Risk Communication, Values Clarification and Vaccination Decisions

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Abstract

Many health-related choices require choosing between two options, each of which carries an element of risk. When presented with such risk tradeoffs, people often make choices that fail to align with available scientific evidence and/or with their own values. In our previous research, we have developed risk visualizations and interactive values clarification designs that help people make more coherent choices. This study tested such methods in the context of parental decisions about influenza vaccinations for their children. We aimed to help parents understand the risks associated with vaccinating and not vaccinating their children against influenza, grasp the tradeoffs inherent in the decision, visualize how their individual values relate to their options, and make choices that align with their values. Participants (n=407) in this online factorial experiment were a diverse sample of parents and guardians whose children were aged 6 months to 17 years and were eligible for influenza immunization but who had not yet received a vaccine in the current year. We randomly assigned participants to view either standard information about influenza vaccines or information presented in an absolute risk communication format, and then to either be presented or not presented with an interactive values clarification interface. Participants who were randomized to the absolute risk communication format combined with the values clarification interface were more likely to indicate intentions to vaccinate and make choices that aligned with their stated values. The effect was particularly notable among participants who had previously demonstrated less willingness to have their children vaccinated against influenza. (250 words)

1. INTRODUCTION

Many choices in the context of health require choosing between two options in which both carry an element of risk. When presented with such risk tradeoffs, people can make choices that run contrary to their preferences and values. These types of inconsistencies are especially apparent when probabilities are small and when risks are laden with emotion.[1,2] Our previous research has documented this effect through multiple studies,[3,4] demonstrating that this is a robust and persistent phenomenon.

Health decision support tools such as patient decision aids can support informed choices and increased clarity of values[5] but greater research is needed into methods of shared decision making[6] that can help people to better understand risks and benefits as well as how their values relevant to those risks and benefits determine what choice might be best suited to them. Our previous research has demonstrated that particular design features of risk visualizations and interactive online interfaces can help people to make more values-concordant choices when faced with risk tradeoffs.[7,8] By more values-concordant, we mean choices that align with their stated values. Specifically, by using an interactive interface that makes the tradeoffs of a decision apparent and explicitly shows people how their stated preferences imply that one option is more in line with their values than the other, we were able to reduce the proportion of study participants making discordant choices by 40% in the context of a hypothetical treatment for colon cancer.[9]

In this study, we applied methods and insights from our previous research to the domain of vaccination decisions. Decisions about immunization involve such influences as omission

bias, meaning that people feel more regret about a negative outcome from something they elected to do than from something they elected not to do,[10] complex mental models,[11] social norms derived from increasingly polarized online social groups,[12,13] and growing vaccine hesitancy in developed countries.[14] Childhood influenza immunization offers a particularly interesting and important study context. In 2012, approximately half of children in the US were vaccinated against influenza; yet 90% of deaths occurred among unvaccinated children. Approximately 40% of the children who died had no known health concerns.[15] In addition to the need to reduce mortality and burden of illness among children, increased immunization of children could also reduce the burden of influenza in the population as a whole.[16]

Unlike some other health decisions, public information about influenza immunization does not typically include understandable numerical risk estimates (e.g., see information for the public from the Centers for Disease Control and Prevention.[17]) It can be difficult even for highly numerate people to develop a clear, well-informed sense of the overall risk-benefit balance. Parental concerns about the effectiveness and potential side effects of influenza vaccines have been noted as key reasons for choosing not to have their children vaccinated against influenza,[18] making the lack of clear, comprehensible information an important concern. Furthermore, little work has been done to help people understand how these decisions relate to their values. The process of values clarification, that is, sorting out what is important to an individual relevant to a decision,[19] is a key step in making a coherent decision.[20] By coherent decision, we mean a decision that meets key criteria of

normative frameworks of health decision quality, specifically, that the decision must be based on relevant knowledge and aligned with one's values.[21,22]

The overall objective of this study was to better understand how to help people make more coherent choices when presented with risk tradeoffs. To pursue this aim, we experimentally tested methods that might help parents understand the risks associated with immunizing and not immunizing their children against influenza, grasp the tradeoffs inherent in the decision, see how their individual values relate to their options, and make choices that align with their values. Available statistics about the risks and benefits of flu vaccines suggest that, in the context of most people's values, the benefits of influenza immunization outweigh the risks. Thus, while nonetheless allowing for a certain proportion of participants whose values may lead to a different risk-benefit balance, we hypothesized that by helping people to understand the different statistics for vaccinated and non-vaccinated children and also guiding them through the process of aligning their choices with their values relevant to the decision, we would observe greater intentions among participants to vaccinate their children against influenza.

2. METHODS

2.1. Recruitment

In November through December 2013, we invited members of Amazon's Mechanical Turk (MTurk) to take an online survey about flu vaccines for children. To be eligible in the study, participants had to live in the United States, be 18 years or older, and be a parent or guardian who makes medical decisions for at least one child aged 6 months to 18 years. In

addition, their child could not have received a flu vaccine yet in the current flu season nor could the child have medical reasons to avoid such a vaccine. In other words, both through timing and through inclusion and exclusion criteria, we deliberately sought parents of children who were likely to be undecided about vaccinating their children against influenza. Participants were compensated $0.50 for completing the survey. Comparative studies have demonstrated that survey responses on MTurk are comparable to those obtained via more costly sources.[23]

The study was deemed exempt by the Institutional Review Board as anonymous survey research. Before clicking to begin the study, all participants viewed a consent page in which they were informed that the survey would involve learning about flu vaccines for children. The consent page included an explicit statement to the effect that the study was not funded by or associated with any pharmaceutical company, and that we were interested in participants' honest opinions.

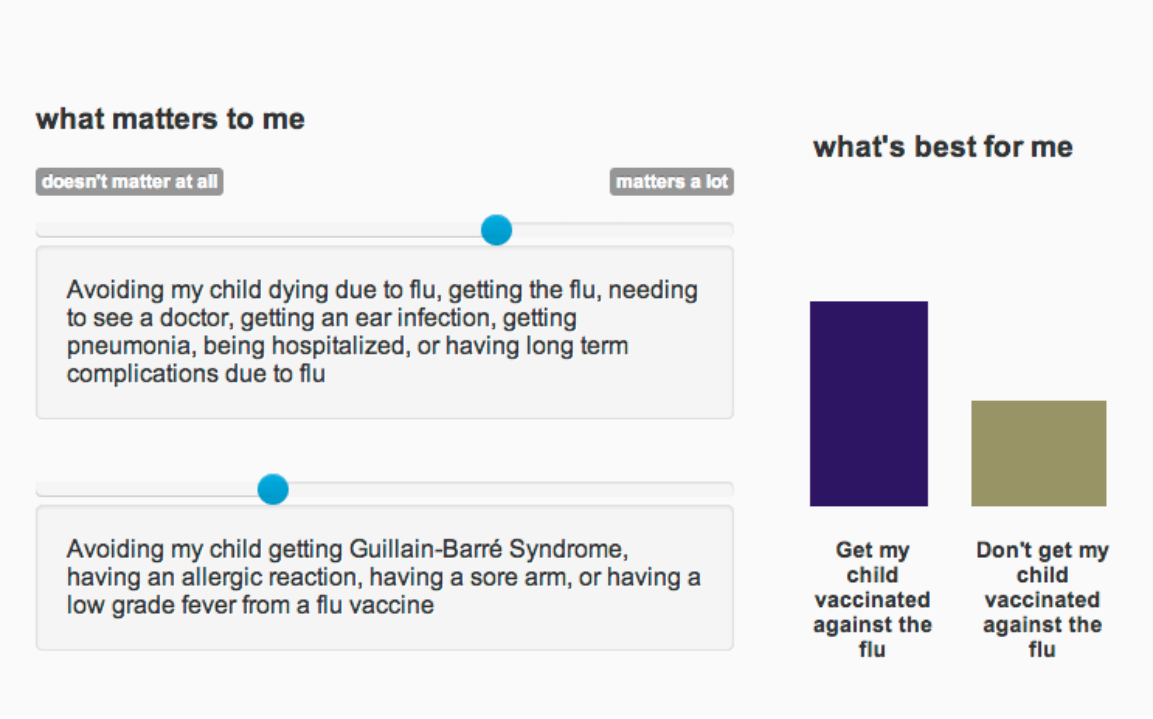
2.2. Design of Experiment

We conducted a 2x2 factorial experiment. The first factor, *Risk Communication*, randomly varied between a *Control condition*, for which we presented standard information about influenza immunization copied directly from the Centers for Disease Control and Prevention with their formatting, and a *Risk Communication condition*, in which we presented numerical information and graphics showing absolute risk estimates of the risks and benefits of flu vaccines for children, including last year's rates of death due to influenza and side effects of flu vaccines among children in the US. We derived our estimates from

published models and epidemiological studies.[15,24-26] As much as possible, we based our calculations on publications that were publicly available in order to facilitate transparency. For participants randomized to the Risk Communication condition, we provided links to our sources after participants had completed the survey. Estimates were presented as rates per 10 million children; we further contextualized this number by informing participants that there are approximately 65 million children in the United States. When presenting data about children's deaths due to influenza, we also included icon arrays[7] to help participants better understand the differences in death rates between groups of vaccinated and unvaccinated children. We presented the benefits of flu vaccines first, followed by the risks. We first presented tables of numbers for both vaccinated and unvaccinated children, for example, 'Out of every 10 million children **vaccinated** against the flu, about 86 will be hospitalized because of the flu or its complications. Out of every 10 million children **NOT vaccinated** against the flu, about 367 will be hospitalized because of the flu or its complications,' (emphases original). These were followed by summaries in which we calculated the differences for participants, e.g., 'For every 10 million children who are vaccinated against the flu, about 281 children will **avoid being hospitalized** because of the flu or its complications,' (emphasis original). This technique, in which we do the arithmetic for people to highlight the incremental risk difference, has been associated with better outcomes in other decision contexts.[8,27] After presenting the benefits and risks separately, we presented a summary table of incremental benefits and risks side by side.

The second factor, *Values Clarification*, randomly varied between a control condition (*No Values Clarification condition*) and a *Values Clarification condition* in which participants were asked to use sliders to indicate the importance of competing risks, such as avoiding death due to flu and avoiding a serious complication such as Guillain-Barré syndrome from the vaccine. The sliders were constrained such that as a participant moved one slider in one direction, the other automatically moved in the other direction, making the tradeoffs in the decision explicit and salient. We also displayed a recommended option via vertical bars that moved dynamically based on a simple linear function of the slider positions. See Figure 1 for an image of the Values Clarification interface.

Figure 1: Values Clarification Interface



2.3. Study Procedure

Participants began the study by reading about influenza. Following this general information, they were exposed to either the Control or Risk Communication presentation of information. Participants who had been randomized to the Values Clarification condition were then asked to complete a brief values clarification exercise, whereas those randomized to No Values Clarification proceeded directly to the portion of the survey in which we assessed outcomes. (See Figure 2 for a study flow diagram.) We then collected participants' responses to our primary outcome, followed by other questions that included a secondary outcome, moderator and sociodemographic questions. We asked participants to think of their child when answering the questions. Participants with more than one child within the eligible age range were randomly instructed to think of their child who has either the earliest or latest birthday in the calendar year.

At the conclusion of the survey, participants were provided with a brief list of resources for learning more about flu vaccines, including where they could get their child vaccinated.

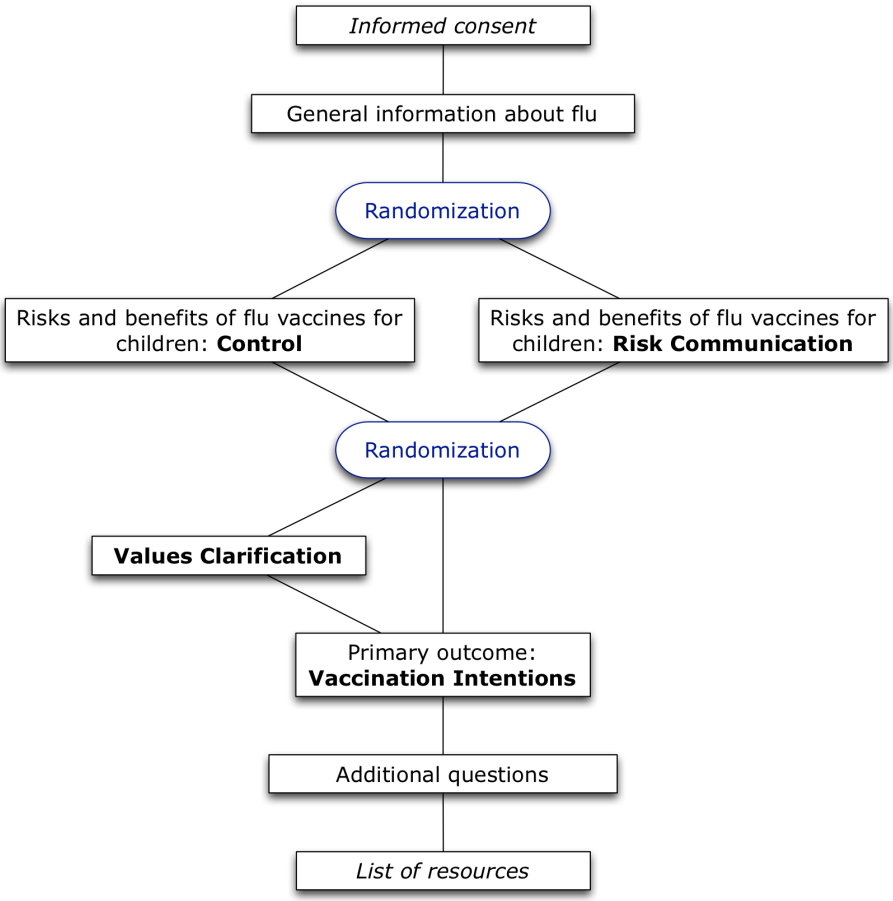
2.3. Measures

2.3.1. Independent Variables

There were two independent variables in the experimental design, as described in the previous section. The variable *Risk Communication* describes whether study participants were presented with absolute risk and benefit estimates of influenza immunization for children (Risk Communication condition) or standard information copied directly from the website of the Centers for Disease Control (Control condition.) The variable *Values*

Clarification describes whether or not participants were asked to complete a values clarification exercise designed to help them clarify what is important to them and align their decision with their values (Values Clarification condition versus No Values Clarification condition).

Figure 2: Study Flow



2.3.2. Primary Outcome: Vaccination Intentions

The primary outcome in this study was *Vaccination Intentions*, a measure of participants' intentions to vaccinate their child against influenza. The introductory text for this outcome read, "You may or may not have made a decision about whether or not to get a flu vaccine

for your child this year. We would like to know your feelings about this decision at this moment." Participants were then asked to respond to the question, "Based on how you feel about this decision right now, would you say you will choose to," on a 9 point Likert scale, with anchors, "Definitely GET my child a flu vaccine this year," (value 4) on the left of the scale and, "Definitely NOT get my child a flu vaccine this year," (value -4) on the right (capitalization original). Participants did not see the numbers associated with the response options, only a row of radio buttons. Because this research was designed to ultimately assess outcomes of actual vaccination behaviors in a follow-up study, we were particularly interested in exploring experimental effects associated with participants selecting the leftmost option, thus suggesting a strong, definite intention to vaccinate their child. We labeled this outcome variable, *Definite Intentions*.

2.3.3. Secondary Outcome: Values Concordance

We also considered a secondary outcome in this study *Values Concordance*. To assess this, near the end of the survey, we asked all participants a question based on previous research about attitudes in the United States about childhood vaccination,[28] "Which of the following statements best represents your opinion (choose one): When it comes to flu vaccines for children …" with five possible response options, "The benefits of the vaccine strongly outweigh the risks," "The benefits of the vaccine slightly outweigh the risks," "The benefits and risks of the vaccine are about equal," "The risks of the vaccine slightly outweigh the benefits," or, "The risks of the vaccine strongly outweigh the benefits."

To assess participants' Value Concordance, we compared their response about the risk-benefit balance to their Vaccination Intentions and defined each participants' responses as either concordant or not. We defined the top two points on the Vaccination Intentions scale (top point = definitely get my child the vaccine) as concordant with the first risk-benefit balance statement (benefits strongly outweigh risks), the third and fourth top points as concordant with the second statement (benefits slightly outweigh risks), the middle point of the Vaccination Intentions measure as concordant with the third statement (benefits and risks about equal), the sixth and seventh points as concordant with the fourth statement (risks slightly outweigh benefits) and the bottom two points on the *Vaccination Intentions* scale (bottom point = definitely not get my child the vaccine) as concordant with the fifth statement (risks strongly outweigh benefits).

2.3.4. Moderator: Decision History

When making a decision about vaccination, people are likely to integrate their existing opinions into the decision. As an indicator of participants' overall attitudes toward flu vaccines for children, we asked about their *Decision History*, "Which of the following statement best describes your decisions about flu vaccines for your child(ren) in the past 5 years? If you have not been a parent/guardian for at least 5 years, answer for the number of years you have been a parent/guardian," with response options, "I chose to get my child(ren) a flu vaccine every year," "I chose to give my child(ren) a flu vaccine some years," and, "I never chose to get my child(ren) a flu vaccine." For analyses, we combined the first two statements to create a dichotomous variable indicating whether or not the participant had previously demonstrated openness to immunizing their child(ren) against influenza.

2.4. Analyses

Analysis of the primary outcome Vaccination Intentions was conducted as a linear regression with both experimental factors as well as the moderator entered into the model. We examined all potential main effects and interactions. Other outcomes were examined via Chi-squared analyses. The alpha level for all analyses was .05 and all analyses were conducted in R, version 3.0.2.[29]

3. RESULTS

3.1. Study Participants

Of the 666 people who clicked on the survey and answered the eligibility questions, 579 of them were eligible to participate in the study. Of these, 412 (71%) completed the survey. The median time to complete the full survey was 14 minutes (interquartile range 10-19 minutes); we excluded from analysis participants who completed the full survey in less than 5 minutes, as this speed suggested that they might not have been paying attention to the content. Five participants were excluded on this basis. Thus, the final sample for analysis comprised responses from 407 participants (70% of eligible participants).

Participants were predominantly female and half of participants were between the ages of 28 and 41. Participants' ethnicities and races were diverse, though not completely representative of the US population. Nearly half (47%) had no college degree. See Table I for details of study participant characteristics.

Table I: Study Participant Characteristics

Characteristic		Statistic
Sociodemographic Characteristics of Participants		
Age: Mean (SD)		35 (9)
Gender: N (%)	Female	257 (63%)
	Male	149 (37%)
Ethnicity: N (%)	Hispanic	33 (8%)
	Middle Eastern	1 (0.2%)
Race: N (%)	White or Caucasian	324 (80%)
	Black or African American	42 (10%)
	American Indian or Alaska Native	11 (3%)
	Asian or Asian-American	18 (4%)
	Pacific Islander or Native Hawaiian	0 (0%)
	Other	5 (1%)
Highest education level reached: N (%)	None	0 (0%)
	Elementary school	0 (0%)
	Some high school, but no diploma	6 (1%)
	High school (Diploma or GED)	42 (10%)
	Trade school	11 (3%)
	Some college, but no degree	133 (33%)
	Associate's degree (AA, AS, etc.)	58 (14%)
	Bachelor's degree (BS, BA, etc.)	113 (28%)
	Master's degree (MA, MPH, etc.)	35 (9%)
	Doctoral/Professional degree (PhD, MD, etc.)	9 (2%)
Characteristics of Child		
Age of child: N (%)	6 - 23 months old	70 (17%)
	2 - 4 years old	114 (28%)
	5 - 11 years old	140 (34%)
	12 - 17 years old	83 (20%)
Is the child in school? N (%)	Yes	237 (58%)
	No	169 (42%)
Is the child in daycare? N (%)	Yes	71 (18%)
	No	326 (82%)
Is the child at higher risk of complications due to flu? N (%)	Yes	29 (7%)
	No	351 (86%)
	I don't know	26 (6%)
Characteristics of Family (Including Child Considered in Study)		
Number of children total: N (%)	1	222 (55%)
	2	128 (31%)
	3 or more	56 (14%)
Any children in school: N (%)		268 (66%)
Any children in daycare: N (%)		79 (19%)
Any children at higher risk of complications due to flu: N (%)		29 (7%)
Previous Vaccination Decisions		
Child has received: N (%)	All standard vaccines, on standard schedule	258 (64%)
	Selected vaccines, on standard schedule	54 (13%)
	All standard vaccines, on alternate schedule	23 (6%)
	Selected vaccines, on alternate schedule	39 (10%)
	Not applicable (no vaccines)	31 (8%)
In the past 5 years, participants chose to get a flu vaccine for her/himself: N (%)	Every year	48 (12%)
	Some years	159 (39%)
	Never	199 (49%)
	Every year	80 (20%)

In the past 5 years, participants chose to get a flu vaccine for her/his child: N (%)	Every year	80 (20%)
	Some years	159 (39%)
	Never	168 (41%)
Previous Experience with Flu and Vaccines		
Knows an adult (including self) who has had the flu: N (%)	Yes	342 (84%)
	No	49 (12%)
	Not sure	15 (4%)
Knows a child (including own) who has had the flu: N (%)	Yes	236 (58%)
	No	141 (35%)
	Not sure	28 (7%)
Knows an adult who has had a bad reaction to flu vaccine or other vaccine: N (%)	Yes	154 (38%)
	No	222 (55%)
	Not sure	30 (7%)
Knows a child who has had a bad reaction to flu vaccine or other vaccine: N (%)	Yes	79 (19%)
	No	299 (74%)
	Not sure	28 (7%)
Health Care Access		
Child has a primary health care provider: N (%)	Yes	377 (93%)
	No	28 (7%)
Child's health insurance: N (%) (Note 1)	Private/employer insurance	225 (55%)
	Government insurance	166 (41%)
	Other health insurance	4 (1%)
	No health insurance	24 (6%)
Flu vaccine available for child without any out of pocket costs: N (%)	Yes	237 (58%)
	No	84 (21%)
	Not sure	85 (21%)
Participant knows where to get the flu vaccine: N (%)	Yes	385 (95%)
	No	13 (3%)
	Not sure	8 (2%)
Other Individual Difference Measures		
Subjective Numeracy (out of possible 6 to 48): Median (IQR)		38 (11)
Beliefs about Medicines (out of possible 8 to 40): Median (IQR)		24 (8)

Note 1: Insurance statuses sum to 419 rather than 407 because 11 participants indicated both private and government insurance and 1 participant indicated both private and other insurance. Percentages are calculated out of 407.

Nearly all of these characteristics were evenly distributed across the experimental factors (p's >.05). However, two of the characteristics demonstrated unbalanced distribution. First, participants who identified as Asian or Asian-American were unequally divided on the Values Clarification factor. Three of these participants were randomized to the Values Clarification condition; the remaining 15 were not (Fisher's exact test: Odds Ratio 5.4, 95% CI (1.5, 29.5), $p < .05$). Second, participants who indicated that they either did or did not know an adult who had experienced a negative reaction to a vaccine were more or less

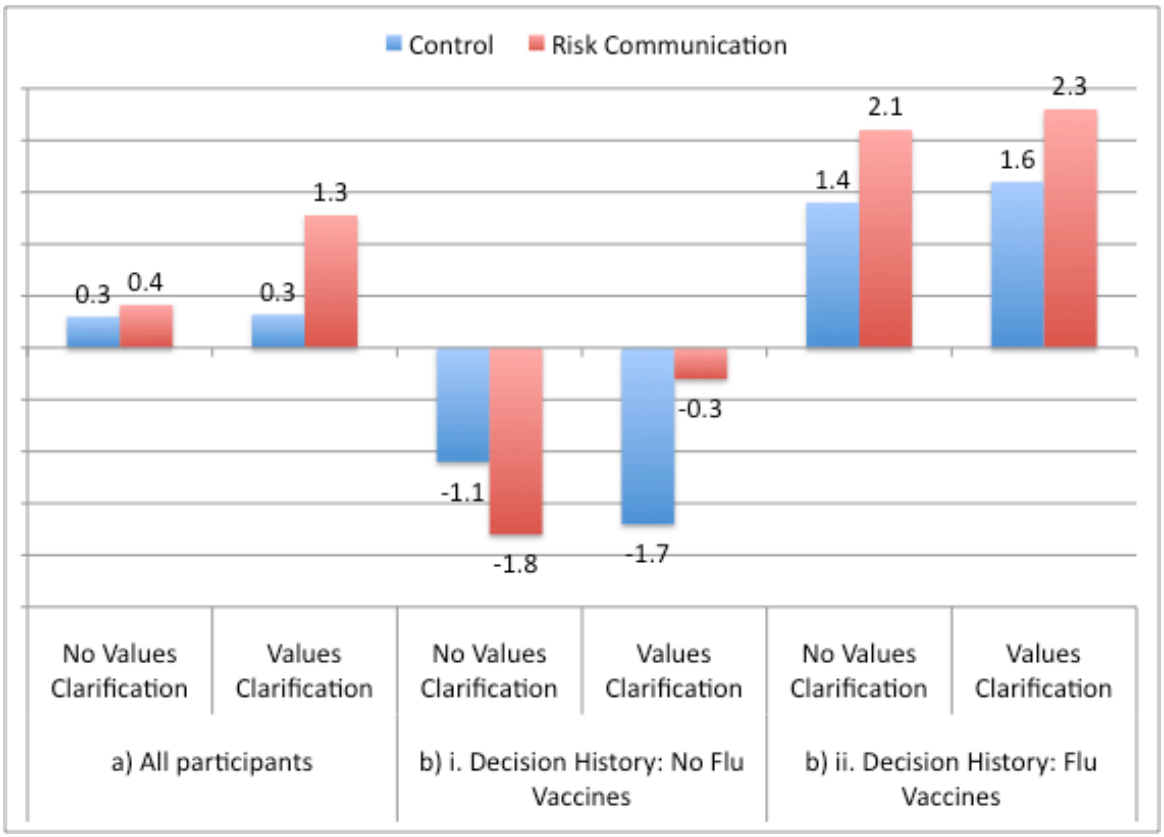
equally distributed across the Values Clarification factor (participants who indicated they knew an adult who had had a negative vaccine reaction: 107 No Values Clarification, 115 Values Clarification; participants who indicated they did not know any such adult: 73 No Values Clarification, 81 Values Clarification). However, the proportion of participants indicating they were unsure whether or not they knew such an adult was unequally distributed, with 22 participants assigned to No Values Clarification versus 8 assigned to Values Clarification (Chi-squared(2) = 7.23, $p < .05$). As these participants represented a fraction of our sample and neither variable was a planned moderating factor in our analyses, these imbalances did not change our analytical approach.

3.2. Primary Outcome: Vaccination Intentions

We observed a main effect of participants' *Decision History*. This moderator predicted their *Vaccination Intentions* ($\beta = 2.51$, $t(399) = 4.92$, $p < .001$), meaning that participants who had previously decided to vaccinate one or more children against influenza were more inclined to do so again. We also observed a two-way interaction between *Risk Communication* and *Values Clarification* in their association with *Vaccination Intentions* ($\beta = 2.08$, $t(399) = 2.63$, $p < .01$) in which neither the Risk Communication condition nor the Values Clarification condition alone appeared to increase intentions significantly; however, when combined together, they increased intentions from the control condition by nearly one point on the nine-point scale (see Figure 3a). In addition, we observed a three-way interaction between all three predictors ($\beta = -2.14$, $t(399) = -2.06$, $p < .05$) which suggested that while Risk Communication alone was more or less sufficient to help people who had vaccinated their children against flu within the past 5 years choose to do so again, the combination of Risk

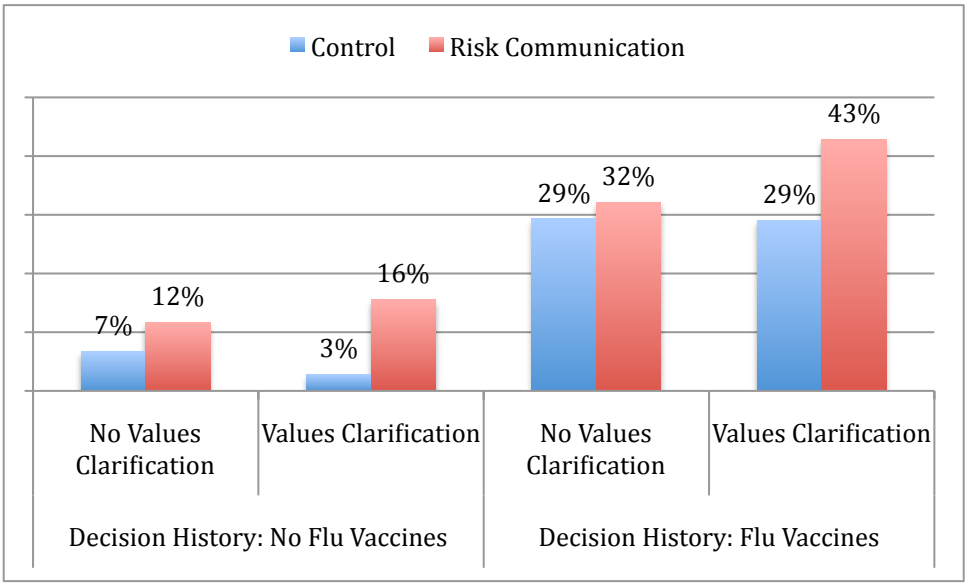
Communication and Values Clarification was especially important for participants who had not recently vaccinated their children against influenza (see Figure 3b). When we examined participants' rates of *Definite Intentions* to vaccinate their children against influenza, we again observed a statistically significant interaction (Chi-squared (15) = 140, $p < .001$) suggesting that the combination of *Risk Communication* and *Values Clarification* was associated with the greatest rates of intentions to definitely vaccinate (see Figure 4).

Figure 3: Vaccination Intentions



Note: Response scale ranged from 4 ("Definitely GET my child a flu vaccine this year") to -4 ("Definitely NOT get my child a flu vaccine this year")

Figure 4: Participants with Definite Intentions to vaccinate their child against flu



3.3. Secondary Outcome: Values Concordance

Rates of *Values Concordance* varied according to the experimental and moderating factors, ranging from 34% to 64% of participants making choices that were concordant with their stated values. Rates of values concordance were higher for participants who had previous decisions to vaccinate their child(ren) against influenza; however, regardless of decision history, the combined Risk Communication and Values Clarification conditions yielded the highest rates of values concordance (see Table II).

Table II. Number of Participants with Values Concordant Responses

		Decision History: No Flu Vaccines	Decision History: Flu Vaccines
No Values Clarification	Control	19/45 (42%)	23/58 (40%)
	Risk Communication	20/43 (47%)	30/56 (54%)
Values Clarification	Control	12/35 (34%)	31/55 (56%)
	Risk Communication	22/45 (49%)	45/70 (64%)
		Chi-squared (15) = 32.1, $p < 0.01$	

4. DISCUSSION

3.1. Principal Findings

In this study, we examined the effects of a risk communication format that clearly presents numerical estimates of the risks and benefits of influenza vaccines for children along with a values clarification interface intended to help people understand which option is likely to be best aligned with their values. Our results suggest that it is the combination of these two approaches that is most effective for encouraging both vaccination and values concordant choices. Our results further suggest that, while risk communication alone may be helpful for parents and guardians who have demonstrated openness to flu vaccines in the past, the combination of risk communication and values clarification is critical for parents and guardians who may be more hesitant to vaccinate their children against influenza.

Similar to our findings, previous studies have demonstrated that patient decision aids designed to help parents and guardians make informed choices about routine childhood vaccines are associated with increased knowledge, reduced decisional conflict,[30] more positive attitudes toward vaccination,[31] and increased uptake of standard vaccines on the recommended schedule.[10] These findings, together with ours, suggest that supporting parents and guardians in the process of making informed choices about vaccinating their children is a promising approach. On the other hand, more recently, it has been suggested that the process of shared decision making may not be appropriate to the context of vaccination. This recent suggestion rests on the findings of an observational study of conversations between parents and health care providers, which demonstrated

that when health care professionals linguistically framed whether or not to vaccinate as a decision to make (versus a presumed action), parents were less likely to choose to vaccinate their children.[32] This study did not include an analysis of whether or not health care providers explicitly drew on parents' values to make recommendations.

Recommendations for health care providers to address vaccine hesitancy are to educate parents more thoroughly about reasons to vaccinate their children, correct misinformation and consider drawing on the power of narrative.[33,34] However, a trial of an educational intervention that included personal accounts by parents whose children contracted vaccine-preventable diseases – but that did not include a values clarification exercise – did not change behavior.[35] Our study suggests that the inclusion of values clarification techniques such as ours, designed specifically to support informed, values-concordant decisions, may be particularly important when seeking to help vaccine-hesitant parents and guardians make fully informed decisions. Our findings about the potential of a values clarification technique was particularly interesting in light of the fact that vaccine-critical information sources have been observed to focus more on values versus official information sources that focus more on communicating about risks and benefits.[11] We note that the values clarification exercise in this study used both a simple interface and a simple underlying model. Further research is needed to investigate whether, for example, more complex models or theoretically-based interfaces designed to support more aspects of the decision making process[20] might have even stronger effects.

3.2. Limitations

This study has several limitations. First, participants were recruited from an online pool of potential survey participants and thus may not be representative of the broader population. Second, the primary outcome for this study was the intention to vaccinate one's child, not actually vaccinating him or her. Although behavioral theories suggest that intentions are a key predictor of behavior,[36] intentions may fail to translate into action. The experiment described in this paper is the first step in a longer study in which we will conduct follow-up surveys near the end of this year's flu season to assess participants' children's actual flu vaccination status. Third, the risk and benefit information and decision attributes used in the values clarification exercise consisted only of those for which data were available for risk estimates. This means that other potentially important decision attributes, for example, the out of pocket cost of the vaccine to a given participant or the time required to take the child to a location to receive the vaccine, were not integrated into the risk-benefit information nor the values clarification exercise. Fourth and finally, the study used values concordance as a secondary outcome. Values concordance is a key metric of decision quality[21,22] but measuring it is problematic because the mere act of asking questions about values is a values clarification intervention in and of itself. To avoid this problem to the greatest extent possible, we framed the question very broadly – asking about participants' opinions of the risk-benefit balance, not asking directly about their values for different attributes of the options – and placed it near the end of the survey among fact-based questions to help elicit an immediate answer rather than a contemplative process. However, including this question may reduce our ability to detect effects of the

experimental factor Values Clarification in the follow-up study of actual flu vaccination behavior.

3.3. Conclusions

Current standard methods of providing parents and guardians with information about childhood influenza immunization could be improved by providing absolute estimates of risks and benefits. However, to support parents and guardians in making high quality decisions about whether or not to vaccinate their children against influenza, it is not enough to present information about risks and benefits well; we also need to help people align their choices and actions with their values. Some people's values may be such that not vaccinating their child is the most coherent choice for them. However, this study suggests that by explicitly acknowledging both the risks and benefits of vaccinations and showing the relationship between values and options, we may be able to support parents and guardians – including those who are vaccine-hesitant – in making informed vaccination choices that are aligned with their values. Furthermore, in doing so, we can increase intentions to vaccinate.

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