Behavioral Interventions to Increase HPV Vaccination Acceptability Among Mothers of Young Girls

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Objective: To determine the most effective ways to present human papillomavirus (HPV) vaccine risk and benefit information to mothers in Hispanic, African American, and White communities, to increase mothers’ intentions to vaccinate their daughters against HPV. Design: The study used a 3 × 2 between-subjects factorial design, involving 3 different risk presentation formats (graphical HPV statistics, nongraphical HPV statistics, or no-statistics control) and the presence or absence of rhetorical questions (RQ). Data were collected from a national sample of 471 mothers of girls ages 11–16. Main Outcome Variables: The primary outcome variable was mothers’ intention to vaccinate their daughters against HPV. Secondary outcomes included mothers’ self-reported message comprehension and perceptions of daughters’ vulnerability to HPV infection, infection severity, vaccine efficacy, and obstacles to immunization. Results and Conclusion: Results showed that both risk presentation format and RQs had an overall positive effect on mothers’ intention to vaccinate their daughters. However, the interventions appear to be more effective when used separately than when used in combination. Each of these interventions is brief and could easily be implemented by health care providers as well as in patient health communication literature.

Keywords: behavioral interventions, HPV vaccination intentions, graphical risk presentation, rhetorical question (foot in the door), health communication

In June 2006, a vaccine to prevent infection with four human papillomavirus (HPV) types, including two causing cervical cancer, was licensed by the U.S. Food and Drug Administration (FDA; Centers for Disease Control & Prevention, 2007). This vaccine has important public health implications for women, especially for low-income and minority women, for whom cervical cancer risk is especially high. However, the vaccine’s potential public health benefits will be realized only if they are widely understood by parents and if large numbers decide to have their daughters vaccinated. This study seeks to determine the most effective ways to present HPV vaccine information to parents, to encourage adherence to HPV vaccination recommendations for adolescent and preadolescent girls. Using social psychological research in social compliance, and research on the visual presentation of risk information, this study uses a randomized experiment to (a) test alternative methods (graphic and nongraphic) for presenting HPV risk and vaccine efficacy information and (b) test the effectiveness of a social compliance technique (rhetorical questions; RQs) in increasing acceptability to mothers of vaccinating their daughters against HPV infection.

Literature Review

HPV Infection and Vaccination

HPV infection is the major cause of cervical cancer, with two HPV types (16 and 18) causing about 70% of all cervical cancers (International Agency for Research on Cancer [IARC], 1995; Kuper, Adams, & Trichopoulos, 2000). In the United States, about 10,000 women are diagnosed with cervical cancer annually and nearly 4,000 die from it; worldwide, the disease afflicts nearly half a million women each year, causing about 250,000 deaths (National Cancer Institute [NCI], n.d.-a). For women with regular access to health care, cervical cancer mortality can be greatly reduced by regular Pap tests (Sanders & Taira, 2003). Still, this disease exacts substantial health and economic costs, suggesting that widespread HPV vaccination could prove cost effective (Elbashir, Dasbach, & Inginga, 2007; Kulasingam et al., 2006), particularly among preadolescent girls (Kim & Goldie, 2008). HPV vaccination may be especially beneficial to Hispanic and African American women, who are less likely to get regular Pap tests (Huerta, 2003; O’Brien et al., 2003). In the United States, cervical cancer incidence per 100,000 women is 6.6 among non-Hispanic Whites, but much higher among Hispanic (12.6) and African American (9.2) women (National Cancer Institute [NCI], n.d.-b).

In June 2006, the FDA licensed the first HPV vaccine, for use in girls and women ages 9–26. Soon thereafter, the Advisory Committee on Immunization Practice (ACIP) recommended rou-
tine HPV vaccination for girls ages 11 and 12 and “catch-up” vaccination for older girls and young women (Centers for Disease Control & Prevention, 2007). In the ensuing months, efforts were made in some states to mandate HPV vaccination for school entry. However, these efforts generated considerable backlash, making widespread school mandates unlikely. Thus, for the foreseeable future, the ability of the HPV vaccine to reduce cervical cancer in the United States will depend on provision of the vaccine by health care providers and individual parents deciding to have their daughters vaccinated.

In recent years, several descriptive studies have examined parents’ beliefs and attitudes toward HPV vaccination (see the review by Zimet, Shew, & Kahn, 2008), but surprisingly few experimental studies have examined alternative approaches to communicating the vaccine’s risks and benefits to parents. In one of the few such studies, Dempsey, Zimet, Davis, and Koutsly (2006) examined the effect of an educational intervention on HPV vaccine acceptability among parents of 8- to 12-year-olds. Although the intervention increased parents’ HPV knowledge, it had no impact on vaccination acceptability. In contrast, Davis, Dickman, Ferris, and Dias (2004) found that HPV information increased parents’ support for adolescent HPV vaccination. More recently, both Gerend and Shepherd (2007) and Leader, Weiner, Kelly, Hornik, and Cappella (2009) found evidence that HPV message “framing” influences self-vaccination intentions among adult women; however, neither study presented evidence of message effects on parents’ intentions to vaccinate their daughters. (The Gerend and Shepherd study focused solely on college-age women, while the Leader et al. study sample included very few parents of young daughters.)

Research on Graphic Versus Nongraphic Presentation of Risk Information

A parent’s decision to vaccinate (or not vaccinate) her child can be influenced by a number of factors, including perceived social norms regarding vaccination, provider recommendation, and the perceived risks and benefits of vaccination (see, e.g., Sturm, Mays, & Zimet, 2005). For those parents seeking to assess a specific vaccine’s risks and benefits, it is important that they clearly understand the relative likelihood of different events: For example, “How likely is my daughter to get cervical cancer during her lifetime?” and “How will this likelihood change if she receives the HPV vaccine?” Without an understanding of relative risk probabilities, parents may overestimate extremely low-likelihood risks (e.g., a life-threatening vaccine reaction) and underestimate much higher likelihood events (e.g., contracting the disease the vaccine is intended to prevent).

In presenting such risk information, one has essentially three options: verbal, numerical, and graphic. Verbal communication of risk (using adjectives such as rare or common) is popular but problematic. First, such words are inherently ambiguous, leading to widely divergent interpretations (Berry, 2004; Bonnefon & Villejoubert, 2006). Second, lay interpretations of risk terms often deviate dramatically from the intent of risk communicators. For example, risk communication guidelines issued by the European Commission dictate that a drug’s side effect should be described as very rare if it occurs in less than 0.01% of patients (Berry, 2004). However, Cox and Cox (2007) found that consumers encountering these terms in prescription drug advertisements interpreted them quite differently. For example, when a side effect was described as very rare, participants indicated that it would occur in over 30% of patients—only slightly less often than a side effect described as very common.

Numerical presentations of likelihoods (e.g., odds, percentages, and probabilities) have the advantage of greater precision but also present communication problems. Research suggests that many people find percentages and probabilities to be confusing (Berry, 2004; Tversky & Kahneman, 1981). In addition, research (e.g., Cox & Cox, 2001) suggests that audiences often perceive numerical information to be uninteresting and uninvolving and therefore may tend simply to disregard it when making decisions.

One possible method to overcome some of these problems is the graphic presentation of risk likelihoods. Previous research suggests that graphic risk presentations are often easier to understand (Chua, Yates, & Shah, 2006; Edwards, Elwyn, & Gwyn, 1999; Lipkus & Hollands, 1999; Stone, Yates, & Parker, 1997; Waters, Weinstein, Colditz, & Emmons, 2006), can be processed more rapidly (Paivio, 1971), may help people tolerate low-probability risks (Stone et al., 1997), and often increase intention to adopt risk-reduction behaviors (Chua et al., 2006). Recently, Wallace, Leask, and Trevena (2006) found that an online decision aid using graphic information on risks of the measles-mumps-rubella vaccine increased parents’ intentions to vaccinate their children. Graphic risk presentation may be particularly helpful for those with less education, those with low numerical fluency, and those whose first language is not English.

We expect the effect of risk presentation on parents’ vaccination intentions to be mediated by components of the Health Belief Model (Becker, 1974; Rosenstock, 1966). For example, perceived HPV vulnerability and severity have been shown to influence vaccine acceptance among parents (Ferris, Waller, Owen, & Smith, 2008; Olshen, Woods, Austin, Luskin, & Bauchner, 2005). Perceived vaccine efficacy and obstacles were also shown to influence vaccine acceptance (Gerend, Lee, & Shepherd, 2007; Zimet, 2005).

On the basis of the literature, we expect that graphic presentation of HPV risk information will increase both reported message comprehension and vaccination intention, in comparison with non-graphic or control conditions. We also expect that the effects of risk presentation on mothers’ vaccination intention will be mediated by perceived HPV vulnerability and severity, vaccine efficacy, and vaccination obstacles.

Schwartz, Woloshin, Black, and Welch (1997) found that participants scoring low on numerical fluency (or numeracy) had more difficulty interpreting medical statistics. Because a potential benefit of graphic risk presentation is ease of understanding, we expect that numeracy will moderate the effect of graphic presentation on self-reported message comprehension and HPV vaccine intention; that is, the effects of graphic presentation on comprehension and vaccination intent will be strongest among mothers with low numeracy scores.

Research on Rhetorical Question (RQ) Technique

Another intervention that may be helpful in increasing HPV vaccine acceptance is the rhetorical question (RQ) technique (Cialdini, Trost, & Newsom, 1995; Freedman & Fraser, 1966). This intervention (also known as foot in the door) involves gaining
agreement with a small, high-compliance request or question before making a larger (target) request. The theory is that after respondents agree to the initial request, they are more likely to agree to the larger request, in order to seem consistent in their behavior. For example, people may be more likely to donate to an environmental cause (large request), if first asked to sign a proenvironmental petition (small request). This is typically explained in terms of self-perception: agreeing to the initial request changes one’s self-concept (“Because I signed the petition, I must support the environment.”); then when faced with the second request, one feels a need to be consistent with the initial behavior (“Because I support the environment, I probably should give some money.”).

Dolin and Booth-Butterfield (1995) published one of the few studies to apply the RQ method to changing health behavior. Women attending a health fair were asked to schedule a gynecological exam. However, prior to this request, half the women were asked if they wanted a breast self-exam demonstration card (all of them said “yes”). Among women offered the card, 41% later scheduled an exam, in comparison with 25% in the control condition. Interestingly, women in the RQ group had slightly less favorable attitudes toward gynecological exams than did the controls but were more likely to actually sign up for one. Interpretation of this study is complicated by a possible confound: the mere receipt of a gift may have increased adherence, because people who receive gifts often feel obligated to reciprocate (Cialdini, 1988). Our study remedies this limitation, by using a RQ intervention that does not involve a gift.

On the basis of the literature, we expect that mothers asked RQs about protecting their daughter’s health will express stronger intentions to vaccinate their daughters against HPV, in comparison with mothers not asked RQs. Furthermore, we expect the effects of RQ on vaccination intention to be mediated by perceptions of HPV vulnerability and severity and of vaccination efficacy and obstacles.

Cialdini et al. (1995) argued that compliance with a small request should have the greatest impact on the subsequent behavior of people with a high need for internal consistency. Thus we expect that need for consistency will moderate the effect of the rhetorical question on HPV vaccine intention; that is, that the effects of the RQ intervention will be strongest among mothers scoring high on need for consistency.

Summary of Hypotheses

Hypothesis 1: Graphic presentation of risk statistics, in comparison with both nongraphic statistics and a no-statistics control, will increase mothers’ (a) intention to have their daughters receive the HPV vaccine and (b) self-reported message comprehension.

Hypothesis 2: The effects of risk presentation on mothers’ vaccination intention will be mediated by perceptions of their daughters’ vulnerability to HPV infection, HPV severity, vaccine efficacy, and obstacles to immunization.

Hypothesis 3: The effects of risk presentation will be moderated by mothers’ numeracy; that is, the positive effects of graphic presentation on message comprehension and vaccination intention will be stronger among mothers with low numeracy scores.

Hypothesis 4: Mothers asked rhetorical questions (RQs) about protecting their daughter’s health will report greater intention to vaccinate their daughters than will mothers not asked RQs.

Hypothesis 5: The effects of RQ on vaccination intention will be mediated by perceived vulnerability to HPV infection, HPV severity, vaccine efficacy, and obstacles to immunization.

Hypothesis 6: The effects of RQ will be moderated by need for consistency; that is, the effects of RQ will be strongest among mothers with high need-for-consistency scores.

Method

Sample

A total of 522 mothers of girls ages 11–16 years were recruited from a national online survey panel purchased from a commercial sample vendor, Survey Sampling International (SSI). SSI maintains a national panel of over 1 million potential respondents. For each study, SSI sends e-mail invitations to a random subset of those panel members meeting the study’s demographic criteria. Volunteers are placed by SSI into a lottery to win a monetary prize, to increase response rates. Panel members can complete a maximum of four surveys per year. Because researchers do not know respondents’ identities, responses are completely anonymous.

Given the importance of HPV vaccination in low–socioeconomic status (SES) and minority populations, we asked SSI to oversample these groups by using quota sampling. The final sample was 21% African American, 20% Hispanic, and 56% with a high school diploma or less (see Table 1).

After initial recruitment by SSI, each potential respondent was directed to a web survey (housed on the Indiana University server), which first asked if she was a custodial parent of a girl between ages 11 and 16. If not, she was thanked and excluded from the study. Mothers also were excluded from analysis if they reported that their daughters had already received the HPV vaccine. Of 522 mothers recruited, 19 were excluded because their daughters had already had at least one HPV shot, 21 were excluded because they were not a custodial parent, and 11 had missing values on key variables. Thus, a final usable sample of 471 mothers completed the survey.

Experimental Design

The study used a 3 × 2 between-subjects factorial design, in which participants were assigned randomly to one of three risk presentation formats (graphic HPV statistics, nongraphic HPV statistics, or no-statistics control) and the presence or absence of a rhetorical question (RQ). The study’s design and procedure were approved by the institutional review board at Indiana University.

Interventions

The rhetorical question intervention comprised two yes–no questions: “Do you want to protect your daughter from cancer?”
and “If there was a vaccine to protect your daughter against cancer, would you have her get it?” Consistent with the foot-in-the-door paradigm, these initial questions were designed to (a) elicit high agreement levels (99.6% said “yes” to the first question, 90% to the second question) and (b) gain respondents’ commitment to a broad principal (cancer prevention) consistent with the target behavior (HPV vaccination).

The risk-information intervention consisted of two components: First, all study participants (including those in the no-statistics control condition) were given basic, nonstatistical information about cervical cancer, HPV infection, and the HPV vaccine in preventing cervical cancer. Thus, rather than using bar or pie charts (which present relative risk information but no familiar reference point to judge absolute numbers), we developed a “statistical” HPV risk information conveyed in the graphic and nongraphic statistics conditions:

- **Girls who get the HPV vaccine are much less likely to get cervical cancer later in life. Right now, there are 12 million American girls between the ages of 11 and 16. If none of these girls get the HPV vaccine, about 87,000 will get cervical cancer later in life. That’s enough to fill a football stadium. If all girls get the HPV vaccine, only about 27,000 will get cervical cancer. So the HPV vaccine would save 60,000 girls from getting cancer later in life.**

The statistical HPV risk information was based on the most current data on the lifetime risk of cervical cancer among American women (from the National Cancer Institute [NCI] SEER database) and the efficacy of the quadrivalent HPV vaccine (Centers for Disease Control & Prevention, 2007; Villa, Perez, Kjaer, et al., 2007). The length of protection provided by the HPV vaccine is known to be at least 6 years and is expected to extend well beyond this period of time (Fraser et al., 2007; Olsson et al., 2007; Villa et al., 2006); however, the precise lifetime efficacy of the HPV vaccine in preventing cervical cancer will not be known with certainty for decades.

### Development and Pretest of Graphic Stimuli

Next, we developed a graphic depiction of the statistical information, working with a medical-graphics design firm. In designing these graphics, we sought a familiar reference point to help mothers visualize the absolute number of girls who would get cervical cancer with and without the vaccine. Thus, rather than using bar or pie charts (which present relative risk information but no familiar reference point to judge absolute numbers), we developed a “sta-
“диум” graphic that used contrasting colors to depict the number of vaccine recipients who would be “saved” from cervical cancer, versus those who still get cervical cancer. We created four prototypes of this graphic, varying in color scheme and layout: (a) green to depict saved and red to depict got cancer; (b) red for saved and green for got cancer; (c) gray tones instead of color; and (d) a graph similar to that in prototype a but reversing the left–right position of get cancer and saved.

Next, we pretested the four graphic prototypes for potential differences in message evaluation and vaccination intention. The pretest sample consisted of 206 mothers of girls ages 11–16 years (none of whom participated in the main study), recruited by SSI and directed to a brief Web survey. The sample was 13% African American, 10% Hispanic, and 51% with a high school diploma or less. All respondents were first given the baseline, nonstatistical HPV information (see above) and then assigned randomly by the Web survey program to one of the four alternative graphic formats. Next, participants completed Likert scales for message believability (“This information seemed believable”), ease of understanding (“This information was easy to understand), usefulness (“This information was useful to me”), and relevance (“This information was relevant to me”) as well as intention to have their daughters get the three HPV vaccine doses (three 5-point scales: 5 = definitely would get vaccinated, 1 = definitely would not get vaccinated). An analysis of variance (ANOVA) revealed no significant differences among the four graph versions on any of the message characteristics or intention. Thus, the stadium graphic appears to elicit similar responses regardless of the specific colors, or the left–right layout. For the main study, we chose the graphic that used red for got cancer and green for saved. This color representation draws on common associations from everyday life (e.g., green and red of traffic lights) in which red signals “warning” and green “normal.”

Figure 1 shows the graphic and nongraphic risk messages used in the main study. As can be seen, the text (content, size, and spacing) was identical in these two conditions; the only difference was the presence or absence of the stadium graphic.

Procedure for Main Study

For the main study, potential participants recruited by SSI were directed to a Web survey. The first question was a screener, confirming that the respondent was the custodial parent of a girl between the ages of 11 and 16 years. Next, half of the participants (randomly assigned by the interview program) were asked the two rhetorical questions, while half were not. Next, all participants received the basic (nonstatistical) HPV information. Next, participants were randomly assigned to one of three risk-presentation groups: nongraphic risk presentation, graphic risk presentation, or a no statistics control group that skipped to the next section. Next, all participants were told that if they had more than one daughter in the age range, to think about only one daughter with respect to subsequent questions. Then, mothers were asked the age of that daughter. Finally, participants completed a series of measurement scales, discussed in the next section.

Main Outcome Measures

The primary outcome variable was mothers’ intention to have their daughters receive the three HPV vaccine doses. Intention was measured with three questions, each using a 5-point scale anchored by “I definitely would NOT have her get the first [2nd, 3rd] shot” and “I definitely would have her get the first [2nd, 3rd] shot” (Jamieson & Bass, 1989). The sum of these three items formed the measure “Total shot intention” with a coefficient alpha of .99.

Next, secondary outcomes were measured, beginning with respondents’ HPV-related health beliefs (Becker, 1974; Rosenstock, 1966), all measured with summed 7-point Likert scales. Perceived severity of HPV infection was measured with a four-item scale with coefficient α = .84 (e.g., “Infection with HPV can lead to a serious illness,” and “HPV can cause cervical cancer”). Perceived vaccine efficacy was measured with a four-item scale with α = .90 (e.g., “This vaccine is effective in preventing cervical cancer,” and “This vaccine would greatly reduce the chance of getting cervical cancer”). Perceived vulnerability was measured with a four-item scale with α = .70 (e.g., “My daughter will get cervical cancer at sometime in her life,” and “It is very unlikely that my daughter will get infected with the HPV virus (R).”) Perceived obstacles to vaccination were measured via a four-item scale with α = .89 (e.g., “I would find it hard to find the time to take my daughter to get the shots,” and “It would be hard to get the transportation to take my daughter to get the shots”).

Perceived message comprehension was measured with a summed four-item Likert scale with α = .85, taken from Cox, Cox, and Zimet (2006; e.g., “The message was easy to understand,” and “This message was useful to me”). The Need for Internal Consistency scale (Cialdini et al., 1995) consists of nine statements that use a Likert-type response scale (e.g., “It is important to me that I can predict what I do,” and “I want to be described as stable and predictable”; α = .87). Numeracy was assessed as the total number of correct responses to Schwartz et al.’s (1997) three-question scale of numerical fluency. Finally, participants provided demographic information (e.g., race, age, and education) and were asked about prior awareness of the HPV vaccine, whether they or any female relative had ever been diagnosed with cervical cancer, and their perceptions of whether their daughter had engaged in sexual activity.

Statistical Analysis Methods

The baseline demographic characteristics of the six experimental groups were compared by using Pearson chi-square tests for categorical variables and one-way ANOVA for continuous variables (daughter’s age). A significance level of .05 was used to assess significance.

The main and interactive effects of the experimental interventions on the outcome variables were assessed by using an ANOVA. Where significant interactions were found, the simple effects of one factor within levels of the other factor were analyzed per Keppel (1982, pp. 214–219). Tests of mediation were performed by using Baron and Kenny’s (1986) method (estimating a series of regression models and testing the significance of the unstandardized regression coefficients) as well as the Sobel (1982) test. All analyses were performed using SPSS version 14.0 (SPSS, Chicago, IL).
Results
Effects of Interventions on Reported Message Comprehension

We predicted that those viewing the graphic depiction of the HPV statistics would report higher message comprehension than those in the nongraphic or control groups. To test this hypothesis, an ANOVA was conducted with perceived message comprehension as the dependent variable and risk presentation format and rhetorical question as independent variables. Respondents' demographic traits (e.g., age, race, and education), personal and family history of cervical cancer, and perceptions regarding their daughters’ sexual activity were all evaluated as potential covariates. However, none of these background variables correlated significantly ($p < .05$) with either reported message comprehension or vaccination intention. Thus, no covariates were included in the analysis.

The reported message comprehension mean for the graphic-presentation condition ($M = 23.70$) is higher than that for both the nongraphic presentation ($M = 22.83$) and the control ($M = 22.82$), but these differences are not significantly different at $p < .05$, $F(2, 465) = 2.65$, $p = .072$. However, there is a significant interactive effect of risk presentation and rhetorical question on perceived message comprehension, $F(2, 465) = 3.80$, $p = .023$, measure of effect size $\eta^2 = .016$. Please see Figure 2 for this interactive effect.

To understand this interaction better, we analyzed the simple effects of the risk presentation within each of the two RQ condi-

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**Figure 1.** Examples of risk presentation formats (graphic vs. nongraphic). The stadium graphic is shown here in gray scale; the actual stadium graphic viewed by participants used a red background for “87,000 get cancer” and a green background for “60,000 saved.”

**Graphic Version**

**Some Facts About Cervical Cancer and the HPV Vaccine:**

Girls who get the HPV vaccine are much less likely to get cervical cancer later in life. Right now, there are 12 million American girls between the ages 11 and 16.

If NONE of these girls get the HPV vaccine, about 87,000 will get cervical cancer later in life. That's enough to fill a football stadium.

If ALL girls get the HPV vaccine, only about 27,000 will get cervical cancer. So the HPV vaccine would save 60,000 girls from getting cancer later in life.

**Non-Graphic version**

**Some Facts About Cervical Cancer and the HPV Vaccine:**

Girls who get the HPV vaccine are much less likely to get cervical cancer later in life. Right now, there are 12 million American girls between the ages 11 and 16.

If NONE of these girls get the HPV vaccine, about 87,000 will get cervical cancer later in life. That's enough to fill a football stadium.

If ALL girls get the HPV vaccine, only about 27,000 will get cervical cancer. So the HPV vaccine would save 60,000 girls from getting cancer later in life.
This analysis revealed that when the rhetorical questions are asked, there is no significant difference between the risk presentation formats on perceived message comprehension. However, when the rhetorical questions are not asked, the graphic presentation results in higher reported message comprehension ($M_{\text{graphic}} = 24.20$) than in the no-graph condition ($M_{\text{no-graph}} = 22.66$) and the control condition ($M_{\text{control}} = 22.03$). A post hoc Bonferroni test revealed that the graphic condition was significantly different from the control condition ($p = .006$) and approached a significant difference from the no-graph condition ($p = .06$). This interaction demonstrates that asking the rhetorical questions moderates the effect of risk presentation on perceived message comprehension, so that when RQ is not asked, the graphic risk presentation condition elicits the highest level of reported message comprehension.

### Effects of Interventions on Vaccination Intention

We also expected main effects of both the RQ and the risk presentation on mothers’ intention to have their daughter receive the HPV vaccination. To test this, an ANOVA was conducted with the three-item total shot intention scale as the dependent variable. This analysis revealed a significant main effect of risk presentation on total shot intention, $F(2, 465) = 5.68, p = .004, \eta^2 = .024$, with the graphic presentation producing significantly higher mean vaccination intentions ($M = 12.96$) than did either the non-graphic ($M = 11.89$) or no-statistics control ($M = 11.88$) conditions. Examining categorical responses, we found that 53% of mothers in the graphic condition stated that their daughters would “definitely” get at least one HPV vaccine dose, in comparison with 41% in the non-graphic condition and 37% in the control group. A post hoc Bonferroni test revealed that the mean intention in the graphic condition was significantly higher than was either the no-graph ($p = .01$) and the control ($p = .01$) conditions.

There was also a significant main effect of RQ on HPV vaccination intention, $F(1, 465) = 4.55, p = .033, \eta^2 = .01$. Mothers who were asked the RQ reported significantly stronger intentions to have their daughters get the HPV vaccine ($M = 12.60; 48\%$ saying “definitely” will get at least one dose) than did those who were not asked the RQ ($M = 11.9, 39\%$ definitely). However, the main effects of both risk presentation and RQ should be interpreted with some caution, because there is also a significant interactive effect between RQ and risk presentation format on total shot intention, $F(2, 465) = 3.37, p = .035, \eta^2 = .014$. As can be seen in Figure 3, the graphic presentation appears to produce higher total shot intentions than does the non-graphic presentation, regardless of whether the RQ is asked. However, Figure 3 also suggests that the effect of RQ on total shot intention varies markedly among the three risk-information groups. In the two conditions in which mothers were given statistical risk information (graphic or non-graphic), asking RQ had little effect on total shot intention. However, among participants in the no-statistics control condition, asking rhetorical questions had a strong effect, with participants in the RQ condition expressing significantly higher total shot intentions ($M = 12.77$) than did participants in the no-RQ condition ($M = 11.04$). $F(1, 147) = 10.17, p = .002, \eta^2 = .065$. This suggests that the presentation of numerical risk information (whether accompanied by a graph or not) somehow diminishes or disrupts the effect of the rhetorical question on mothers’ total shot intentions.
Mediation Analyses

We expected that the effects of risk presentation and RQ on vaccination intention might be mediated by respondents’ health beliefs, including perceptions of their daughters’ vulnerability to HPV infection, severity of HPV infection, vaccine efficacy, and pragmatic obstacles to vaccination. To identify potential mediators, we conducted a series of ANOVAs, examining the effect of the two independent variables on each of the four possible mediators. These analyses revealed that risk presentation affected only one health belief, vaccine efficacy, $F(2, 468) = 4.3, p = .014$, while rhetorical question affected two: perceived severity of HPV infection, $F(1, 469) = 8.1, p = .005$, and perceived pragmatic obstacles to vaccination, $F(1, 469) = 5.32, p = .021$.

Next, we conducted mediation analyses to determine (a) whether perceived vaccine efficacy mediates the effects of risk presentation on total shot intention and (b) whether perceived HPV severity and pragmatic obstacles mediate the effects of RQ on total shot intention. We used Baron and Kenny’s (1986) mediation test method, estimating a series of regression models and testing the significance of the (unstandardized) regression coefficients.

Tests of mediation for risk-presentation effects. First, we examined whether perceived vaccine efficacy mediated the effect of risk presentation on total shot intention. Because risk presentation has three levels, two dummy variables were created for this analysis: one comparing the graphic condition to the no-statistics control (graphdum) and the other comparing the nongraphic condition to the control (statdum). Following Baron and Kenny (1986), we first regressed total shot intention on each of the risk-presentation dummy variables. Results indicate that graphdum is a significant predictor of total shot intention ($B = 1.075, t = 3.426, p = .001$), while statdum was not. Next, we regressed total shot intention simultaneously on both graphdum and vaccine efficacy. In this case, the impact of graphdum on total shot intention remained significant, even when vaccine efficacy was included as a predictor. Therefore, vaccine efficacy does not mediate the effect of graphic presentation on total shot intention.

Tests of mediation for rhetorical-question effects. First, bivariate regression models confirmed that RQ had a significant impact on perceived HPV severity ($B = -1.30, t = -2.85, p = .005, r^2 = .017$; if RQ asked, higher perceived severity) and pragmatic obstacles ($B = -1.018, t = -2.307, p = .021, r^2 = .011$; if RQ asked, higher perceived obstacles). Second, a bivariate regression model confirmed that RQ had a significant effect on total shot intention ($B = .676, t = 2.24, p = .025, r^2 = .011$). Third, we regressed total shot intention simultaneously on both (a) perceived severity and (b) RQ. This analysis revealed that the proposed mediator (perceived severity) had a significant effect on total shot intention ($B = .112, t = 3.82, p = .000$, partial $r^2 = .030$), whereas the effect of the independent variable (RQ) became nonsignificant ($B = -.526, t = -1.756, p = .08$, partial $r^2 = .006$). In addition, Sobel’s (1982) test confirmed the statistical significance of the indirect effect of rhetorical question on intention, mediated by perceived severity ($z = -2.29, p = .022$). When these same analyses were conducted with the proposed mediator, pragmatic obstacles, there was no evidence of mediation. Thus only one factor, perceived HPV severity, appears to mediate the effect of rhetorical question on vaccination intention (RQ→ increased perceived HPV severity→ increased total shot intentions).
Analysis of Potential Moderators: Numeracy and Need for Consistency

To test for the moderating effect of numeracy, we entered each of the three numeracy scale items into a separate ANOVA, along with risk presentation format, to determine its main and interactive effects on reported message comprehension and total shot intention. Education was a significant correlate of each of the numeracy items ($r = .118, r = .136, \text{ and } r = .127$, respectively) and was included as a covariate in the three analyses. These analyses found no main or interactive effects ($p \leq .05$) of any of the three numeracy items on either shot intention or reported message comprehension.

To test for the moderating effect of “need for consistency,” a median split was conducted on this scale. Next, an ANOVA was conducted, with this dichotomous scale and RQ as independent variables, and total shot intention as the dependent variable. Results revealed that there was no significant interaction between RQ and need for internal consistency ($p \leq .05$), but need for internal consistency had a main effect on total shot intention, $F(1,467) = 5.94$, $p = .015$, $\eta^2 = .013$. Mothers with a high need for consistency had significantly stronger intentions to vaccinate their daughters ($M = 12.63$) than did mothers with a low need for consistency ($M = 11.86$).

Discussion

Routine HPV vaccination of adolescent and preadolescent girls has the potential to greatly reduce the incidence of cervical cancer, especially in minority and disadvantaged communities, where access to regular Pap screening is less common. However, childhood HPV vaccination, unlike other ACIP-recommended vaccinations, is not mandated for school entry in most states, and this is unlikely to change in the foreseeable future, given the political backlash against previous mandate attempts. Therefore, the potential public health benefits of childhood HPV vaccination will only be realized if a large percentage of parents decide voluntarily to have their daughters vaccinated.

This study examined two message interventions designed to help achieve this goal. First, we examined the impact of a graphic depiction of cervical cancer risk and HPV vaccine efficacy on parents’ self-reported understanding of these risks and benefits, and their intentions to have their daughters vaccinated. Past research suggests that lay people often find traditional risk-communication methods (using either numerical probabilities or verbal descriptors such as “rare” or “common”) confusing and ambiguous, but that graphic risk depictions may facilitate message comprehension in relation to both nongraphic statistics and the no-statistics control. This interruption appears to have disrupted the “rhetorical” question essentially initiates an uninterrupted syllogism, pointing to the logical conclusion that one’s daughter should receive the HPV vaccine:

1. Major premise (rhetorical question): “If there was a vaccine to protect my daughter against cancer, I would have her get it.”
2. Minor premise (baseline HPV information given to all participants): “Girls who get this [HPV] vaccine now are much less likely to get cervical cancer later in life.”
3. Conclusion (intention question): “[Therefore] I will have my daughter get the HPV vaccine.”

However, for parents in the two statistical conditions (graphic or nongraphic), this logical sequence is interrupted after Step 2, when participants are asked to process fairly detailed quantitative risk information. This interruption appears to have disrupted the “rhetorical” (or persuasive) effect of the rhetorical questions on parents’ vaccination intentions.

Similar effects can be seen in examining the interventions’ impact on parents’ beliefs concerning HPV infection and vaccination. As was noted earlier, rhetorical question had a main effect on perceived severity, strengthening parents’ belief that HPV is a serious disease (and especially their belief that HPV causes cancer). However, this effect was significantly moderated by risk presentation: Again, among parents who did not see risk statistics.
(graphic or nongraphic), RQ had an extremely strong effect on perceived HPV severity ($\eta^2 = .13$). However, among parents exposed to either type of risk statistics, RQ had no effect. Along the same lines, while graphic risk presentation had a positive main effect on parents’ perceptions of vaccine efficacy, this effect was much stronger among parents who were not asked the RQ ($\eta^2 = .036$) than among those who were ($\eta^2 = .004$). Together, these findings suggest that rhetorical question and graphic presentation work through quite different, and perhaps conflicting, persuasive mechanisms. Thus, while each of these interventions had an overall positive effect on parents’ intention to vaccinate their daughters, they appear to be more effective when used separately than when used in combination.

As with all research, this study has limitations that should be addressed in future research. First, the principal dependent variable in this study was parents’ intention to vaccinate their children rather than actual vaccination behavior. Future research should examine the effectiveness of these interventions in a clinical setting, using actual vaccination behavior as the outcome measure. The interventions examined in this study show promise for clinical application: Both are quite brief and might easily be integrated into questionnaires that are increasingly administered in clinical settings. However, before these interventions are widely implemented, their behavioral efficacy should be confirmed in a randomized clinical trial. Second, while an ever-growing share of Americans now have Internet access (including an estimated 50–60% in low-SES and minority communities; see Kind, Huang, Farr, & Pomerantz, 2005) and our Internet sample intentionally oversampled less-educated and minority populations, future studies should expand this research to populations without Internet access. Third, while the present study offered some insights into the mechanisms through which the interventions work, more research is needed in this area. Specifically, a number of studies have now found that graphic displays enhance the effectiveness of risk presentations; however, the exact mechanism through which this effect occurs is still not entirely clear. In this study, we found that graphic display had positive effects on both self-reported message comprehension and perceived efficacy; however, neither of these variables fully mediated the persuasive impact of graphics. Future researchers should both examine these two mediators in greater depth (e.g., by including objective measures of message comprehension, such as speed and accuracy of message recall) and examine a broader range of potential mediators, to help us better understand how graphics may aid medical decision making. Finally, this study focused on one specific health phenomenon, parents’ intentions to vaccinate their daughters against HPV infection. Future research should examine the potential efficacy of these interventions in other health contexts.

Cervical cancer takes thousands of lives each year, taking a particularly heavy toll within disadvantaged communities. HPV vaccination has the potential to greatly reduce the incidence of this costly disease. However, such potential will only be realized if clinicians and health communicators are able to effectively communicate the vaccine’s benefits and risks to parents and if large numbers of these parents choose voluntarily to have their daughters vaccinated. In this article, we have presented two message interventions that may aid such communication and presented encouraging evidence of their potential effectiveness in increasing parents’ intentions to protect their daughters from HPV infection through early vaccination. We hope that future research will continue to examine the potential of these interventions, in the context of both HPV vaccination and other important health-protective behaviors.

References


INTERVENTIONS TO INCREASE HPV VACCINATION


