Effective Messages in Vaccine Promotion:
A Randomized Trial

Brendan Nyhan, Ph.D. (corresponding author)
Dartmouth College
HB 6108, Hanover, NH 03755
603/646-2894 / nyhan@dartmouth.edu

Jason Reifler, Ph.D.
University of Exeter
J.Reifler@exeter.ac.uk

Sean Richey, Ph.D.
Georgia State University
srichey@gsu.edu

Gary L. Freed, M.D. M.P.H.
University of Michigan/University of Melbourne
gfreed@med.umich.edu

Short title: Which Messages Are Effective in Vaccine Promotion?

Abbreviations: MMR – measles, mumps, and rubella; CDC – Centers for Disease Control and Prevention; AOR – adjusted odds ratio

Keywords: vaccines, myths, MMR, autism, false, misperceptions, misinformation

What's known on this subject: Maintaining high levels of MMR immunization is an important public health priority that has been threatened by discredited claims about the safety of the vaccine. Relatively little is known about what messages are effective in overcoming parental reluctance to vaccinate.

What this study adds: Pro-vaccine messages do not always work as intended. The effectiveness of those messages may vary depending on existing parental attitudes toward vaccines. For some parents, they may actually increase misperceptions or reduce vaccination intention.

Contributor's statement

Brendan Nyhan: Dr. Nyhan initiated the project, obtained funding for the study, designed the experiment, analyzed the data, drafted the initial manuscript, and approved the final manuscript as submitted.

Jason Reifler: Dr. Reifler initiated the project, obtained funding for the study, designed the experiment, analyzed the data, drafted the initial manuscript, and approved the final manuscript as submitted.

Sean Richey: Dr. Richey initiated the project, obtained funding for the study, designed the experiment, interpreted the data, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Gary L. Freed: Dr. Freed initiated the project, obtained funding for the study, designed the experiment, interpreted the data, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Abstract

Objective: To test the effectiveness of messages designed to reduce vaccine misperceptions and increase vaccination rates for measles, mumps, and rubella (MMR).

Methods: A Web-based nationally-representative two-wave survey experiment was conducted with 1759 parents age 18 and over residing in the United States who have children in their household age 17 or younger (conducted June-July 2011). Parents were randomly assigned to receive one of 4 interventions: (1) information explaining the lack of evidence that MMR causes autism from the CDC; (2) textual information about the dangers of the diseases prevented by MMR from the Vaccine Information Statement; (3) images of children with diseases prevented by the MMR vaccine; (4) a dramatic narrative about a baby who almost died from measles from a CDC fact sheet; or to a control group.

Results: None of the interventions increased parental intent to vaccinate a future child. Refuting claims of a MMR/autism link successfully reduced misperceptions that vaccines cause autism but nonetheless decreased intent to vaccinate among parents with the least favorable vaccine attitudes. In addition, images of sick children increased expressed belief in a vaccine/autism link and a dramatic narrative about an infant in danger increased self-reported belief in serious vaccine side effects.

Conclusion: Current public health communications about vaccines may not be effective. For some parents, they may actually increase misperceptions or reduce vaccination intention. Attempts to increase concerns about communicable diseases or correct false claims about vaccines may be especially likely to be counterproductive. More study of pro-vaccine messaging is needed.

The measles, mumps, and rubella (MMR) vaccine has attracted extensive attention in recent years due in large part to discredited claims about its safety[1] that circulate widely among anti-vaccination activists and websites.[2-6] While U.S. MMR vaccination rates for children ages 19-35 months exceeded the *Healthy People 2020* target of 90% in the 2011 National Immunization Survey, fifteen states had rates below that threshold.[7] Some areas have even lower immunization rates due to clustering of unvaccinated or undervaccinated children.[8-9] Moreover, the prevalence of concerns about the vaccine,[10-11] requests for exemptions from vaccination requirements,[9] and use of alternative schedules[12-13] suggest reason for concern about future MMR vaccination rates. For instance, parents who follow alternative schedules are more likely to refuse or delay MMR,[13-14] which is associated with increased measles risk.[15]

Maintaining high levels of MMR immunization is thus an important public health priority, especially given the increased number of measles cases observed recently in the U.S.[16] The public health consequences of MMR non-compliance can also be seen in the recent measles epidemic in the United Kingdom, which infected more than 1000 people and prompted a massive vaccination campaign by public authorities.[17-18]

Given these concerns, how should physicians and public health agencies respond to parental questions about vaccine safety? This question is difficult to answer. For instance, while some have advocated that health professionals engage in dialogue with vaccine-hesitant parents,[19-21] relatively little is known about which messages are effective in overcoming parental reluctance to vaccinate.

In particular, some pro-vaccine messages may do more harm than good, especially those targeting misinformation, which is often difficult to correct.[22-24] The

problem is that people often interpret evidence in a biased fashion.[25-28] As a result, corrective information about controversial issues may fail to change factual beliefs and/or opinions among respondents who are most likely to be misinformed.[22,29] In some cases, corrections can even make misperceptions *worse*.[22] Resistance to scientific evidence about health risks is also a serious concern.[30-32] It is therefore important to determine whether corrective information about MMR and other vaccines provokes a similar response. We hypothesize that respondents with the least favorable vaccine attitudes will increase their belief in false claims and decrease their intent to vaccinate in response to corrective information.

A more effective approach than describing the safety of vaccines may be to highlight risks from disease. Messages describing potential dangers put individuals into the "domain of losses," which should make them more tolerant of perceived risks than messages about the benefits of vaccines.[33] Despite significant interest in applying this approach to health,[34] only a handful of experiments have done so for vaccines.[35-38] In addition, there are many ways to communicate such dangers, including text, visuals, and narrative accounts. The relative merits of these approaches for vaccine promotion are not clear, especially given the risk that fear appeals or disturbing messages will backfire.[39-40]

In this study, we present results from a nationally representative experiment testing four informational approaches to encouraging MMR vaccination among parents. We evaluate the effects of these messages relative to a no-information control condition.

Methods

Data collection/sample

Respondents were drawn from a nationally representative Knowledge Networks online panel recruited via random digit dialing and address-based sampling from a population probability sample.[41] The data come from online interviews with parents (18 years old and over) with one or more children aged 17 or younger living in their household. The first wave of the study was completed by 2,471 respondents out of 4,462 who were sampled (response rate: 55.4%). Among those, 2,299 qualified for inclusion in the study (93.0%). We then re-contacted all eligible respondents from Wave 1. A total of 88% of those contacted (N=1,759) completed Wave 2. Our sample for analysis consisted of the 1,759 participants who completed both waves of the study. The first wave was conducted June 10-23, 2011 and the second was conducted June 22-July 5, 2011. The median number of days between waves was twelve (range: 1-22).

Study design

The study was conducted as a two-wave online panel. In the first wave, respondents completed pre-intervention measures of health and vaccine attitudes, which were asked in a separate wave to avoid directly affecting their responses during the second wave. We first asked a series of questions about the health status of their children. Respondents then answered eight agree/disagree questions about attitudes toward vaccines from a previous study, which were averaged as a pre-intervention measure of vaccine attitudes.[11] Respondents were also asked if they have ever delayed or refused a recommended

vaccine, how important vaccines are to them personally, and how much trust they place in various health professions and institutions.

In the second wave of the study, respondents were randomly assigned by the survey software to receive one of four pro-vaccine messages or a control message. Subjects were unaware of the other experimental conditions; researchers were blind to assignment until data was delivered. After the experimental manipulation, we then asked a series of questions designed to assess misperceptions about MMR, concerns about side effects, and intent to give MMR to future children.

Experimental intervention

We tested the effectiveness of providing information about the safety of the MMR vaccine or the danger of contracting measles, mumps, or rubella. We specifically tested four strategies commonly used by public health agencies to promote vaccination – (1) correcting misinformation, (2) presenting information on disease risks, (3) using dramatic narratives, or (4) displaying visuals to make those risks more salient or accessible. To maximize the realism of our experimental stimuli, each of the first three interventions uses text adapted nearly verbatim from Centers for Disease Control materials. The first, *Autism correction*, presented scientific evidence debunking the vaccine/autism link using language drawn nearly verbatim from the MMR vaccine safety page on CDC's website.[42] The second intervention, *Disease risks,* described symptoms and adverse events associated with measles, mumps, and rubella using text adapted nearly verbatim from the CDC's MMR vaccine information statement.[43] The third intervention, *Disease narrative*, uses a CDC narrative of a mother recounting her infant son's hospitalization with

measles.[44] The fourth intervention, *Disease images*, presents parents with pictures of a

child with each disease.[45] Results from these interventions were contrasted with those

obtained in the control condition (*Control*), which consisted of a text about the costs and

benefits of bird feeding. (The interventions are presented in the online appendix.)

Outcome measures

There are three key outcome measures. First, we evaluated general misperceptions about

vaccines causing autism (*Vaccines cause autism*) by asking whether respondents agree or

disagree that "some vaccines cause autism in healthy children" on a five-point scale. The

MMR side effects question (*MMR side effects)* asked about the perceived likelihood that

children "will suffer serious side effects" from MMR on a six-point scale. Finally, the

vaccination intent question (*MMR for next child*) asked how likely they would be to give

MMR to a future child on the same six-point scale. (Note: This measure only captures

self-reports of future MMR intent, not other forms of resistance such as delaying

vaccination or employing alternate schedules.)

Statistical analysis

The data are analyzed using ordered logistic regression in Stata 11 (Stata Corporation;

College Station, TX, USA). We estimate the effects of assignment to each intervention

condition ("intention to treat") for three key outcome measures, *Vaccines cause autism*,

MMR side effects, and *MMR next child*, using indicators for the different interventions

and pre-intervention indicators of respondents' attitudes toward vaccines (by tercile).

Because our survey experiment is a randomized controlled trial, we can interpret the

effects of the interventions in causal terms. Our statistical models account for respondent attitudes toward vaccines by also including indicators for the third of the sample with the most favorable attitudes toward vaccines (mean response of 4.4 on a 1-5 scale) and the middle third of the sample, which we describe as having somewhat favorable attitudes towards vaccines (mean of 3.8). (The third with the least favorable attitudes [mean of 3.0] is the omitted category.) To determine if intervention effects vary due to vaccine attitudes, we also test for statistical interactions between vaccine attitude groups and intervention indicators. When significant interactions are found, we present separate estimates of the effect of the interventions for each group. We also estimate adjusted Wald tests of the joint significance of the disease risk interventions to assess their effects as a group. Tabular results are presented as adjusted odds ratios with 95% confidence intervals; we also present predicted probabilities in graphical form.

The University of Michigan's Health and Behavioral Sciences Institutional Review Board classified this study as exempt (registration number: IRB00000246). All participants provided informed consent before taking part. No adverse events were reported.

Results

Table 1 presents sample demographics, which were weighted to represent the population of parents with children under 18 at home in the Knowledge Networks panel.

[Table 1]

Because the panel is recruited via random probability sampling, our weighted sample should represent the national population of parents with children 0-17 living at home (for instance, the distribution of demographic variables are consistent with population norms). As such, we can directly extrapolate our findings to the national population.

Response to pro-vaccine messages

We first examined the outcome measures that assess misperceptions about the disproven vaccines-autism link (*Vaccines cause autism*) and the likelihood of serious side effects from MMR (*MMR side effects*). While *Autism correction* was the only intervention that directly addressed such concerns, the disease risk interventions might have heightened parents' concerns or risk sensitivity. Table 2 presents ordered logistic regression models of the effect of the interventions on MMR misperceptions.

[Table 2]

The *Autism correction* intervention successfully reduced agreement that "some vaccines cause autism in healthy children" (AOR=0.55, 95% CI: 0.38 to 0.79). However, it did not significantly reduce concerns about *MMR side effects*. *Disease risks*, which provided information about symptoms and adverse events from measles, mumps, and rubella, did not have a significant effect on either *Vaccines cause autism* or *MMR side effects*. *Disease narrative,* which recounts a mother's story of her infant son's hospitalization with measles, actually increased beliefs in the likelihood of serious side effects from MMR (AOR=1.92, 95% CI: 1.33 to 2.77), allowing us to reject the null that the risk

interventions had equal effects ($F(2, 1744) = 7.98$, $p < .01$). Likewise, while *Disease images* did not have a significant effect on *MMR side effects*, it did increase beliefs that vaccines cause autism (AOR=1.47, 95% CI: 1.02 to 2.13), though the effect was not distinct from the other risk interventions ($F(2, 1734) = 0.96$, *n.s.*).

We could not reject the null hypothesis that intervention effects do not vary by vaccine attitude group for any intervention on *Vaccines cause autism* or *MMR side effects*. We thus do not estimate the effects of the treatments separately by vaccine attitude group in Table 2. We also could not reject the null hypothesis that the effects of the three risk interventions were jointly zero for *Vaccines cause autism*. However, we found that they were jointly significant for *MMR side effects* due to the *Disease narrative* effect described above ($F(3, 1743) = 6.17$, *p*<.01). (In addition to these results, pre-specified interactions between the interventions and measures of trust in health professions and institutions were not consistently significant.)

Figure 1 summarizes the effects of the interventions on vaccine misperceptions for a respondent in the least favorable vaccine attitude group using predicted probabilities from Table 2.

[Figure 1]

Autism correction is most effective in reducing agreement with the autism misperception. Strong agreement declines from a predicted probability of 8.9% to 5.1% (and likewise for other response options). By contrast, the predicted probability of strong agreement increases to 12.6% for *Disease images*. Similarly, the predicted probability of believing

serious side effects from MMR are very likely increased from 7.7% among controls to 13.8% in the *Disease narrative* condition.

Table 3 presents ordered logistic regression models examining how the interventions affect participants' intent to vaccinate future children (*MMR next child*). The model in the left column of Table 3 estimates the effects of the interventions for the full sample. We then estimate separate models by vaccine attitude group to investigate how the effects of the interventions vary depending on respondents' pre-existing attitudes. (Results from a model with vaccine attitude/intervention interactions are virtually identical; we report separate models to ease interpretation.)

[Table 3]

The model estimated among all respondents indicates that *Autism correction* resulted in parents reporting they would be *less* likely to vaccinate future children (AOR=0.52, 95% CI: 0.32 to 0.84). No other intervention significantly increased intent to vaccinate. Likewise, we cannot reject the null hypothesis that the joint effects of the risk interventions are zero. When we estimate the model separately by vaccine attitude group, we observe that the negative effects of *Autism correction* on *MMR next child* were concentrated among respondents with the least favorable vaccine attitudes (AOR=0.36, 95% CI: 0.20 to 0.64). By contrast, the effects of *Autism correction* on intent to vaccinate were positive among respondents with more favorable attitudes, though not statistically significant. Additional analyses indicate that this difference in effects between the least and most favorable groups was significant (AOR=8.27, 95% CI: 1.19 to 57.49), allowing

us to reject the null hypothesis that the effect of *Autism correction* did not vary by vaccine attitude group (F(2, 1749) = 3.31; *p*<.05). None of the other interventions significantly increased intent to vaccinate in any vaccine attitude groups, nor can we reject the null that the effects of the risk interventions are jointly zero.

The results in Table 3 are illustrated in Figure 2, which presents predicted probabilities that respondents would be very likely to vaccinate future children by experimental condition for each vaccine attitude group.

[Figure 2]

Among respondents with the least favorable attitudes toward vaccines, the predicted probability that respondents would be very likely to give MMR decreased from 70% among controls to 45% for those given information debunking the supposed autism link.

Discussion

We find that pro-vaccine messages do not always work as intended and that the effectiveness of those messages may vary depending on parental attitudes toward vaccines. Unlike several other studies of resistance to scientific evidence,[30-32] corrective information from the CDC website successfully corrected misperceptions about MMR causing autism. However, the correction also *reduced* vaccination intent among parents with the least favorable vaccine attitudes. This finding suggests respondents brought to mind other concerns about vaccines to defend their anti-vaccine attitudes, a response that is broadly consistent with the literature on motivated reasoning about politics and

vaccines.[25-28] In addition, our data provide little evidence that messages emphasizing the risks of vaccine-preventable diseases were effective in promoting vaccination intent. This finding is consistent with prior studies finding mixed effects of loss-framed messages and fear appeals on vaccination and other preventive health behaviors.[34-40] However, we additionally find a danger-priming effect in which both a dramatic narrative about measles and images of sick children *increased* misperceptions about MMR. Finally, no intervention increased intent to vaccinate among parents who are the least favorable toward vaccines (those with more favorable attitudes were extremely likely to intend to vaccinate, reducing the scope for a positive effect).

As with any study, these results have limitations that are worth noting. First, the safety and disease risk messages tested, while drawn nearly verbatim from actual messaging by the CDC and other agencies, were not the only possible approaches to presenting information about MMR. Other messages might prove to be more effective. Second, logistical and privacy constraints limited the scope of the study to self-reported beliefs and intent to vaccinate, not actual vaccine receipt. Finally, to minimize the complexity of the research design, we did not explicitly attribute the intervention materials to external sources such as the CDC.

Nonetheless, these results have important implications for public health. First, health messages must be tested before dissemination to assess their effectiveness, especially among resistant or skeptical populations. For instance, we found that a pro-vaccination message was *least* persuasive among parents with the *most* negative attitudes towards vaccines – the group of greatest public health concern. In particular, corrections of misperceptions about controversial issues like vaccines may be counter-productive in

some populations. The best response to false beliefs is not necessarily correct information. Likewise, trying to scare parents with emotive stories could paradoxically increase vaccine safety concerns among those who are already hesitant to immunize.

In addition, our results demonstrate the importance of measuring beliefs *and* behavioral intent when assessing health interventions. Corrective information about the disproven vaccine-autism link significantly reduced misperceptions, but also reduced intention to vaccinate among parents with the least favorable vaccine attitudes. If we had not measured intent, we might have missed a potentially dangerous backfire effect.

Finally, these results suggest several avenues for future research. First, why did the narrative we tested increase beliefs in MMR side effects? Subtle narratives have been found to be persuasive because individuals "may not marshal their cognitive resources to defend against a potentially counterattitudinal message."[47] Our narrative may have been insufficiently subtle and therefore ineffective at overcoming prior beliefs. Additionally, there is some evidence that health narratives that induce fear are less effective in changing beliefs and attitudes.[48] Future research should investigate the heterogeneity of health narrative effects further. Second, the resistance to persuasion we observe highlights the difficulty of identifying credible sources of vaccine information. Given that parents rate their children's doctor as their most trusted source of vaccine safety information, future research should explore whether pediatricians would be an especially persuasive source.[49] Third, while it is possible that alternate approaches might be more effective than our interventions, these findings suggest that any such approaches should be carefully tested.

Conclusion

None of the pro-vaccine messages created by public health authorities increased intent to vaccinate with MMR among a nationally representative sample of parents with children 17 or younger at home. Corrective information reduced misperceptions about the vaccine/autism link but nonetheless *decreased* intent to vaccinate among parents with the least favorable attitudes toward vaccines. Moreover, images of children with measles, mumps, and rubella and a narrative about a child with measles actually increased beliefs in serious vaccine side effects. These results suggest the need to carefully test vaccination messaging before making it public.

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Table 1: Sample demographics

	Wave 1	Wave 2	Wave 2 by experimental condition				
			Disease risks	Autism correction	Narrative danger	Disease images	Control
Sex							
Female	55%	56%	50%	42%	47%	42%	41%
Male	45%	44%	50%	58%	53%	58%	59%
Race/ethnicity							
White	62%	62%	68%	65%	53%	61%	67%
Black	12%	12%	9%	14%	19%	9%	7%
Hispanic	19%	19%	16%	16%	22%	20%	21%
Other	4%	4%	5%	4%	4%	6%	3%
Multiracial	3%	3%	3%	1%	3%	4%	2%
Education							
Not a high school graduate	13%	14%	13%	12%	15%	6%	21%
High school graduate	27%	26%	25%	24%	28%	27%	25%
Some college	29%	29%	31%	28%	25%	33%	28%
College graduate	31%	31%	31%	35%	31%	34%	25%
Household income							
Less than $30,000	30%	30%	25%	28%	34%	27%	37%
$30,000-$59,999	25%	24%	28%	24%	21%	23%	25%
$60,000-$99,999	25%	25%	26%	23%	27%	28%	22%
$100,000+	21%	20%	21%	24%	17%	22%	16%
Age							
Less than 30	20%	20%	21%	18%	20%	22%	20%
30-40	40%	39%	38%	39%	39%	39%	40%
41 and older	41%	41%	40%	43%	41%	39%	40%
Region							
Northeast	16%	16%	18%	20%	14%	15%	16%
Midwest	22%	22%	22%	27%	21%	22%	18%
South	37%	37%	35%	33%	42%	36%	38%
West	25%	25%	25%	20%	23%	27%	28%
Number of children in household							
1	39%	39%	35%	41%	40%	38%	42%
2	40%	39%	46%	39%	38%	42%	32%
3	15%	15%	14%	13%	15%	12%	18%
4	5%	5%	4%	6%	4%	5%	6%

5	1%	1%	1%	--	2%	2%	2%
6	<1%	<1%	--	<1%	<1%	1%	<1%
7+	<1%	<1%					
Refused	<1%	--					
N	2229	1759	337	340	371	337	374

Sample statistics are computed using weights calculated by Knowledge Networks;[41] weights are calculated separately for each wave so that the sample reflects the population of parents of children 0-17 years old from the Knowledge Networks panel. Due to rounding, some percentages may not add to 100%. The number of children in household was only asked in wave 1; the proportions listed for wave 2 reflect answers from wave 1 among those who completed both waves of the survey. Pearson's chi-square is non-significant for differences across intervention groups after a Bonferroni correction for multiple comparisons.

Table 2: Effects of interventions on MMR misperceptions

|	Vaccines cause autism	MMR side effects
Autism correction	0.55*	0.81
	[0.38, 0.79]	[0.57, 1.15]
Disease risks	1.15	0.93
	[0.79, 1.67]	[0.65, 1.35]
Disease narrative	1.35	1.92*
	[0.91, 2.01]	[1.33, 2.77]
Disease images	1.47*	1.18
	[1.02, 2.13]	[0.82, 1.69]
Somewhat favorable toward vaccines	0.22*	0.49*
(Baseline: Least favorable)	[0.16, 0.30]	[0.37, 0.64]
Most favorable toward vaccines	0.06*	0.23*
(Baseline: Least favorable)	[0.04, 0.08]	[0.17, 0.31]
N	1736	1746

Ordered logit models with coefficients expressed as adjusted odds ratios and 95% confidence intervals in brackets (cutpoints omitted; * $p<.05$). "Vaccines cause autism" measures agreement on a five-point scale from "Strongly disagree" (1) to "Strongly agree" (5) to the statement "Some vaccines cause autism in healthy children." "MMR side effects" measures responses on a six-point scale from "Very unlikely" (1) to "Very likely" (6) to the question "Just based on what you know, how likely is it that children who get the measles, mumps, and rubella vaccine, which is known as the MMR vaccine, will suffer serious side effects?" The experimental interventions are provided in the online appendix.

Table 3: Effects of interventions on MMR intention

| | All | Vaccine attitudes | | |
		Least favorable	Somewhat favorable	Most favorable
Autism correction	0.52*	0.36*	1.12	2.98
	[0.32, 0.84]	[0.20, 0.64]	[0.36, 3.52]	[0.48, 18.36]
Disease risks	0.98	0.96	1.23	0.82
	[0.54, 1.77]	[0.50, 1.86]	[0.29, 5.30]	[0.12, 5.45]
Disease narrative	1.09	0.87	2.26	7.29
	[0.62, 1.94]	[0.45, 1.68]	[0.60, 8.45]	[0.64, 82.77]
Disease images	1.29	1.20	2.00	0.86
	[0.73, 2.26]	[0.64, 2.26]	[0.71, 5.67]	[0.09, 8.48]
Somewhat favorable toward vaccines (Baseline: Least favorable)	7.61* [4.74, 12.22]			
Most favorable toward vaccines (Baseline: Least favorable)	16.19* [7.16, 36.59]			
N	1751	678	529	544

Ordered logit models with coefficients expressed as adjusted odds ratios and 95% confidence intervals in brackets (cutpoints omitted; * $p<.05$). "MMR intention" measures responses on a six-point scale from "Very unlikely" (1) to "Very likely" (6) to the question "If you had another child, how likely is it that you would give that child the measles, mumps, and rubella vaccine, which is known as the MMR vaccine?" Indicators for vaccine attitudes groups (least, somewhat, and most favorable) are based on a tercile split of responses to the vaccine attitudes scale from Freed et al.,[11] which was administered in a prior wave of the study. The experimental interventions are provided in the online appendix.

Figure 1

Vaccines cause autism:
Strongly agree

MMR side effects:
Very likely
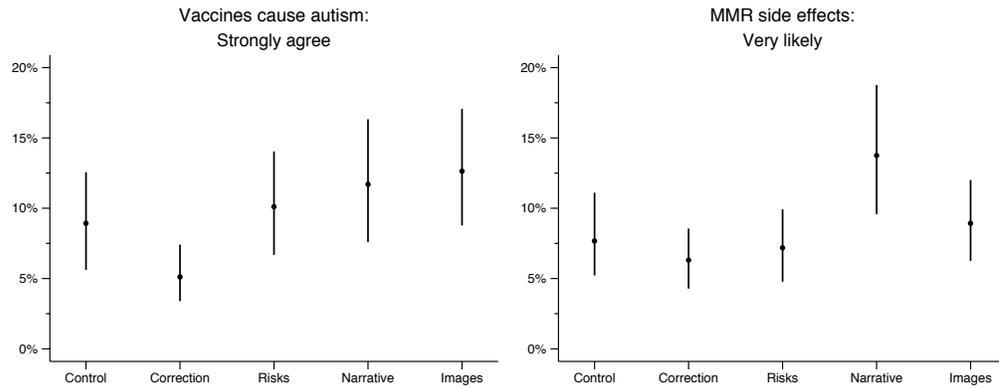
Predicted intervention effects for MMR misperceptions (parents with least favorable vaccine attitudes). The figure depicts predicted probabilities for respondents with the least favorable attitudes toward vaccines (defined based on a tercile split of responses to the vaccine attitudes scale from Freed et al., which was administered in a prior wave of the study). Predicted probabilities and bootstrapped 95% confidence intervals were estimated from the ordered logit models in Table 2 using SPost in Stata 11.[46] The left panel presents the predicted probabilities that participants would respond "Strongly agree" to the statement "Some vaccines cause autism in healthy children." Respondents were less likely to strongly agree if they received corrective information but more likely to do so if they received images of sick children. The right panel presents the predicted probabilities that respondents would say "Very likely" to the question "Just based on what you know, how likely is it that children who get the measles, mumps, and rubella vaccine, which is known as the MMR vaccine, will suffer serious side effects?" The narrative increased the predicted likelihood that respondents would believe serious side effects were very likely. Intervention text is provided in the online appendix.

Figure 2
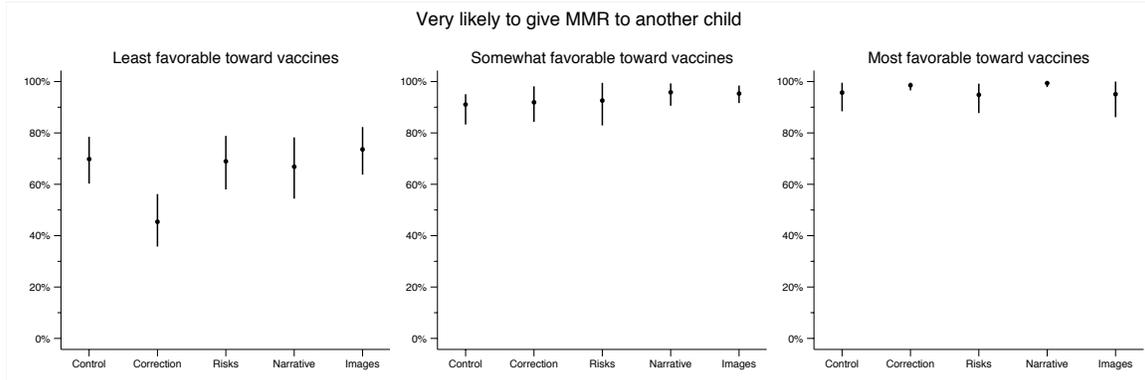
Predicted intervention effects for MMR intention. The figure depicts predicted probabilities and bootstrapped 95% confidence intervals from the ordered logit models in Table 3 generated using SPost in Stata 11.[46] The panel presents the predicted probability that respondents would answer "Very likely" to the question "If you had another child, how likely is it that you would give that child the measles, mumps, and rubella vaccine, which is known as the MMR vaccine?" for respondents with the least favorable attitudes toward vaccines, those with somewhat favorable attitudes, and those with the most favorable attitudes (the groups were defined based on a tercile split of responses to the vaccine attitudes scale from Freed et al.,[11] which was administered in a prior wave of the study). Corrective information disproving the vaccine/autism link reduced intent to vaccinate among parents with the least favorable attitudes toward vaccines; no significant effect was found among the other groups. Intervention text is provided in the online appendix.