no significant differences between the positive reinforcement (M = 5.30, SD = 1.48) and negative reinforcement (M = 5.04, SD = 1.70) conditions in parental attitudes toward vaccination, $F(1, 282) = 1.67$, $p = 0.20$, $\eta^2 = .016$. Similarly, no significant differences were found in parental intentions to vaccinate their children between the positive reinforcement (M = 5.03, SD = 1.56) and negative reinforcement (M = 4.85, SD = 1.88) conditions, $F(1, 282) = 0.55$, $p = 0.46$, $\eta^2 = .018$.

Hypothesis 1 predicted that parents with high trust in government would show more positive attitudes and stronger intentions toward child vaccination compared to those with low trust. The results strongly supported this hypothesis. The main effect of trust in government was significant for parental attitudes toward child vaccination, $F(1, 280) = 198.02$, $p < 0.001$, $\eta^2 = .035$, with parents reporting high government trust expressing substantially more positive vaccination attitudes than those with low government trust. Similarly, a significant main effect of trust in government was found for vaccination intentions, $F(1, 280) = 197.95$, $p < 0.001$, $\eta^2 = 0.040$, with high-trust parents reporting much stronger intentions to vaccinate their children than low-trust parents. These findings confirm that trust in government is a powerful predictor of both vaccination attitudes and behavioral intentions among parents of unvaccinated children. **Table 2** presents the mean and standard deviation of the results.

Table 2. The role of trust in government in attitude and intention.

	Attitude toward vaccination		**Intention to vaccinate children**	
	M	***SD***	***M***	***SD***
Low trust	3.62	1.84	3.27	2.01
High trust	5.84	0.84	5.67	0.88

A series of two-way ANCOVAs was performed to examine interaction effects of reinforcement type and government trust on parental attitudes (RQ2a) and intentions toward child vaccination (RQ2b). As presented in **Figure l**, the result revealed a significant interaction effect between reinforcement type and levels of trust in government on parental attitudes toward vaccination for children, $F(l, 280) = 4.01$, $p < 0.05$, $\eta^2 = 0.054$. Parents low in government trust reported more positive attitudes toward the vaccination when presented with the positive reinforcement (M = 3.95, SD = 0.19) message rather than the negative reinforcement message (M = 3.33, SD = 0.17),

$F(1, 280) = 5.63$, $p < 0.05$, $\eta^2 = 0.045$. There was not a significant difference in child vaccination attitudes between the positive and negative reinforcement message conditions, when the message was presented to those with high trust in government, $F(1, 280) = 0.00$, $p = 0.97$, $\eta^2 = 0.016$.

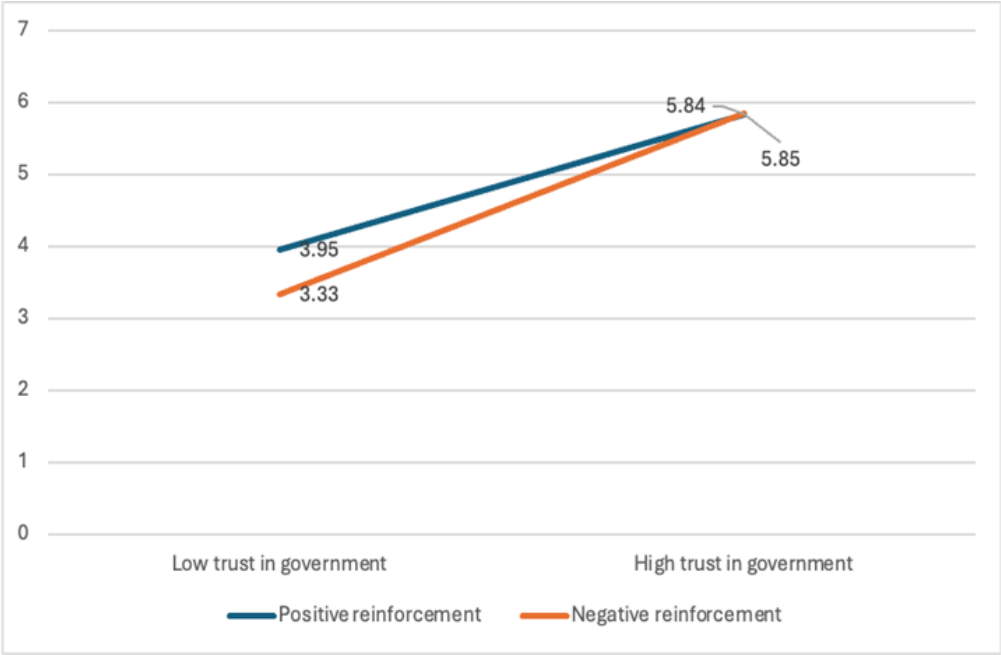

Figure 1. Interaction between reinforcement type and government trust on parental attitudes toward child vaccination.

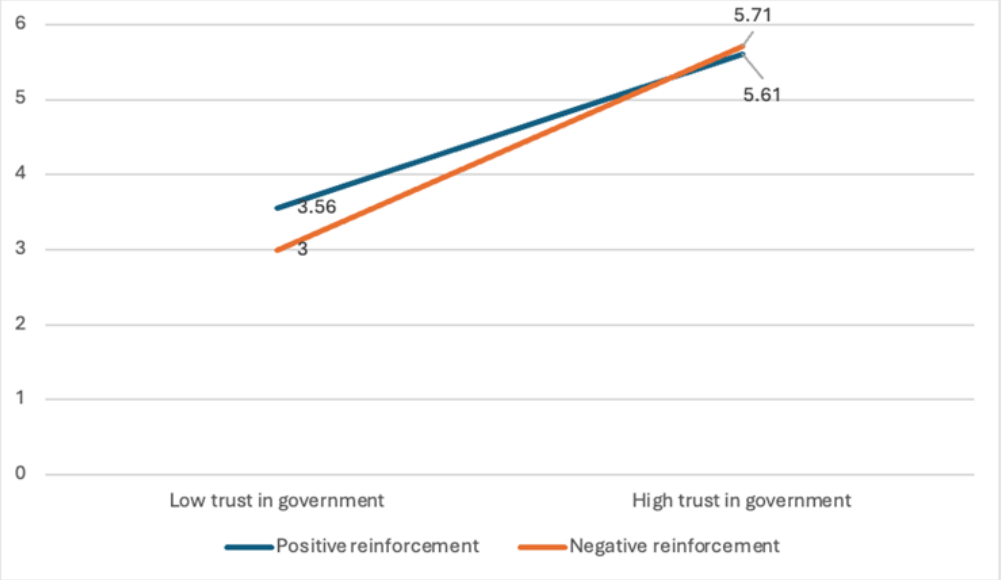

Figure 2. Interaction between reinforcement type and government trust on parental intention for child vaccination.

Also, as presented in **Figure 2**, a significant interaction effect was found on parental intentions to get their child vaccinated, $F(1, 280) = 4.00$, $p < 0.05$, $\eta^2 = 0.021$. Those who were low in government trust reported a higher intention to get their child vaccinated when presented with the positive reinforcement message ($M = 3.56$, $SD =$

0.21) rather than the negative reinforcement message (M = 3.00, SD = 0.19), F(l, 280) = 3.89, $p < 0.05$. $\eta^2 = 0.025$. There was not a significant difference in vaccination intention between positive and negative reinforcement, when the message was presented to those with high trust in government, F(l, 280) = 0.41, $p = 0.52$, $\eta^2 = 0.016$.

5. Discussion

The study aimed to develop tailored vaccination promotional messages targeted at parents and guardians of previously unvaccinated children to ensure their health during future pandemics and diseases caused by low vaccination rates. To do so, the study tested the role of reinforcement strategies (e.g., positive reinforcement and negative reinforcement) and trust in government as main factors that affect parental decision-making.

5.1. Trust as a fundamental determinant of vaccine communication effectiveness

The most significant implication of this study is that trust between government sources providing vaccine information and parents represents an essential foundation for effective vaccine communication. Our findings indicate that trust in government is a significant predictor of vaccination attitudes and intentions, with a substantial difference in vaccination intention scores between low-trust and high-trust parents. This large effect size suggests that while tailored messaging strategies can improve outcomes, addressing the underlying trust deficit remains essential for achieving sufficient vaccination rates in target populations.

These results align with longitudinal studies of COVID-19 vaccine acceptance [7,56] that identified trust in government as a persistent predictor of vaccination behavior across different populations and phases of the pandemic. As Larson et al. [37] emphasized, trust is a fundamental determinant of vaccine hesitancy, and our findings provide empirical support for this relationship.

5.2. Tailoring communication strategies based on trust levels

This research provides concrete evidence that different vaccine communication approaches should be tailored according to trust levels. Notably, the study revealed that positive reinforcement is the most effective strategy for people with low trust—the most critical target group—establishing a foundation for developing optimal strategies in vaccine communication. While positive reinforcement was more effective than negative reinforcement for parents with low government trust, the overall vaccination intention scores remained substantially lower in this group compared to parents with high government trust.

This offers practical guidance, as most U.S. states have clear political stances, making it possible to implement customized strategies aligned with each state's basic attitude toward the government and corresponding trust levels. Similar to findings by Pennisi et al. [57] who highlighted the importance of tailored approaches to vaccine messaging, our research supports the need for regionally tailored communication strategies.

5.3. Theoretical implications for reinforcement theory

These results also reveal important considerations regarding the practical utility of reinforcement theory in health communication. The study identifies variables that must be considered when determining which specific reinforcement types can be effective in particular situations, expanding the theoretical implications and research scope. This aligns with Quinn et al. [58], who proposed that message effectiveness depends significantly on audience characteristics and pre-existing attitudes.

Our findings suggest that reinforcement theory must account for pre-existing trust relationships when predicting message effectiveness, particularly in contexts where the message source's credibility significantly impacts reception. Public health officials should therefore prioritize trust-building initiatives along with appropriate reinforcement strategies when promoting child vaccination during infectious disease crises.

5.4. Future research directions

Future research can extend beyond COVID-19 pandemic vaccine communication to studies focused on the uptake of various vaccines. As Brewer et al. [59] suggested, principles of effective vaccine communication can be adapted across different vaccine contexts while maintaining core trust-building elements. Also, this study focused specifically on unvaccinated parents, concentrating on elements that could elicit positive attitudes and higher intentions toward vaccination. The study did not conduct a comparative study of pre- and post-intervention attitudes. Follow-up research should examine the degree to which existing attitudes and intentions improved, allowing for more detailed exploration of the effects and implications of each strategy. Such longitudinal approaches, as recommended by Thomson et al. [60], would strengthen the evidence base for vaccine communication interventions.

In addition, the primary goal of this study was to examine the main and interaction effects between categorical variables—specifically, reinforcement type and trust in government—within a controlled experimental design. Accordingly, the analysis focused on group differences, categorizing trust in government into high and low groups. While this approach allowed us to assess between-group differences, it limited our ability to explore how varying levels of trust might influence vaccination decisions across a broader spectrum. Treating trust as a continuous variable and applying regression analysis could have provided a more nuanced understanding of the factors most strongly associated with vaccination decisions. Future research may benefit from employing regression techniques with continuous variables to identify potential linear effects and uncover more detailed patterns beyond group-level comparisons.

Lastly, the study exclusively focused on parents of unvaccinated children aged 12–17. This age group was intentionally selected due to their relatively low COVID-19 vaccination rate compared to other age groups. However, given the overall decline in routine childhood vaccination rates, future studies should consider including a wider age range to gain a more comprehensive understanding of how parental decision-making processes may vary across different stages of child development.

Institutional review board statement: The study was conducted in accordance with the Declaration of Helsinki. All experimental protocols were approved by Ball State University IRB review board. protocol code [2087099-1].

Informed consent statement: Informed consent was obtained from all subjects involved in the study.

Conflict of interest: The author declares no conflict of interest.

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