# The Carrot or the Stick?: Effects of Reinforcement and Trust in Government on Parental Decision on Vaccination for Teens during an Infectious Disease Crisis

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*Article*

# The Carrot or the Stick?: Effects of Reinforcement and Trust in Government on Parental Decision on Vaccination for Teens during an Infectious Disease Crisis

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**Abstract:** This study investigated how positive (e.g., incentives) and negative (e.g., restrictions) reinforcement used in vaccination promotional messages and trust in government impact parental vaccine perceptions and decisions on vaccinating their children during a large-scale infectious disease crisis. Two hundred and eighty-six parents of unvaccinated teens participated in a 2 (reinforcement: positive vs. negative) × 2 (trust in government: high vs. low) between-subjects experimental survey. Positive reinforcement (e.g., gift cards for the vaccinated) was more effective for parents with low trust in the government to improve their attitudes and intentions toward child vaccination, while parents with high trust in the government were unaffected by reinforcement types. To the best of our knowledge, this study is among the first to examine the effects of both positive and negative reinforcement on vaccination perceptions and behavioral intentions through a controlled experiment and is the first study to do so in a large-scale infectious disease crisis setting. This research is expected to help public health professionals better prepare for and manage virus-induced public health crises in the future.

**Keywords:** reinforcement; vaccination; incentives; child vaccination; trust in government

## 1. Introduction

Since the unprecedented challenges posed by the COVID-19 pandemic, health professionals have warned that the world may experience similar infectious disease crises in the future, which may be even more threatening than the recent pandemic [25,36]. It is worth making continuous efforts to better prepare for and respond to the next infectious disease crisis based on what we have learned from the COVID-19 pandemic. Vaccination, if available, is one of the most effective ways to protect individuals and communities from infection [37]. Therefore, it is important to develop effective vaccine-promotional messages to help more people understand the benefits of vaccines and increase vaccination rates.

Anti-vaccine sentiments and vaccine hesitancy have existed since vaccines have become widely available, regardless of the disease they target. Worries about vaccines, such as concerns about side effects and lack of confidence in their effectiveness [21], as well as mistrust in government, have been found to be barriers to vaccination [13,25]. In fact, during the recent COVID-19 pandemic, people who mistrusted the government resisted efforts to promote vaccination [2,12].

However, the cost of a situation where vaccination rates are low is higher for populations more vulnerable to the given disease, particularly children. During the COVID-19 pandemic in the United States, Republicans, who were known to have higher levels of mistrust in the government's direction for pandemic management, reported lower levels of intent to vaccinate their children than their counterparts [12]. To mitigate the mistrust-driven divide in vaccination rates and better protect children from future infectious disease threats, it is imperative to develop and implement effective communication strategies to boost parental intent to vaccinate their children.

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In the United States (and many countries around the world), governments and public health sectors implemented various types of vaccine-promotional strategies during the COVID-19 pandemic, including providing incentives (positive reinforcement) and regulating access to places and services (negative reinforcement). However, empirical evidence about which type of reinforcement is more effective is lacking, leading to controversy over the effectiveness of vaccination promotional programs. Although many studies have looked at vaccination-related perceptions and behaviors among parents and individuals in general (e.g., [21,31]), there has been limited research to identify and empirically test vaccine-promotional messages to convince parents of unvaccinated children in a situation where children's vaccination is strongly encouraged.

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, the present study 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.

## 2. Literature Review

### *2.1. Positive and Negative Reinforcement*

Reinforcement theory posits that a desired behavior, such as vaccination, can be increased or repeated when rewards are promised for well-performed behavior (positive reinforcement; e.g., rewards given to those who choose to get vaccinated) or when unpleasant stimuli are removed to encourage the desired behavior (negative reinforcement; e.g., restrictions removed when vaccinated) (e.g., [7,19,29]). In the health-related realm, reinforcement theory has often been applied to interventions for psychiatric problems, such as substance use and destructive behaviors, or for health management (e.g., medication adherence) [3].

There has been limited research on the effects of reinforcement in the context of vaccine communication. Reinforcement, particularly negative reinforcement, was not a common communication strategy until the COVID-19 pandemic because, in many cases of disease (except for childhood vaccinations, often assumed to be required), vaccination is encouraged but appealed to the individual's choice. For instance, human papillomavirus (HPV) vaccines and influenza (flu) vaccines are widely recommended, and some health sectors provide incentives to increase uptake of those vaccinations. However, it is uncommon for those who choose not to receive those vaccines to expect or experience restrictions in their personal or social lives.

Unlike other infectious diseases with available vaccines, the COVID-19 pandemic highlighted the need for stronger vaccination promotion and caused many U.S. state and local governments (and some other countries) to employ negative reinforcement through restrictions and mandates, such as limiting access to public places, programs, and services. The negative reinforcement during the pandemic, or the restrictions, ranged from requiring proof of vaccination or a negative test result to travel [6] to restricted access to in-person environments in workplaces [14] to restricted entry to concerts and festivals [9]. After the vaccine became available for teens, in some states unvaccinated teens were not allowed to use school cafeterias and gyms or to participate in sports and other extracurricular activities [23]. While both positive and negative reinforcement strategies were used as attempts to increase COVID-19 vaccination rates, there were questions about whether such reinforcement strategies would actually contribute to improving the vaccination rates.

Due to mixed findings and a dearth of extensive research on the effects of reinforcement-based strategies on vaccination, it is difficult to predict or gain a clear insight about the effect of positive and negative reinforcement on vaccination-related perceptions and behaviors during a large-scale infectious disease crisis. Albeit not specific to a large-scale infectious disease crisis context, Adams et al. [1] report that there is insufficient evidence to conclude that one strategy is more effective than the other between financial incentives and quasi-mandatory interventions (restricting access to childcare or educational settings) in increasing the acceptability of child vaccinations, and there needs to be

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more context-specific research. Regarding vaccination-promoting strategies during the COVID-19 pandemic, some research found both positive (incentives offering) and negative reinforcement (vaccine mandates for sporting events or travels) to be effective in increasing intention to get vaccinated [22], while others found no significantly positive effect of vaccine incentives (versus no incentives) on the actual vaccination behavior [32].

Given that future infectious disease crises similar to the COVID-19 pandemic have been expected, research is warranted to empirically examine the effectiveness of different reinforcement strategies that are likely to be practiced during the next infectious disease crisis.

### *2.2. Trust in Government*

Trust in government is particularly important during large-scale infectious disease crises because having the public comply with official guidelines (e.g., vaccinating, washing hands, social distancing) is critical to effectively manage the crisis situation and protect as many people as possible [15]. Kim et al. [16] found that the public's confidence in the government's ability to manage the infectious disease crisis situation positively affected compliance with the government-recommended protective behaviors. Also, Dohle et al., [8] suggested trust in politics as one of important predictors of protective measures during an infectious disease crisis.

On the other hand, mistrust in government or health authorities often brings negative consequences during an infectious disease crisis. Research has found that people low in their trust in government were less likely to follow official recommendations during public health crises (e.g., [18,26]). Furthermore, when individuals have low trust in the government's ability to handle the given public health crisis, they may adopt inappropriate practices and further diminish the crisis situation (e.g., relying on and spreading misinformation; [10,15]).

Since individuals with low trust in government may be less likely to comply with vaccination recommendations [17], research is warranted to understand which communication strategy helps with increasing vaccination among those with low government trust.

### *2.3. Parental Attitudes and Intentions toward Child Vaccination*

How parents view vaccination plays a critical role in child vaccination, given that parents often determine whether their child(ren) would be vaccinated or not [30]. Parents who have negative vaccine beliefs may not vaccinate their child(ren) and put the younger population at increased risk (children are often more vulnerable to infection). During the COVID-19 pandemic, parents who had not vaccinated themselves were more likely not to vaccinate their child(ren) as well [27]; Shi et al. [28] reported that the hospitalization rate during the Omicron-predominant period was two times as high among unvaccinated children as among vaccinated children.

Some parents may choose not to vaccinate their children due to their mistrust in the government. In fact, during the Biden (Democratic) administration in the United States, Republicans were often not supportive of the government's pandemic management, and children of Republican parents showed lower vaccination rates than their counterparts [12].

### *2.4. Research Questions*

In aim of examining the effects of different reinforcement strategies for vaccination promotion and varied levels of trust in government on parental perceptions and behaviors for child vaccination during a large-scale infectious disease crisis, the following research questions were raised:

**RQ1a-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?

**RQ2a-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?

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## 3. Method

A 2 (reinforcement: positive vs. negative) × 2 (trust in government: high vs. low) between-subjects experiment was conducted ($N$ = 286). Parents of a child between 12 and 17 years old who reported that they lived in the United States and their child had not been vaccinated against COVID-19 were recruited through Amazon Mechanical Turk. The U.S. Food and Drug Administration authorized the COVID-19 vaccine for children aged 12 years or older in May, 2021 under Emergency Use Authorization [33]. Participants were given 1.00 U.S. dollars as compensation for their participation in the study.

### *3.1. Participants*

Of the 286 parents, 40.6%, 57.7%, and 1.7% reported as mother, father, and other (e.g., grandparent, foster parent, etc.), respectively. Participants were primarily White/Caucasian (72.2%), followed by African American/Black (8.7%), Asian/Pacific Islander (7.7%), Hispanic/Latino (7.7%), Native American (2.8%), and Other (0.3%). Mean age was 41.1 years old ($SD$ = 7.82).

### *3.2. Procedure*

A screening questionnaire was presented first to disqualify those who are not a parent or guardian of a child aged 12 - 17 and whose child has been partially or fully vaccinated against COVID-19. Participants qualified for the study were then randomly assigned into one of the following two conditions: positive reinforcement message ($n$ = 138) and negative reinforcement message ($n$ = 148). Participants in each condition viewed two messages varied in the topic (e.g., topics of gift card and scholarship in the positive reinforcement condition). Manipulation check items and items to measure the dependent variables were given after the presentation of each message. Demographic information, including trust in government and political viewpoints, was collected at the end of the survey and a debriefing page to disclose the use of fictitious messages was presented before closing the survey.

### *3.3. Stimulus Messages*

Fictitious Instagram posts promoting COVID-19 child vaccination by a state health department were created for each experimental condition. Positive and negative reinforcement in the posts were operationalized in terms of incentives which could be attained as a result of vaccination versus restrictions which could be avoided by choosing to get vaccinated. Two different topics were used for each type of reinforcement to reduce potential influence of a particular topic. The topics of (a) a chance to win one of five $100,000 college scholarships and (b) a $100 gift card when vaccinated were used as positive reinforcement messages. The topics of restricted participation in (a) after-school extracurricular activities and (b) school sports were used for negative reinforcement messages.

### *3.4. Measures*

#### 3.4.1. Trust in the government.

Participants indicated how much they trust the federal government in terms of their COVID-19 pandemic management on a semantic differential scale (1 = not at all trust, 7 = very much trust; $M$ = 4.96, $SD$ = 1.85). Scores 4 or lower were dummy-coded as 0 to index for low trust in government, while scores 5 or above were dummy-coded as 1 to index for high trust in government.

#### 3.4.2. Attitudes toward child vaccination.

Nine semantic differential items (bad/good, negative/positive, harmful/beneficial, unwise/wise, threatening/assuring, risky/safe, worrying/reassuring, unimportant/important, worthless/worthwhile) were adopted from prior research [35] and measured how participants viewed child COVID-19 vaccination (Cronbach's $\alpha$ = .97, $M$ = 5.17, $SD$ = 1.60).

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3.4.3. Intention to get child vaccinated.

Participants were asked if they would get their child vaccinated against COVID-19 within the next two months, using a Likert scale (1 = strongly disagree, 7 = strongly agree) ($M$ = 4.94, $SD$ = 1.73).

3.4.4. Control variable.

Political viewpoint (1 = very conservative, 5 = very liberal) was controlled, as it is known that COVID-19 vaccination rate is particularly lower among those who hold more politically conservative viewpoints [11].

## 4. Results

### *4.1. Manipulation Check*

An independent-samples t-test was performed for manipulation check. Participants were asked to indicate their thoughts on if the given message was to address a reward which could be attained by getting vaccinated or a restriction which could be avoided by getting vaccinated, using a semantic differential scale. Participants in the positive reinforcement condition ($M$ = 5.86, $SD$ = 1.25) were significantly different than those who were in the negative reinforcement condition ($M$ = 4.12, $SD$ = 2.25) in terms of their perceived type of reinforcement presented in the messages ($t$(284) = -7.99, $p$ = .00).

### *4.2. Research Questions Testing*

A series of one-way ANCOVAs was performed to examine the effects of reinforcement type on parental attitudes (**RQ1a**) and intentions toward child vaccination (**RQ1b**). Parental attitudes toward child vaccination were not significantly different between the positive ($M$ = 5.30, $SD$ = 1.48) versus negative ($M$ = 5.04, $SD$ = 1.70) reinforcement message condition, $F$(1, 282) = 1.67, $p$ = .20. Reinforcement type did not have a significant effect on parental intention to vaccinate their children either, as the participant child vaccination intention scores were not significantly different between the positive ($M$ = 5.03, $SD$ = 1.56) and negative ($M$ = 4.85, $SD$ = 1.88) reinforcement message condition, $F$(1, 282) = .55, $p$ = .46.

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 1, the result revealed a significant interaction effect between reinforcement type and levels of trust in government on parental attitudes toward vaccination for children, $F$(1, 280) = 4.01, $p$ < .05. Parents low in government trust reported more positive attitudes toward the vaccination when presented with the positive reinforcement ($M$ = 3.95, $SD$ = .19) message rather than the negative reinforcement message ($M$ = 3.33, $SD$ = .17), $F$(1, 280) = 5.63, $p$ < .05. 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, $p$ = .97. Main effect of trust in government was also significant with high government trust ($M$ = 5.84, $SD$ = .84) predicting more positive parental attitudes toward child vaccination than low government trust ($M$ = 3.62, $SD$ = 1.84), $F$(1, 280) = 198.02, $p$ < .001.

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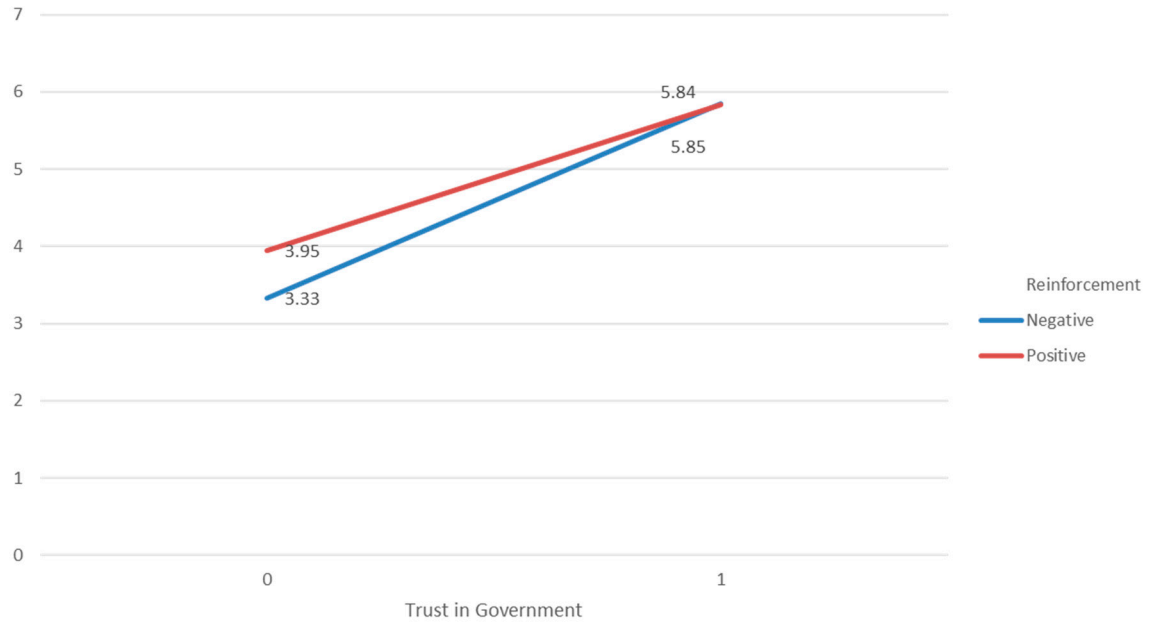


**Figure 1.** Interaction between Reinforcement Type and Government Trust on Parental Attitudes toward Child Vaccination.

Also, as presented in Figure 2, a significant interaction effect was found on parental intentions to get their child vaccinated, $F(1, 280) = 4.00$, $p < .05$. Those who low in the government trust reported higher intention to get their child vaccinated when presented with the positive reinforcement message ($M = 3.56$, $SD = .21$) rather than the negative reinforcement message ($M = 3.00$, $SD = .19$), $F(1, 280) = 3.89$, $p < .05$. 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, $F(1, 280) = .41$, $p = .52$. Main effect of trust in government was also significant with high government trust ($M = 5.67$, $SD = .88$) predicting higher child vaccination intentions than low government trust ($M = 3.27$, $SD = 2.01$), $F(1, 280) = 197.95$, $p < .001$.

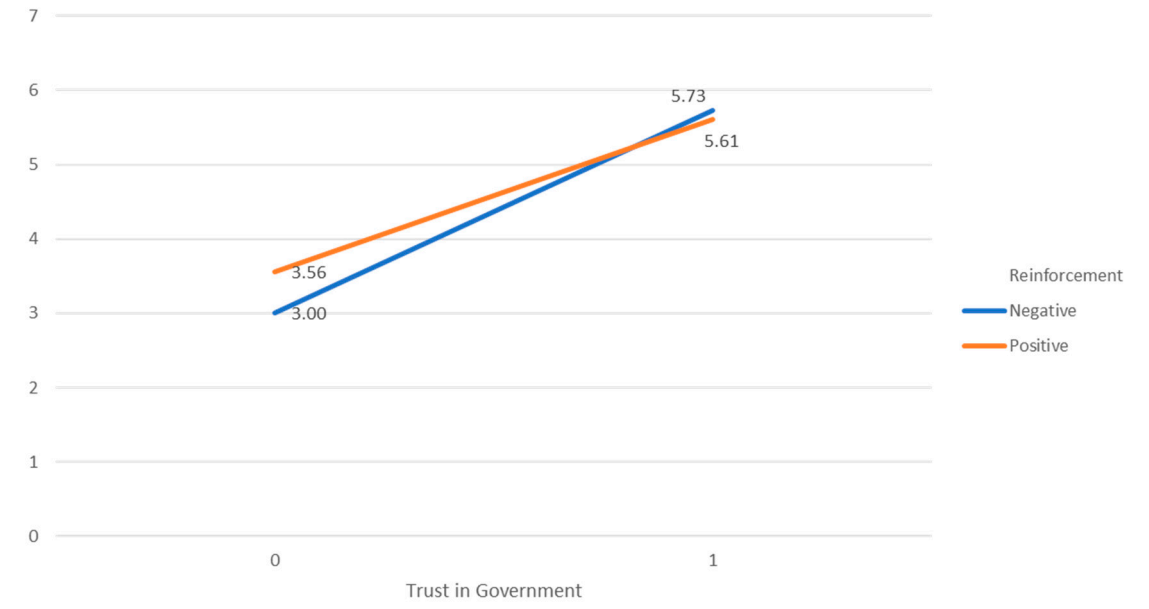

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**Figure 2.** Interaction between Reinforcement Type and Government Trust on Parental Intention for Child Vaccination.

## 5. Discussion

During the COVID-19 pandemic, there has been an increase in public awareness of the importance of vaccines. Therefore, the focus of vaccine communication now needs to shift towards providing various stimuli to increase actual vaccination rates, rather than simply disseminating general vaccine information, such as the benefits and risks of vaccination [34]. Furthermore, given the negative correlation between mistrust in government and vaccination, there is a need for empirical research, including controlled studies like the present one, to identify effective strategies to encourage vaccination among those who have low trust in the government. This research will help to better prepare for and manage virus-induced public health crises in the future. The recent COVID-19 pandemic has demonstrated the critical role of active promotion of vaccination through communication efforts in increasing vaccination rates. According to the Kaiser Family Foundation, self-reported child vaccination rates were higher among parents who had received encouragement from their children's school to get their children vaccinated during the pandemic than among those who had not [12].

### *5.1. Positive Reinforcement and Parents with Low Government Trust*

According to the present study's findings, neither positive nor negative reinforcement alone is effective in improving parental vaccine perceptions or behavioral intentions for their children. However, positive reinforcement may be a better strategy than negative reinforcement to increase child vaccination among parents with low government trust. Positive reinforcement, such as gift cards, was found to be more effective than negative reinforcement, such as participation restrictions for school activities, in eliciting positive vaccine attitudes and vaccination intentions among parents with low levels of trust in government.

On the other hand, negative reinforcement was found to be less effective than positive reinforcement in leading parents with low trust in government to accept vaccines for their children during an infectious disease crisis. Negative reinforcement or the government's active use of its authority to limit people's freedom may have furthered the pre-existing negative attitudes toward the government among those with low government trust.

These findings on the moderate effectiveness of positive reinforcement strategies for people with low government trust reflect results from prior quasi-experimental research that studied the COVID-19 pandemic and vaccination. Thirumurthy et al. [32] compared vaccination rates in groups of U.S. states with and without statewide incentive programs and reported that the vaccination rates between the two groups of states were not significantly different; nonetheless, there was a slight positive effect on the vaccination rates in Republican-leaning states where mistrust in the (Democratic) government of the time would have been relatively high. Although political beliefs or trust in government were not taken into account, Mantzari et al. [20] also identified the moderate effectiveness of positive reinforcement on vaccination in the context of HPV vaccination promotion for 17- and 18-year-old girls in the U.K.

Given the continuous calls for more extensive research to develop and implement vaccination-promotional strategies in times of large-scale infectious disease crises, further reinforcement and vaccination research needs to be done in various contexts. Thirumurthy et al. [32] suggested that incentives people would perceive as substantial may be more helpful in increasing vaccination, and the effectiveness of negative reinforcement needs to be further investigated. Also, Brewer et al. [5] explain that for vaccine incentives to be most effective, three criteria need to be met: the receipt of the incentive is guaranteed; the incentive is delivered immediately; and recipients perceive the incentive as valuable. Along with continuous research to further develop the existing understanding of positive reinforcement, more research on negative reinforcement and vaccination and comparative research to examine the relative effectiveness of different types of reinforcement are warranted.

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*5.2. Mistrust in Government, a Strong Barrier to Herd Immunity*

Mistrust in government is a significant barrier to achieving herd immunity. The present study's findings suggest that reinforcement strategies do not substantially predict positive effects on parental attitudes or intentions towards child vaccination during an infectious disease crisis. Although positive reinforcement was more effective than negative reinforcement in improving vaccine attitudes and child vaccination intentions among parents with a low level of trust in the government, overall attitude and intention scores were consistently higher among parents with a high level of government trust, regardless of the type of reinforcement. In both positive and negative reinforcement conditions, the low government trust group's average child vaccination intention scores were below 4 on the 7-point scale. Conversely, among parents with high government trust, average intention scores were close to 6, regardless of the assigned reinforcement condition. Similarly, in terms of parental attitudes, while the interaction between reinforcement and trust in government was significant, the main effect of reinforcement was also significant; higher trust in government significantly predicted more positive attitudes towards child vaccination among parents. Mistrust in government has long been recognized as a significant barrier to vaccine beliefs and behaviors [17]. Therefore, researchers and public health professionals need to continuously identify and examine effective vaccine communication strategies, including various reinforcements, to help low government trust populations receive vaccinations.

*5.3. Limitations and Future Research Suggestions*

Future research is warranted to identify effective vaccination-promotional message strategies in countries other than the United States. The globe has witnessed that an infectious disease crisis may place a risk to the public at an international level. Also, mistrust in government has been found to be a barrier to receiving vaccines not only in the United States but in other countries [24]. Evidence-based and tailored strategies for different regions, countries, and communities around the world need to be developed and implemented to better manage globally threatening infectious disease crises in the future.

The present study used the COVID-19 pandemic (a respiratory infectious disease) as an infectious disease crisis scenario. Future studies may examine how positive and negative reinforcement influence vaccination perceptions and behaviors in the context of different types of infectious disease crises (e.g., vector-borne infectious diseases), given that reactions to the crisis and information people look for may vary based on the characteristics of the given crisis (e.g., controllability and predictability of the disease, levels of perceived threat during the crisis) [4].

## 6. Conclusion

Mistrust in government is a significant barrier to achieving herd immunity when the government encourages vaccination during infectious disease crises. As one of the first studies that examined the effects of common child vaccination-promotional strategies during large-scale infectious disease crisis situations (i.e., incentives, restrictions) through a controlled experiment, the present study suggests that positive reinforcement (incentives) is likely to be a better strategy than negative reinforcement (restrictions) to increase child vaccination among parents with low government trust. Future research needs to look at the role of positive and negative reinforcement in more various contexts (e.g., different incentive types, different disease types) to further help low government trust populations receive vaccination.

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**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

**Declaration of interest statement:** The authors declare that they have no conflict of interest.

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