Community Immunity: Social Pressure and Vaccine Choices

Kathryn Haglin
Postdoctoral Fellow
Annenberg Public Policy Center

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Abstract

Research in public opinion suggests that individuals often hold beliefs that are not consistent with the current state of scientific research. Studies addressing this question often operate within a rational choice framework; however, there is evidence that attitudes about scientific findings are not primarily motivated by these factually driven appeals. In this study, I examine whether pro-social appeals to identity can produce shifts in beliefs about the seasonal flu vaccine and change an individuals' self-reported intent to vaccinate. The findings suggest that misperceptions can be changed without altering intentions to vaccinate. The results also show that various demographic groups are differentially affected by pro-social identity appeals, with some appeals creating backfire effects and others leading to more positive attitudes towards vaccines.

Keywords: vaccines, identity, experiment, flu

Research in public opinion suggests that individuals often hold beliefs that are not consistent with the current state of scientific research. For example, many people are not concerned about climate change and/or do not feel responsible for it despite being well-read on the subject (Kellstedt et al. 2008). Many parents do not give their children common vaccinations because they consider them unsafe (Nyhan et al. 2014**?**), and millions of Americans do not get an annual flu vaccine because of their unfounded fear of actually getting the flu.[1] These misperceptions persist despite the prevailing scientific consensus and frequent attempts to communicate that consensus to the public.

These misperceptions have significant normative and public health implications. As noted by Nyhan and Reifler (2015), seasonal influenza leads to thousands of deaths and high costs in medical care and lost earnings, yet immunization rates continue to fall well below targeted numbers. Similarly, childhood diseases like measles which rarely occur in the contemporary United States have experienced several major outbreaks as parents forgo the advice of doctors in vaccinating their children. These diseases can cause serious complications and death in young children and other vulnerable populations. These individual consequences underscore the importance of correcting vaccination misperceptions.

Additionally, individuals' skewed risk perceptions have consequences for public policy. Mandatory vaccination policies for children remain controversial despite the scientific consensus on vaccine safety, and parents disagree on the extent to which state governments can regulate the choices they make about their children's health. Findings demonstrating resistance, rejection, and backfire effects from corrective information (Kuklinkski et al. 2000**?**; Nyhan and Reifler 2010**?**; Nyhan and Reifler 2015**?**) have substantial implications for discourse between the scientific community and the public. It appears that a knowledge deficit is not the primary explanation for misperceptions about scientific issues and that education

[1]Centers for Disease Control and Prevention. Flu vaccination coverage, United States, 2014-15 Influenza Season; 2013. https://www.cdc.gov/flu/fluvaxview/coverage-1415estimates.htm.

is ineffective or counter-productive for correcting them.

This chapter reports the results of a study investigating the extent to which social appeals in public health campaigns are effective communications in changing vaccination attitudes and intentions. The findings suggest that information that debunks myths about the flu vaccine can have different effects on beliefs about vaccines than on intentions to vaccinate. Additionally, messages that emphasize pro-social appeals to identity have differential effects across demographic groups of interest.

1 Misperceptions and Their Correction

In recent years, information available to the public about the importance and safety of vaccines has become increasingly salient and more widely available. Yet misperceptions continue to persist; many parents are concerned about the connection between autism and childhood vaccinations, and still others believe the flu shot will give you the flu. Given the scientific consensus that neither of these concerns pose a serious risk, scholars have explored how we might correct these misperceptions and re-weight individuals' cost/benefit calculations such that they arrive conclusions that are in line with the current scientific consensus, with some success (e.g. van der Linden, Clarke, and Maibach 2015**?**). If individuals' policy preferences are based on false or unsubstantiated information, correcting these misconceptions is of great normative importance.

However, studies of misperception correction often find that it is difficult to realign individuals' beliefs. Individuals resist information and arguments that contradict their opinions (e.g. Lord, Ross and Lepper 1979**?**; Redlawsk 2002**?**; Taber and Lodge 2006**?**). Attempts to correct misperceptions can also result in "backfire effects" as people defend their prior beliefs (Nyhan and Reifler 2010; Nyhan and Reifler 2015)[2]. In some cases, those that are

[2]The 'backfire effect' has not always been found in subsequent studies (Haglin 2017**?**; Wood and Porter 2016)**?**.

the most informed about a topic are the ones least likely to be persuaded by the evidence, indicating that more information may not solve the misconception problem (Kellstedt et al. 2008). Overall, misperceptions are rarely altered, and even when we are able to change minds, individuals' intentions and behavior typically remain the same (e.g. Nyhan and Reifler 2014). These contradictory findings suggest that simply trying to reorder individuals' considerations may not be the most effective approach to correcting misperceptions.

To summarize, scholarship to this point gives us reason to suspect that individuals' intentions about vaccines do not always operate in a purely rational framework. Yet misperception studies often do not go beyond attempts to provide factual information that we anticipate will cause a broad audience of individuals to change their minds. This suggests that there is room to explore other possible avenues for effecting attitude change. Drawing on research in social psychology, this chapter posits that psychological appeals to identity, specifically one's social identity and community, have the potential to move attitudes and behavioral intentions.

2 Context and Misperception Correction

Previous work has often studied misperception correction in specific topical contexts, such as vaccines, climate change, and the like. These studies typically investigate corrective treatments that are intended to fit a general audience, rather than examining tailored approaches to correcting misperceptions. As a result, misperception studies provide corrective information without any situational references or connections to the context of the individual. Because of this, studies addressing general solutions to misperception correction may underestimate the potential effectiveness of corrections. Examining general approaches does not tell us if the effects of corrective treatments are conditional or if they are weakened due to a lack of contextual framing.

This chapter addresses this issue by positing that appeals to identity and applications of social pressure have the potential to move attitudes and behavioral intentions by providing contextual and situational references to corrective appeals. While there may be many types of appeals that may be effective at correcting misperceptions, the importance of individual affinity and circumstances has implications for how people respond to corrective information. Citizens often use mental shortcuts to make political decisions (Downs 1957**?**) and there has been a long recognition of the importance of group identification and social identity as a basis for such shortcuts (Converse 1964**?**; Sniderman, Brody, and Tetlock 1991**?**). Furthermore, Brewer (1991, 1996)**??** suggests that social identity is a dynamic element of a person's life and that priming more social contexts and self-concepts leads to changes in judgment. This broader work suggests that references to these concepts play a meaningful role in information processing and thus may serve as a catalyst for changing attitudes and perceptions in a variety of situations.

An array of research has shown that social pressure and social norms can also influence behavior. People are aware of the behavior of others around them and conform to the norms of the community. Knowing one's behavior will be made public is also a compelling factor in complying with social norms (Cialdini and Goldstein 2004**?**; Kallgren, Reno, and Cialdini 2000**?**). For example, Gerber and Green (2008)**?** demonstrate this effect in a voter turnout context, finding that social pressure influences voter turnout, especially when shaming tactics are used to incentivize compliance. They further conclude that social pressure is additive: more pressure leads to more voting regardless of predispositions to vote. While there are typical caveats like ceiling effects, on balance, people typically comply with social norms when they know they are being watched in order to avoid being socially excluded when their behavior is made public.

The importance of social setting and norms has been demonstrated in the vaccine context. Nyhan, Reifler, and Richey (2012)**?** find that health discussion networks play a key role

in shaping vaccination attitudes. Those who believe their network supports vaccination feel more positively towards vaccines and express stronger intent to vaccinate themselves. Similarly, Betsch et al. (2017)**?** find that cultures that focus on collective benefits have higher rates of compliance with vaccines and communicating the concept of herd immunity improves an individual's willingness to get vaccinated. While this is not entirely surprising, it does underscore the importance of the climate in which individuals form attitudes. Being in a particular context can evoke feelings of pride or shame or change an individual's disposition system. Working to understand the individual, the context they find themselves in, and the relationship between the two could provide significant leverage into understanding attitudes that are not consistent with the current scientific consensus. If information is not perceived as relevant to the recipient, it is unlikely they will incorporate it into their decision making calculus.

Consistent with previous findings and subsequent discussion, I derive two primary hypotheses. First, social appeals to community norms should increase the effectiveness of appeals to get vaccinated. By priming a social identity and connecting it to a pro-social vaccine appeal, I attempt to exploit the relationship between the individual and the context in order to change perceptions and intentions. In this study, the identity I prime and connect to CDC data on vaccinations rates is one's identity as a Texan. Texans have high levels of state pride and care deeply about their identity as Texans. Hence, in order to test the effect of pro-social identity appeals, I use data from the CDC reporting the final vaccination rate in the state of Texas at the end of the 2014-2015 flu season. From this discussion, I therefore hypothesize:

Pro-social Hypothesis: Exposure to a pro-social identity appeal will increase intentions to vaccinate more than corrective treatments will.

Furthermore, previous findings suggest that simple textual appeals are not compelling enough to change intentions and misperceptions (Nyhan et al. 2014; Nyhan and Reifler

2015). Outside of the misperceptions literature, Gibson, Lodge, and Woodson (2014)**?** have found evidence that visual symbols can reinforce institutional legitimacy. Building upon this work, I go beyond text-only appeals and activate the identity of interest (being a Texan) using symbolic images. Texas is well known for its many icons, including flags, bluebonnets, and the Texas star, among others. In this study, we chose the Texas state flag as the background imagery for our pro-social appeal. The state flag is well-known, very prevalent in public places, and a symbol of Texas pride. The design elements of the flag also made it an ideal image to use with text in a public health-style appeal. Hence:

Pro-social Image Hypothesis: Adding visual symbols of a community's identity to a pro-social appeal will lead to more positive attitudes toward vaccines than the appeals without images.

In addition to these two primary hypotheses, I also expect that the effect of these pro-social treatments will be stronger for certain individuals. As noted by Nyhan and Reifler (2015), high concern individuals may be more susceptible to the backfire effect and are more likely to believe vaccine misperceptions. Thus, level of concern about vaccine side effects may strengthen individuals' resistance to pro-social appeals and reduce their effectiveness. As a result, I hypothesize that:

Concern Hypothesis: Higher levels of concern about vaccine side effects will reduce the effectiveness of pro-social treatments.

Next, I expect that political ideology will have differential effects across the outcome variable measures. Party identification and ideology are well established as a strong source of identity for many individuals (Campbell et al. 1960**?**; Greene 1999**?**; Greene 2004**?**) and in the context of vaccines, might affect responses to pro-social appeals and corrective information. Data from the 2014 Cooperative Congressional Election Study suggests that conservatives are more likely to believe there is a link between vaccines and autism, regardless

of party identification.[3] As such, I hypothesize that:

Ideology Hypothesis: Conservatives exposed to the pro-social images will be more likely to get vaccinated, while conservatives exposed to the correction treatment will be less likely to get vaccinated and more likely to believe the misperception that the flu vaccine gives you the flu.

Finally, gender may play a role in responses to pro-social appeals to vaccinate. Differences in trust placed on sources of information about vaccines varies by gender, as Freed et al. (2011)**?** find that women are more likely to trust vaccine safety information from celebrities, television shows, and parents who claim their child was injured by a vaccine. Additionally, women make the majority of health care decisions for their children; the Kaiser Family Foundation (2014)[4] found that three-quarters of mothers choose their child's doctor and implement recommended care. While this study uses the flu vaccine as its context, this attitudinal and responsibility differences between genders suggests that women may be more receptive to pro-social appeals. Thus, I also hypothesize:

Gender Role Hypothesis: Women exposed to the pro-social identity appeals will be more likely to get vaccinated and have more positive attitudes towards vaccines than men.

3 Method

3.1 Data Collection

This study replicates and extends the work done by Nyhan and Reifler (2015) and thus closely follows their methods and procedures.[5] The data for this study were collected using

[3]Lupton, Robert, and Christopher Hare."Conservatives Are More Likely to Believe That Vaccines Cause Autism." The Washington Post, 1 March 2015, https://www.washingtonpost.com/news/monkey-cage/wp/2015/03/01/conservatives-are-more-likely-to-believe-that-vaccines-cause-autism/?utmterm=.d8b077827c8a

[4]"Balancing on Shaky Ground: Women, Work, and Family Health", October 2014.

[5]The results of the direct replication of Nyhan and Reifler (2015) are reported in Haglin (2017) and thus not covered in detail here.

Amazon's Mechanical Turk platform, using a worker pool limited to those with IP addresses located in Texas. The study was fielded from March 2016 to May 2016. Respondents were adults located in Texas who were told they would be answering questions meant to elicit their opinions on important political issues of today. Data was collected from 525 respondents. After dropping respondents whose geographic coordinates suggested they were not inside Texas, 474 respondents remained.[6]

3.2 Design and Procedure

Respondents were randomly assigned to one of seven different conditions in the experiment. In each condition respondents were asked about the flu vaccine and whether or not they intended to get vaccinated in a future flu season. The seven conditions were as follows[7]:

1. Control- The respondents received no additional information about the flu or flu vaccines prior to answering the outcome questions.

2. Correction- Respondents received information debunking the myth that people can get the flu from the flu vaccine. The text used in this treatment was the same as in Nyhan and Reifler's (2015) study.

3. State Percentage Text- Respondents read a two line statement about flu vaccination in Texas that included an appeal to the respondent's identity as Texans. This condition used the percent of Texans who got vaccinated last year.

4. Raw Number Text- This condition is identical to condition three, but instead used the raw number of Texans who got vaccinated last year.

[6]Qualtrics collects the latitude and longitude of the respondents location. Because IP addresses may not correspond with the current residence of the respondent, respondents outside the bounds of the state of Texas were dropped from the analysis.

[7]Complete treatment wording and images can be found in the appendix.

Figure 1: Flag Image with No CDC Data

5. Flag Image with No Data- As seen in Figure 3.1, respondents were shown an image of the Texas flag with a pro-social slogan printed over the image.[8]

6. Flag Image with Percentage- As seen in Figure 3.2, respondents were shown an image of the Texas flag with the same slogan printed over the image. Additionally, the image also included the appeal to "join the 50% of Texans who got the flu vaccine last year."

7. Flag Image with Raw Number- The final condition showed respondents the same image as in the fifth condition, expect that the percentage (50%) was changed to the raw number of Texans who got a flu vaccine last year (13 million).

The "raw number" and "percentage" treatment figures are taken from data collected

[8]Images of the Texans flag are courtesy of Patriot Wood, LLC and are being used with permission from the company owners.

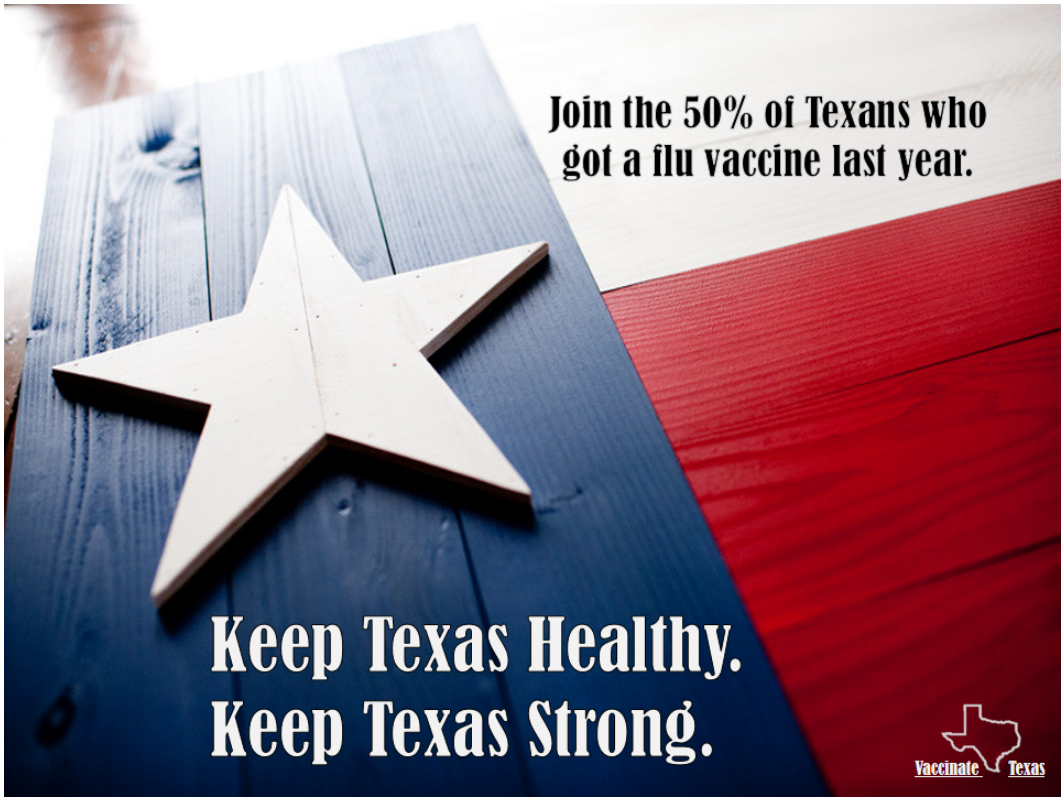

Figure 2: Flag Image with Percent Vaccinated in Previous Flu Season

by the Centers for Disease Control on flu vaccination rates in each state. The numbers used here are based on the 2015 flu cycle, the most recently completed cycle at the time of experimentation. While it would have been possible to vary these numbers to examine the effect of different degrees of social compliance on vaccine attitudes, to present an accurate and realistic representation of a potential public health campaign, this manipulation was avoided.

Additionally, as noted by Nyhan and Reifler (2015), responses to vaccine information might vary based on one's pre-existing attitudes towards vaccines. Since it was not possible to accurately measure prior vaccine receipt as part of the study, I measured each respondent's general concerns about vaccine safety and side effects. Specifically, in replicating Nyhan and Reifler (2015), I asked, "In general, how concerned are you about serious side effects from

vaccines?" prior to the interventions. This was measured on a five point scale ranging from "not at all concerned" to "extremely concerned."

3.3 Outcome Measures

After the experimental intervention, I measured respondents' (mis)perceptions about the flu vaccine ("You can get the flu from the seasonal flu vaccine"), feelings about vaccine safety ("Just based on what you know, how safe do you believe the seasonal flu vaccine, meaning the flu vaccine available every year, is generally for most people to take?"), intent to get vaccinated in the future ("How likely is it that you will get a flu vaccine for the seasonal flu during future flu seasons?"), and attitudes about school vaccination policies ("Just based on what you know, how much do you agree with the following statement: If a child has not been vaccinated (even though they are healthy enough to receive vaccines), that child should be allowed to attend public school."). With the exception of the policy question, these measures were taken from Nyhan and Reifler (2015), and the full text and scale of each measure can be found in the Appendix.

These measures were used not only for replication purposes, but because they measure the complex relationship between attitudes and behavior regarding vaccinations. By asking about both beliefs and intentions, I can assess the effect of debunking misperceptions on two different dimensions. As shown below and in line with previous findings, I demonstrate that the interventions have different effects on people's beliefs as compared to their intentions. If the study had not included these questions, I would not be able to see this differential effect.

The results of the study were analyzed using difference of means tests and ordered logit models. I estimate the effects of assignment to the correction, flag, percent, and raw number conditions on misperceptions about the flu vaccine and intentions to vaccinate in the future. I also test to see if the non-replication treatments result in significantly different outcomes from the correction and control conditions.

4 Results

Table 3.1 summarizes the characteristics of the respondents in the Mechanical Turk sample. As is to be expected when working with convenience samples like those from MTurk, the sample is not fully representative of the demographics of the national, or even Texas, adult population. This sample is younger, more educated, and disproportionately white than the adult population of Texas.[9] However, the sample appears to be balanced across conditions, indicating that the randomization process was successful.

It is also notable that a large portion of the sample (58%) reports themselves as being either not at all concerned or not too concerned about the side effects of vaccines. Approximately 20% of the sample falls into the high concern category, which I define as saying you are either "very" or "extremely" concerned about vaccine side effects. This distribution approximates that found in Nyhan and Reifler's (2015) sample and thus gives us confidence that we can make inferences about high and low concern individuals.

[9] Additional information about the distribution of party identification and ideology in the MTurk sample can be found in the appendix.

Table 1: Characteristics of Respondents in Study Sample by (%)

	Control	Correction	% Text	Raw # Text	Image No Data	% Image	Raw # Image	Total
Age								
18-29	36.2	39.4	46.4	34.8	45.3	38.6	38.8	39.9
30-44	47.8	39.4	37.7	47.8	42.2	35.7	43.3	42.0
45-59	13.0	18.2	14.5	15.9	9.4	22.9	10.4	15.0
60+	2.9	3.0	1.4	1.4	3.1	2.9	7.5	3.2
Gender								
Male	44.9	45.5	50.7	50.7	46.9	50.0	53.7	48.9
Female	55.1	54.5	46.4	49.3	53.1	48.6	46.3	50.4
Education								
High School	7.2	6.1	7.2	10.1	6.3	11.4	7.5	8.0
Some College	27.5	24.2	33.3	33.3	26.6	21.4	25.4	27.4
Trade School	2.9	3.0	2.9	2.9	3.1	7.1	9.0	4.4
Associates Degree	13.0	13.6	8.7	7.2	4.7	10.0	6.0	9.1
Bachelors Degree	30.4	34.8	33.3	29.0	56.3	37.1	29.9	35.7
Masters/Doctoral Degree	18.8	18.2	14.5	14.5	3.1	12.9	22.4	15.0
Other Professional Degree	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.4
Race/ethnicity								
White	66.7	77.3	65.2	69.6	78.1	72.9	64.2	70.5
Black	10.1	9.1	8.7	10.1	9.4	4.3	10.4	8.9
Hispanic/Latino	13.0	10.6	15.9	18.8	6.3	14.3	16.4	13.7
Asian	4.3	3.0	10.1	0.0	3.1	4.3	4.5	4.2
Pacific Islander	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.2
Other	5.8	0.0	0.0	1.4	3.1	2.9	4.5	2.5
Concern About Side Effects								
Not at all concerned	23.2	22.7	31.9	20.3	21.9	31.4	25.4	25.3
Not too concerned	33.3	33.3	26.1	43.5	39.1	24.3	32.8	33.1
Somewhat concerned	24.6	19.7	27.5	15.9	15.6	30.0	16.4	21.5
Very concerned	7.2	21.2	7.2	11.6	12.5	7.1	13.4	11.4
Extremely concerned	11.6	3.0	7.2	8.7	10.9	7.1	11.9	8.6
Number of observations	69	66	69	69	64	70	67	474

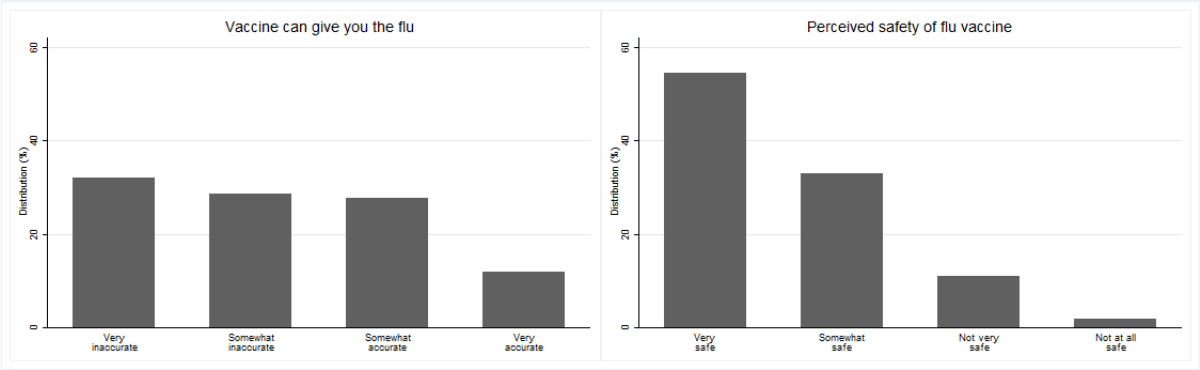

Figure 3: Distribution of Vaccine Misperception and Safety Measures

Figures 3.3 and 3.4 summarize the distribution of responses to the four outcome variables of interest across all seven conditions in the study: this mis-perception that the flu vaccine can give you the flu, perceptions of the vaccine's safety, self-reported intent to vaccinate in the next flu season, and attitudes about school vaccination policies.

Roughly 40% of the respondents believe the myth that the flu vaccine can give you the flu is "somewhat accurate" (28%) or "very accurate" (12%). Far fewer believe the flu vaccine is unsafe. Only a total of 15% say they consider the vaccine "not very safe" or "not at all safe." Figure 5 shows that the distribution of self-reported intentions to vaccinate is bimodal. 31% of respondents say it is very unlikely they will get a flu vaccine in the next flu season, while 30% say it is very likely they will get a vaccine. The remaining 39% of the respondents were not as certain and approximately evenly distributed about the remaining response options, with a slightly larger number in the "somewhat likely" category. Finally, approximately 43% of the respondents thought a child who has not been vaccinated should not be allowed to attend public school by indicating either "disagree" or "strongly disagree", with roughly 25% saying that an un-vaccinated child should be allowed to attend public school.

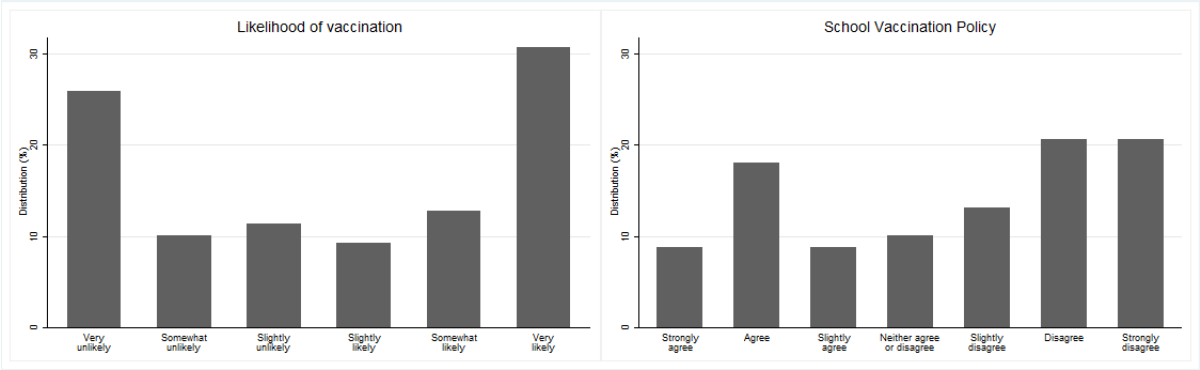

Figure 4: Distribution of Vaccine Intention and School Policy Measures

4.1 Experimental Results: Difference of Means Tests

Figures 3.5-3.8 report the differences of means tests for each of the four outcome variables. To examine the effect of the Texas-based treatments compared to the control and correction treatments, the added treatment conditions were compared to the control and correction conditions using two-sample t-tests. In Figures 3.5-3.8, a diamond over the bar indicates that the effect is statistically significantly different from the control condition at conventional levels, while a triangle over the bar means that the effect is statistically significantly different from the correction condition.[10]

Figure 3.5 shows the difference of means tests for perceptions of safety, where higher bars mean the respondents think the vaccine is more unsafe. The means all fall between 1 ("Very safe") and 2 ("Somewhat safe")[11], with means at nearly identical levels across all conditions. None of the difference of means tests was statistically significant. However, this result does shed some light on the role corrections play in shaping individuals' understanding of vaccine safety; the correction treatment is not moving attitudes any differently than any other condition, indicating that corrections may not have particular appeal beyond the benefits of social identity appeals.

[10] A complete table of the dependent variable means by condition can be found in the appendix.
[11] The question scale ranges from 1 to 4, with 4 corresponding to "Not at all safe".

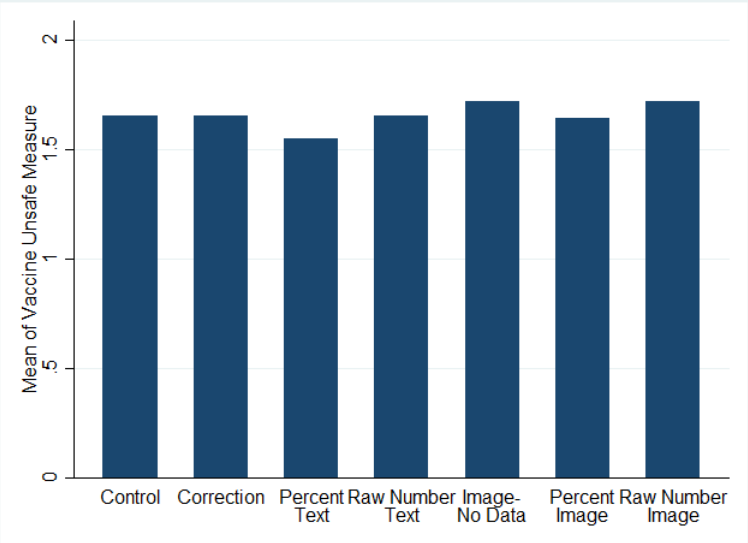

Figure 5: Difference of Means Tests for Perceptions of Safety

Figure 3.6 shows the difference of means tests for vaccine misperceptions, where higher bars mean the respondents believe the statement "You can get the flu from the seasonal flu vaccine" is more accurate. The question scale ranged from 1 ("Very inaccurate") to 4 ("Very accurate"). The diamond above the correction bar indicates that the correction condition is significantly different from the control group, with about .75 point difference, indicating that the correction treatment is effective in correcting the misperception that the flu vaccine can give you the flu. The triangles above the other six bars further evidence this effect, as the control group is significantly different from the correction for all other conditions. The correction treatment reduces misperceptions by approximately .5 to .75 points on the question scale compared to both image and text conditions. While the the image and text treatments were not corrective in the sense that they did not contain information meant to debunk the myth that the flu vaccine gives you the flu, these treatments were found to be ineffective across all outcome measures relative to the control condition.

Figure 3.7 shows the difference of means tests for vaccine intentions, where higher bars mean the respondents are self-reporting a greater likelihood to vaccinate in the next flu

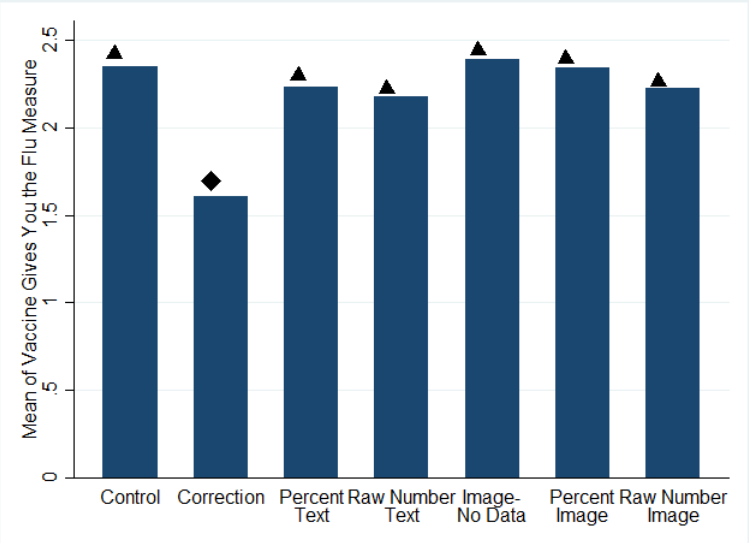

Figure 6: Difference of Means Tests for Vaccine Misperceptions

season. The question scale ran from 1 ("Very unlikely") to 6 ("Very likely").[12] The figure indicates that none of the treatments was significantly different from the control or correction groups.

When examined in concert with Figure 3.6, key conclusions can be drawn from Figure 3.7. First, it appears that corrective interventions can be used to correct misperceptions, but few interventions are effective in changing intentions. In this case, identity appeals that use text to describe the previous year's vaccination rates produce the most absoluate change in intentions to vaccinate, but are not statistically significantly different in effectiveness from receiving no treatment at all. Interestingly, the identity-priming images were all equally ineffective, indicating that the image does not significantly increase vaccination intentions.

Furthermore, Figures 3.6 and 3.7 show that we can change perceptions using corrective information while failing to change intentions using any kind of appeal. Insofar as I find little evidence for the backfire effect thus far, these findings suggest that perceptions and intentions might be changed through separate processes. Even if the backfire effect is not

[12]Here, "very likely" means that the respondent self-reported that they were very likely to get a flu vaccine during future flu seasons.

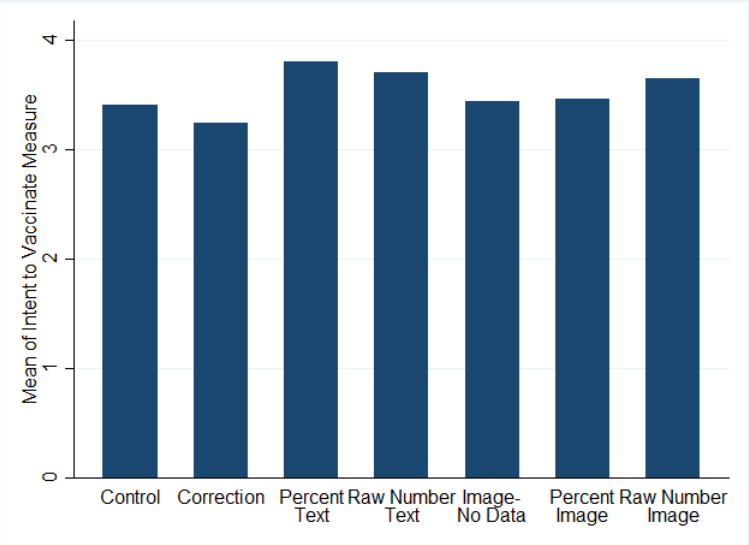

Figure 7: Difference of Means Tests for Intent to Vaccinate

a significant force in the difference of means tests, there is still evidence to support further investigation of the role pro-social identity appeals can play in affecting the attitudes of different individuals.

Finally, Figure 3.8 shows the difference of means tests for the school policy attitudes question, where higher bars mean the respondents disagree more with the statement "If a child has not be vaccinated (even though they are healthy enough to receive vaccines), that child should be allowed to attend public school." While most of the bars all fall between 4 ("Neither agree nor disagree") and 5 ("Slightly disagree"),[13] the raw number with flag image condition was significantly different from both the control and correction conditions. This finding indicates that this condition made individuals more accepting of un-vaccinated students attending public schools. This might suggest that those who saw the raw number of vaccinated individuals thought that the number was high and thus un-vaccinated children do not pose a significant threat to the other students, given the established effects of herd immunity.[14]

[13]The question scale ranged from 1 ("Strongly Agree) to 7 ("Strongly Disagree").

[14]Herd immunity refers to "the resistance to the spread of a contagious disease within a population

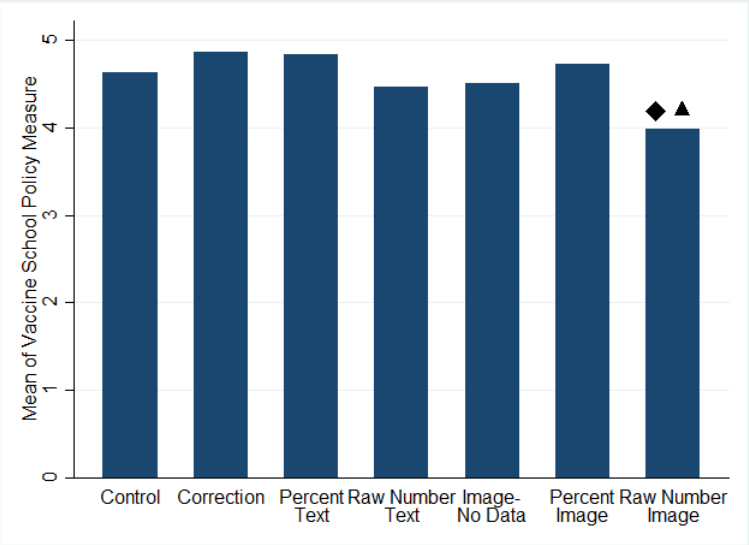

Figure 8: Difference of Means Tests for School Vaccine Policy Attitudes

4.2 Interactive Effects: Ordered Logit Models

Thus far, the data show no evidence of the backfire effect as identified by Nyhan and Reifler (2010; 2015). However, the data suggest that misperceptions can be changed without altering intentions to vaccinate (Nyhan and Reifler 2014). Additionally, there is little support for the pro-social and pro-social image hypotheses, as the text and flag-based appeals appear to have little effect on increasing intentions to vaccinate and creating more positive attitudes towards the flu vaccine. To elucidate the effect of pro-social appeals across different groups of individuals and test the conditional hypotheses, I estimate a model examining the main effects of the treatment variables and the observational variables, followed by models that interact the experimental treatments with observational data collected from participants using separate ordered logit models. These models estimate the interactive effects of the self-reported level of concern about side effects, ideology. and gender with assignment to the various experimental treatments of interest. Because of the directional nature of the

that results if a sufficiently high proportion of individuals are immune to the disease, especially through vaccination" (Oxford Dictionaries).

hypotheses, statistical significance is determined using one-tailed tests.[15]

4.3 Main Effects

Table 3.2 reports the results for the main effects analysis by examining the effects of the treatment variables and the observational variables of interest. Participants' pre-existing concern about vaccines' side effects are significantly associated with all four outcomes measures: intent to vaccinate, perceptions of vaccine safety, belief that vaccines cause the flu, and school vaccine policy preferences. Higher levels of concern are associated with decreased intentions to vaccinate, greater belief vaccines are unsafe, greater belief that the flu vaccine can give you the flu, and more permissive attitudes towards un-vaccinated children in public schools. These results are not particularly surprising and are consistent with a wide range of previous work; those with the highest levels of concern about vaccines tend to express the greatest skepticism about their safety and getting vaccinations. However, it is interesting to note that those more concerned about side effects are also less concerned about children being exposed to un-vaccinated children. This indicates that those individuals may not only hold misperceptions about the vaccines themselves, but that they also misperceive the potential consequences of not being vaccinated and its impact on others.

Furthermore, the models show the effects of the correction treatment on each of the outcome variables. The first model in Table 3.2 shows that the correction treatment has a backfire effect for intentions to vaccinate, in line with those find by Nyhan and Reifler (2010, 2015). The data also show that the correction treatment significantly reduces respondents beliefs that the flu vaccine can give you the flu. This is evident in the third model, which reports a negative and significant coefficient for the correction treatment. Those receiving the correction treatment have a 69% probability of thinking the misperception is "very

[15]Models using two-tailed tests can be found in the appendix.

Table 2: Ordered Logit Models for Main Effects

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvax Child in School
Main Effects				
Side Effects Concern	-0.31**	1.14**	0.48**	-0.57**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.53**	0.10	-1.33**	0.20
	(0.32)	(0.38)	(0.34)	(0.32)
Flag Treatment	-0.02	0.20	0.16	-0.19
	(0.20)	(0.23)	(0.20)	(0.19)
Text Treatment	0.38	-0.16	0.02	0.08
	(0.27)	(0.33)	(0.27)	(0.26)
Conservative	-0.18**	0.24**	-0.02	-0.17**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.35**	-0.06	-0.27	0.59**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.61**	-0.53**	0.32	0.34
	(0.25)	(0.28)	(0.25)	(0.24)
Education	0.11**	-0.10**	-0.10**	0.06
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.18	-0.23**	-0.38**	0.23**
	(0.11)	(0.13)	(0.11)	(0.10)
Observations	459	459	459	459
Pseudo R-squared	0.03	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05 with one-tailed tests

inaccurate", compared to 37% among those who did not see the correction treatment.[16]

Turning to the treatments unique to this study, I find that the flag treatment condition and the pro-social text-only treatment did not have a significant effect on any of the dependent variables. As a result, these findings provide little support for the pro-social hypothesis and the pro-social image hypotheses. Rather than increase intentions to vaccinate, the flag-based appeal and the text-based appeal did not significantly affect intentions to vaccinate, lending no support for the pro-social hypothesis. Additionally, contrary to the pro-social image hypothesis, adding the flag to the pro-social appeal did not lead to more positive

[16]All reported predicted values were calculated using spost for Stata 14 as developed by Long and Freese (2014)**?** . In these calculations, all unspecified variables were held at their medians.

attitudes towards vaccines overall and did not yield a significant improvement in attitudes beyond the text-only appeals. The findings to this point therefore suggest that pro-social identity appeals are not an effective means of changing vaccination attitudes.

There is some evidence of gender differences in vaccines attitudes in the main effects. Women have lower intentions to vaccinate, though the effect is small, with women and men both having approximately a 25% probability of being "very likely" to get a vaccine. Women also have less permissive attitudes towards un-vaccinated children in schools. While this may seem contradictory, this may be a reflection of women often being primary health care providers for their children. While perhaps not concerned about their own need for a vaccine, women may understand the importance of having children immunized to avoid disease outbreaks in schools and thus are not as accepting of un-vaccinated children in classrooms.

I also included three standard control variables (party identification, education, and age) in each model. Being a Republican and more educated has a positive relationship with intentions to vaccinate. Similarly, Republicans, the more educated and older individuals are more likely to think the vaccine is safe. Older individuals are also less likely to think that the flu vaccine can give you the flu and less permissive of un-vaccinated children in public schools. Since older respondents are more likely to recall outbreaks of diseases, such as measles, amongst their peers when they were children, these results are not especially surprising.

Finally, the coefficients for ideology and Republican are oppositely signed across all four models in Table 3.2. In the case of all four models, where significant, the Republican variable is associated with the more "desirable" outcome (greater intent to vaccinate, vaccine perceived as more safe, etc.), while the ideology variable has more "less desirable" outcomes (lower intent to vaccinate, vaccine perceived as unsafe, etc.) This is noteworthy, as the Republican party is often an identity associated with anti-science attitudes and skepticism

about vaccines.[17] However, these findings suggest that it may not be party identification that leads to troubling attitudes towards vaccines. Rather, ideology, and specifically degree of conservatism, acts as the key political demographic factor in predicting vaccination attitudes and intentions.

4.4 Testing Conditional Hypotheses

I next turn to tests the three conditional hypotheses dealing with side effects concern, ideology, and gender. First, in Table 3.3 I test the concern hypothesis in the interactions between levels of side effect concern and the three treatments of interest. I hypothesized that higher levels of concern would reduce the effectiveness of pro-social appeals, and the models suggest this is not the case. The third model in Table 3.3 shows that those who are more concerned and exposed to the correction treatment are more likely to think the flu vaccine will give you the flu. This suggests that the correction treatment backfires among the most concerned individuals, a finding that comports with previous research and indicates that corrective interventions may not be able to override the concerns that individuals have about vaccine side effects.

However, as concern increases among those in the flag and text treatment conditions, I find no significant effects in the hypothesized direction. Two coefficients are of note here. First, for intentions to vaccinate, those who are more concerned in the flag treatment condition were more likely to get vaccinated in the future. This coefficient is statistically significant, but not in the hypothesized direction. Contrary to the predictions of the concern hypothesis, concern did not reduce the effectiveness of the pro-social treatment. The same case emerges in the school policy model: the more highly concerned in the correction treatment are more concerned about children being exposed to un-vaccinated children. This coefficient is also statistically significant in opposition to the hypothesis. While one must

[17] See Mooney (2005) for examples.

Table 3: Ordered Logit Models for Conditional Effects of Concern: Concern Hypothesis

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvax Child in School
Side Effects Concern	-0.56**	1.03**	0.45**	-0.55**
	(0.14)	(0.15)	(0.13)	(0.13)
Correction	-0.80	-0.47	-3.00**	-1.14
	(0.74)	(1.01)	(0.86)	(0.77)
Flag Treatment	-0.90**	-0.28	-0.16	-0.14
	(0.47)	(0.58)	(0.46)	(0.45)
Text Treatment	-0.26	-0.23	0.91	0.87
	(0.62)	(0.81)	(0.62)	(0.62)
Conservative	-0.18**	0.25**	-0.03	-0.16**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.35**	-0.05	-0.25	0.61**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.61**	-0.54**	0.29	0.30
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.12**	-0.09	-0.09**	0.07
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.18	-0.23**	-0.37**	0.24**
	(0.11)	(0.13)	(0.11)	(0.10)
Concern X Correction	0.11	0.21	0.68**	0.56*
	(0.28)	(0.34)	(0.30)	(0.29)
Concern X Flag	0.36*	0.17	0.13	-0.01
	(0.17)	(0.19)	(0.16)	(0.16)
Concern X Text	0.25	0.01	-0.39	-0.35
	(0.24)	(0.28)	(0.23)	(0.24)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05 with one-tailed tests
*p<0.05 in opposition of the hypothesis

be cautious in interpreting such results, there are normative implications for these two findings. If the most concerned individuals are positively affected by pro-social images and have differential reactions to corrections across measures, this could have important implications for future public health research. While only suggestive given the parameters of this study, these findings offer some evidence that should be explored in future research.

Table 4: Ordered Logit Models for Conditional Effects of Ideology: Ideology Hypothesis

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvaxx Child in School
Side Effects Concern	-0.31**	1.14**	0.48**	-0.57**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.89**	0.58	-1.54**	-0.40
	(0.52)	(0.63)	(0.57)	(0.51)
Flag Treatment	-0.38	0.048	-0.03	-0.17
	(0.35)	(0.44)	(0.35)	(0.34)
Text Treatment	0.34	-0.17	0.01	0.07
	(0.27)	(0.33)	(0.27)	(0.26)
Conservative	-0.26**	0.25**	-0.06	-0.20**
	(0.09)	(0.10)	(0.08)	(0.08)
Female	-0.34**	-0.04	-0.26	0.59**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.62**	-0.54**	0.32	0.36
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.12**	-0.10**	-0.10**	0.07
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.17	-0.24**	-0.39**	0.23**
	(0.11)	(0.13)	(0.11)	(0.10)
Conserv. X Flag	0.13	0.05	0.06	-0.01
	(0.10)	(0.12)	(0.10)	(0.09)
Conserv. X Correction	0.12	-0.16	0.07	0.22
	(0.14)	(0.17)	(0.15)	(0.14)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05 with one-tailed tests

Next, I test the ideology hypothesis by interacting ideology with the pro-social treatment variables, as seen in Table 3.4. Looking first at the main effects, the conservative variable indicates results consistent with the finding that conservatives are more distrustful of vaccines. Across the four models, conservative respondents are less likely to get vaccinated, more likely to find the flu vaccine unsafe, and more permissive of un-vaccinated children in public schools. However none of the interactions between ideology and the flag and correction treatments are statistically significant, providing no support for the ideology hypothesis.

Finally, I test the gender role hypothesis by interacting the female variable with the pro-social treatment variables, as seen in Table 3.5. Here we find mixed evidence for the gender role hypothesis. While the relationship between being male and intent to vaccinate is negative, women who are exposed to the flag treatment have higher intentions to vaccinate. This indicates that the flag treatment has a positive effect on behavioral intentions for women, but no significant effects on attitudes. In contrast, women exposed to the text-only pro-social appeal are more permissive towards un-vaccinated children in public schools. This backfire effect suggests that women might find the text persuasive in the sense that they consider the number of vaccinated Texans sufficient to allay their concerns about un-vaccinated children in schools, even if those concerns are valid.

5 Discussion and Conclusions

The results of this study indicate that information seeking to debunk myths about the flu vaccine can have different effects on beliefs than on intentions to vaccinate. I replicate the findings from Nyhan and Reifler (2014, 2015) showing that a corrective intervention reduces misperceptions, but does not change beliefs about safety or intentions to vaccinate. Furthermore, I identify a backfire effect of corrective treatments for intentions to vaccinate. These findings are consistent with previous research on factual corrections, while providing additional evidence for the backfire effect.

Most notably, I find that pro-social identity appeals are not particularly effective mechanisms for changing attitudes towards vaccines. The pro-social treatments have null results in the main effects, suggesting that a general appeal to pro-social identity is not particularly effective at changing attitudes or intentions towards flu vaccination. While additional studies are needed to fully examine the role of pro-social appeals, these results are cause for caution in dedicating scarce public health education resources to pro-social appeals aimed at

Table 5: Ordered Logit Models for Conditional Effects of Gender: Gender Hypothesis

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvaxx Child in School
Side Effects Concern	-0.31**	1.15**	0.49**	-0.58**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.53**	0.10	-1.33**	0.24
	(0.32)	(0.38)	(0.34)	(0.32)
Flag Treatment	-0.40	0.60**	0.35	-0.02
	(0.29)	(0.34)	(0.30)	(0.28)
Text Treatment	0.36	0.01	0.18	0.63**
	(0.35)	(0.44)	(0.36)	(0.34)
Conservative	-0.19**	0.24**	-0.03	-0.17**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.67**	0.37	-0.02	1.07**
	(0.32)	(0.37)	(0.32)	(0.31)
Republican	0.64**	-0.53**	0.32	0.34
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.11**	-0.10**	-0.10**	0.06
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.19**	-0.24**	-0.39**	0.24**
	(0.11)	(0.13)	(0.11)	(0.10)
Female X Flag	0.77**	-0.77	-0.37	-0.32
	(0.41)	(0.48)	(0.41)	(0.39)
Female X Text	-0.05	-0.34	-0.29	-1.18**
	(0.45)	(0.53)	(0.46)	(0.44)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05 with one-tailed tests

the public at large. However, vaccines are only one area of science subject to misperceptions and misguided behavioral intentions. Pro-social identity appeals may still be effective in addressing other topics of interest, including climate change, nuclear power, and the like.

I also find that various demographic groups are differentially affected by pro-social identity appeals. Women and those most highly concerned about vaccines in particular respond differently to two kinds of pro-social identity appeals, with images producing more desirable outcomes for intentions to vaccinate and text and corrective appeals resulting in attitude

changes on school policy. This may be because both groups of individuals find the symbolism of the Texas flag persuasive or because they find the text-based treatments sufficient to convince them that un-vaccinated children are a serious concern. The preliminary findings underscore the need for additional studies to further understand how identity, information, and community expectations interact when people encounter different types of public health appeals and how gender and concern level operates in identity-based appeals.

This study is of course not without limitations. I was not able to measure directly whether the respondents had actually received a flu vaccine for both logistical and privacy reasons. As such, I was not able to fully explore the impact of social pressure by exposing individuals' behavior to their contemporaries, as Gerber and Green (2008) do in their seminal social pressure study. Additionally, I face some challenges when working with a convenience sample from Mechanical Turk, particularly when limiting the workers to a specific state. However, the findings in this chapter show that the primary results might be context-dependent and indicates the need for additional research to identify conditions why the backfire effect occurs, when it does not, and which individuals are most strongly affected. Additionally, further exploration of when pro-social appeals can compliment corrective information to change intentions to vaccinate would also be relevant moving forward. Future research might extend this work to a larger, national sample in different pro-social contexts and examine the role of group behavior as a pro-social force in correcting misperceptions.

Despite these limitations, these results suggest that there is much more work to be done to experimentally evaluate the effects of different types of appeals in science communication. Continuing to explore the role of psychological appeals in this sort of messaging by testing corrective and identity appeals together, as well as separately in contexts other than vaccines, are promising avenues for future studies. Additionally, exploring how political context effects these types of appeals by attaching partisan content to the appeal will further our understanding of how political forces shape the effects of social pressure and the correction

of misperceptions in science communication.

This chapter also has implications for public policy. If a variety of demographic groups react differently to language and images used in public health appeals, this poses a challenge for health agencies working to create those appeals. Funding for public health appeals is typically directed at projects meant address a broad audience across the country or in a specific state. These results suggest that such efforts may not be the best use of public funds. Instead, directing resources towards creating more targeted appeals may be more effective in changing behavior. Accounting for identity in how health agencies address different groups in the public may be key in shifting vaccination behavior and attitudes towards public health more broadly.

Appendix: Survey for "Community Immunity: Social Pressure and Vaccine Choices"

[Vaccine concern - pre-intervention]
In general, how concerned are you about serious side effects from vaccines?

- Extremely concerned [5]
- Very concerned [4]
- Somewhat concerned [3]
- Not too concerned [2]
- Not at all concerned [1]

[Delay questions]

[Randomization after delay; control group receives no message]

Please examine the following information about seasonal influenza ("the flu") carefully.

[Correction intervention]

Can the flu shot give me the flu?

No, a flu shot cannot cause flu illness. The viruses contained in flu shots are inactivated (killed), which means they cannot cause infection. Flu vaccine manufacturers kill the viruses used in the flu shot during the process of making vaccine, and batches of flu vaccine are tested to make sure they are safe. In randomized, blinded studies, where some people got flu shots and others got saltwater shots, the only differences in symptoms was increased soreness in the arm and redness at the injection site among people who got the flu shot. There were no differences in terms of body aches, fever, cough, runny nose or sore throat.

More information about these studies is available at:

Carolyn Bridges et al. (2000). Effectiveness and cost-benefit of influenza vaccination of healthy working adults: A randomized controlled trial. JAMA. 284(13):1655-1663.

Kristin Nichol et al. (1995). The effectiveness of vaccination against influenza in healthy working adults. New England Journal of Medicine. 333(14): 889- 893.

Can the nasal spray flu vaccine give you the flu?

Unlike the flu shot, the nasal spray flu vaccine does contain live viruses. However, the viruses are attenuated (weakened) and cannot cause flu illness. Some children and young adults 2-17 years of age have reported experiencing mild reactions after receiving nasal spray flu vaccine, including runny nose, nasal congestion or cough, chills, tiredness/weakness, sore throat and headache. Some adults 18-49 years of age have reported runny nose or nasal congestion, cough, chills, tiredness/weakness, sore throat and headache. These side effects are mild and short lasting, especially when compared to symptoms of influenza infection.

[Texas Text Only- Percentage intervention]

Join the 50% of Texans who got a flu vaccine last year.

Keep Texas Healthy. Keep Texas Strong.

[Texas Text Only- Raw Number intervention]

Join the 13 million Texans who got a flu vaccine last year.

Keep Texas Healthy. Keep Texas Strong.

[Texas Image (No data) intervention]
[Texas raw number intervention]
—-[See Appendix Figure]————
[Texas percentage intervention]

[Dependent variables]
We would like to ask you some questions about the seasonal flu vaccine (a flu shot or nasal flu spray).

How likely is it that you will get a flu vaccine for the seasonal flu during future flu seasons?

- Very likely [6]
- Somewhat likely [5]
- Slightly likely [4]
- Slightly unlikely [3]
- Somewhat unlikely [2]
- Very unlikely [1]

Just based on what you know, how safe do you believe the seasonal flu vaccine, meaning the flu vaccine available every year, is generally for most people to take?

- Very safe [1]
- Somewhat safe [2]
- Not very safe [3]
- Not at all safe [4]

Just based on what you know, is the following statement accurate or inaccurate?

You can get the flu from the seasonal flu vaccine.

- Very accurate [4]
- Somewhat accurate [3]
- Somewhat inaccurate [2]
- Very inaccurate[1]

Just based on what you know, how much do you agree with the following statement?
If a child has not been vaccinated (even though they are healthy enough to receive vaccines), that child should be allowed to attend public school.

- Strongly Agree
- Agree
- Slightly Agree
- Neither Agree Nor Disagree
- Slightly Disagree
- Disagree
- Strongly Disagree

[Manipulation Checks – not given to control group]
[If in correction group]

The nasal spray flu vaccine contains live viruses.

- True
- False

[If in Texas raw number group OR Texas text only raw number group]

How many million Texans got a seasonal flu vaccine last year?

- 5 million
- 13.5 million
- 20 million
- 10 million

[If in Texas percentage group OR Texas text only percentage group]

What percent of Texans got a seasonal flu vaccine last year?

- 10%
- 50%
- 20%
- 40%

[if in the Texas image (no data) condition]

Which of the following was used as the background image in the graphic you viewed earlier?

- The Texas state flag
- The Texas State Capitol Building
- The Alamo
- The American flag

[Demographics]

Now we would like to ask you some questions about yourself.

Please indicate your age range:

- 18-29
- 30-44
- 45-59
- 60+

Please indicate your gender:

- Male

- Female
- Prefer Not To Answer

What is the highest degree or level of schooling you have completed?

- High school diploma or less
- Some college credit, no degree
- Trade, technical, or vocational training
- Associates degree
- Bachelor's degree
- Masters/Doctoral degree
- Other professional degree

Please indicate your race:

- White
- Black
- Hispanic/Latino
- Native American
- Asian
- Pacific Islander
- Other (please write in)

Generally speaking, do you usually think of yourself as a Republican, a Democrat, an Independent, or what?

- Strong Democract
- Weak Democrat
- Independent Leaning Democrat
- Independent
- Independent Leaning Republican
- Weak Republican

- Strong Republican

We hear a lot of talk these days about liberals and conservatives. Here is a seven-point scale on which the political views people might hold are arranged from extremely liberal to extremely conservative. Where would you place yourself on this scale, or haven't you thought much about this?

- Very Liberal
- Liberal
- Slightly Liberal
- Moderate, Middle of the Road
- Slightly Conservative
- Conservative
- Very Conservative
- Do Not Know/Have Not Thought About It

Appendix: Party Identification and Ideology in the Sample for "Community Immunity: Social Pressure and Vaccine Choices"

Data for the Nyhan and Reifler (2015) study were collected as part of the 2012 Cooperative Congressional Election Survey. Because this paper follows the methods and procedures implemented by Nyhan and Reifler (2015) and they do not report the distribution of party identification and ideology in their panel, I have included the distribution of party identification and ideology from the larger survey as a means of comparison between the Mechanical Turk sample and a national sample taken used for Nyhan and Reifler (2015).

Table 6: Distribution of Party Identification in Community Immunity Sample and 2012 CCES by (%)

	Comm. Immunity	2012 CCES
Strong Democrat	16.5	25.6
Weak Democrat	9.9	11.5
Independent Leaning Democrat	18.5	10.1
Independent	20.7	11.6
Independent Leaning Republican	14.1	11.8
Weak Republican	10.8	8.6
Strong Republican	9.5	18
N	474	53,522

Due to rounding, percentgaes may not add to 100%

Table 7: Distribution of Ideology in Community Immunity Sample and 2012 CCES by (%)

	Comm. Immunity	2012 CCES
Very Liberal	12.2	7.8
Liberal	17.1	12.7
Slightly Liberal	15.4	10.7
Moderate, Middle of the Road	17.5	21.9
Slightly Conservative	12.7	11.1
Conservative	16	18.4
Very Conservative	5.9	12.5
Do Not Know/Haven't Thought About It	3.1	4.7
N	474	54,181

Due to rounding, percentgaes may not add to 100%

Appendix: Means of Dependent Variables by Condition for "Community Immunity: Social Pressure and Vaccine Choices"

Table 8: Mean of Dependent Variables by Condition

	Vax Gives Flu	School Policy	Safety	Intentions	N
Control	2.32	4.61	1.65	3.34	67
Correction	1.61	4.84	1.61	3.26	63
Percent Text	2.21	4.78	1.53	3.92	66
Raw Number Text	2.16	4.48	1.63	3.69	68
Image No Data	2.37	4.5	1.69	3.41	62
Percent Image	2.35	4.76	1.65	3.47	67
Raw Number Image	2.21	4.01	1.71	3.6	66

Appendix: Ordered Logit Models Using Two-Tailed Tests for "Community Immunity: Social Pressure and Vaccine Choices"

Table 9: **Ordered Logit Models for Main Effects Using Two Tailed Tests**

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvax Child in School
Main Effects				
Side Effects Concern	-0.31**	1.14**	0.48**	-0.57**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.53*	0.10	-1.33**	0.20
	(0.32)	(0.38)	(0.34)	(0.32)
Flag Treatment	-0.02	0.20	0.16	-0.19
	(0.20)	(0.23)	(0.20)	(0.19)
Text Treatment	0.38	-0.16	0.02	0.08
	(0.27)	(0.33)	(0.27)	(0.26)
Conservative	-0.18**	0.24**	-0.02	-0.17**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.35**	-0.06	-0.27	0.59**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.61**	-0.53*	0.32	0.34
	(0.25)	(0.28)	(0.25)	(0.24)
Education	0.11**	-0.10*	-0.10**	0.06
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.18	-0.23*	-0.38**	0.23**
	(0.11)	(0.13)	(0.11)	(0.10)
Observations	459	459	459	459
Pseudo R-squared	0.03	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05; * p<0.10 with two-tailed tests

Table 10: **Ordered Logit Models for Conditional Effects of Concern Using Two Tailed Tests: Hypothesis 3**

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvax Child in School
Side Effects Concern	-0.56**	1.03**	0.45**	-0.55**
	(0.14)	(0.15)	(0.13)	(0.13)
Correction	-0.80	-0.47	-3.00**	-1.14
	(0.74)	(1.01)	(0.86)	(0.77)
Flag Treatment	-0.90**	-0.28	-0.16	-0.14
	(0.47)	(0.58)	(0.46)	(0.45)
Text Treatment	-0.26	-0.23	0.91	0.87
	(0.62)	(0.81)	(0.62)	(0.62)
Conservative	-0.18**	0.25**	-0.03	-0.16**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.35**	-0.05	-0.25	0.61**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.61**	-0.54**	0.29	0.30
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.12**	-0.09	-0.09*	0.07
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.18	-0.23*	-0.37**	0.24**
	(0.11)	(0.13)	(0.11)	(0.10)
Concern X Correction	0.11	0.21	0.68**	0.56
	(0.28)	(0.34)	(0.30)	(0.29)
Concern X Flag	0.36**	0.17	0.13	-0.01
	(0.17)	(0.19)	(0.16)	(0.16)
Concern X Text	0.25	0.01	-0.39	-0.35
	(0.24)	(0.28)	(0.23)	(0.24)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05; * p<0.10 with two-tailed tests

Table 11: **Ordered Logit Models for Conditional Effects of Ideology Using Two Tailed Tests: Hypothesis 4**

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvaxx Child in School
Side Effects Concern	-0.31**	1.14**	0.48**	-0.57**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.89**	0.58	-1.54**	-0.40
	(0.52)	(0.63)	(0.57)	(0.51)
Flag Treatment	-0.38	0.048	-0.03	-0.17
	(0.35)	(0.44)	(0.35)	(0.34)
Text Treatment	0.34	-0.17	0.01	0.07
	(0.27)	(0.33)	(0.27)	(0.26)
Conservative	-0.26**	0.25**	-0.06	-0.20**
	(0.09)	(0.10)	(0.08)	(0.08)
Female	-0.34**	-0.04	-0.26	0.59**
	(0.17)	(0.20)	(0.17)	(0.16)
Republican	0.62**	-0.54**	0.32	0.36
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.12**	-0.10*	-0.10**	0.07
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.17	-0.24*	-0.39**	0.23**
	(0.11)	(0.13)	(0.11)	(0.10)
Conservative X Flag	0.13	0.05	0.06	-0.01
	(0.10)	(0.12)	(0.10)	(0.09)
Conservative X Correction	0.12	-0.16	0.07	0.22
	(0.14)	(0.17)	(0.15)	(0.14)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** p<0.05; * p<0.10 with two-tailed tests

Table 12: **Ordered Logit Models for Conditional Effects of Gender Using Two Tailed Tests: Hypothesis 5**

	(1) Intentions To Vaccinate	(2) Believe Vaccine Unsafe	(3) Vaccine Gives the Flu	(4) Prohibit Unvaxx Child in School
Side Effects Concern	-0.31**	1.15**	0.49**	-0.58**
	(0.07)	(0.09)	(0.07)	(0.07)
Correction	-0.53*	0.10	-1.33**	0.24
	(0.32)	(0.38)	(0.34)	(0.32)
Flag Treatment	-0.40	0.60*	0.35	-0.02
	(0.29)	(0.34)	(0.30)	(0.28)
Text Treatment	0.36	0.01	0.18	0.63*
	(0.35)	(0.44)	(0.36)	(0.34)
Conservative	-0.19**	0.24**	-0.03	-0.17**
	(0.07)	(0.08)	(0.07)	(0.06)
Female	-0.67**	0.37	-0.02	1.07**
	(0.32)	(0.37)	(0.32)	(0.31)
Republican	0.64**	-0.53*	0.32	0.34
	(0.26)	(0.28)	(0.25)	(0.24)
Education	0.11**	-0.10*	-0.10**	0.06
	(0.05)	(0.06)	(0.05)	(0.05)
Age	0.19*	-0.24*	-0.39**	0.24**
	(0.11)	(0.13)	(0.11)	(0.10)
Female X Flag	0.77*	-0.77	-0.37	-0.32
	(0.41)	(0.48)	(0.41)	(0.39)
Female X Text	-0.05	-0.34	-0.29	-1.18**
	(0.45)	(0.53)	(0.46)	(0.44)
Observations	459	459	459	459
Pseudo R-squared	0.04	0.22	0.07	0.06

Standard errors in parentheses; ** $p<0.05$ with one-tailed tests