Getting Ahead of Illness: Using Metaphors to Influence Medical Decision Making

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**Background.** Metaphors influence judgments and decisions in nonmedical contexts. **Objective.** First, to investigate whether describing the flu metaphorically increases an individual’s willingness and interest in getting a flu vaccination, and second, to explore possible mediators and moderators of the effect that metaphors might have on vaccination intentions. **Materials and Methods.** Three studies, each using a between-subjects manipulation in which the flu was described literally (as a virus) or metaphorically (as a beast, riot, army, or weed), were conducted. A total of 167 psychology undergraduates (study 1) and 300 and 301 online participants (studies 2 and 3, respectively) were included. Studies 1 through 3 examined vaccination behavioral intentions, absolute risk, comparative risk, perceived flu severity, and recent flu and flu vaccination experience. Studies 2 and 3 assessed vaccination e-mail reminder requests and global affect. Study 3 evaluated affective reactions, personal control, and understanding of the flu. **Results.** Describing the flu metaphorically increased individuals’ willingness to get vaccinated (studies 1–3), while the impact of metaphors on requests to receive an e-mail reminder to get vaccinated was unclear (studies 2 and 3). These results were moderated by vaccination frequency in study 2, such that the effects were found among individuals who occasionally receive flu vaccinations but not among individuals who never or always receive flu vaccinations. Metaphor use did not significantly impact any of the hypothesized mediators: perceived absolute risk, comparative risk, flu severity, affect, personal control, or understanding of the flu. Limitations include convenience samples and measuring behavioral intentions but not actual vaccination behavior. **Conclusions.** Describing the flu virus metaphorically in decision aids or information campaigns could be a simple, cost-effective way to increase vaccinations against the flu. **Key words:** vaccinations; health communication; metaphors; risk; affect. (Med Decis Making XXXX;XX:XXX–XXX)

“I’ve been battling this cold for a week.” “My baby is on fire—his temperature is 104.1.” “You’ve got high cholesterol.” Each of these examples highlights the extent to which metaphors are embedded in how we talk about health and illness. Metaphors have been documented in the descriptions of a wide variety of medical issues and experiences including pulmonary diseases,1 hypertension and cardiovascular disease,1–3 strokes,4 measles,5 AIDS,2,6 psychiatric disorders,7–11 and, most popularly, cancer.1,2,12–21 Given the prevalence of metaphor use when describing health and illness, can metaphors also influence how we think and make decisions about our health?

Broadly speaking, a metaphor is a reference to an object or concept using terms that are literally associated with a different object or concept.22,23 For example, one might say that he or she was “burning up” with a fever. In this example, the person is symbolically referring to his or her fever using terms normally associated with fire. The metaphor “fever is fire” can also be classified as a conceptual metaphor. Conceptual metaphors provide mappings between the target of the metaphor (e.g., fever) and some, but not all, elements of the source of the metaphor (e.g., fire).22,24,25 With the conceptual metaphor “fever is fire,” the heat, variability in temperature, and destructiveness of fire are linked to having a fever (e.g., “burning up,” “my fever is rising”), but the spreading of fire is not. We do not normally say, “This fever is spreading through my body” or “I hope my fever doesn’t spread to you.” As the example demonstrates, multiple metaphors can be derived from a single conceptual metaphor.

Conceptual metaphors are so pervasive that their use often goes unnoticed because they are integral to our ability to think about abstract concepts.24,26 Just as we become relatively unaware of the sounds
that our car engine make, conceptual metaphors become “background noise” in our thinking and communication. However, just as an unusual noise from our car engine might cause us to re-evaluate the state of our engine, the application of a novel metaphor may be salient enough to notice and change how we think about the metaphor target in a way that a more conventional metaphor might not. For example, describing life as a “farmer’s market” conveys the variety of life but is not a commonly used metaphor to depict life.

The current studies were designed to examine whether describing the flu metaphorically increases behavioral intentions towards getting a flu vaccination. To this end, we utilized a method from metaphor research called the alternative source strategy approach. This methodology typically involves examining how using a metaphor, or using different metaphors, changes evaluations. For example, in one study, participants who read a description of the stock market as a living agent (e.g., “The NASDAQ climbed higher.”) were more likely to predict a continuation of stock trends than participants who read a nonmetaphorical description. The current research expands on the finding that metaphor use influences judgments and evaluations by examining the impact of metaphor use on behavioral intentions.

In addition to asking whether metaphors influence intentions, we also examine 5 potential mediators between metaphor use and vaccination intentions: perceptions of risk of the flu, perceptions of severity of the flu, understanding of the flu, feelings of personal control, and changes in affect. Utilizing metaphors that emphasize danger and destruction may increase perceptions of risk or severity of getting the flu, which are factors demonstrated to increase behavioral intentions and behaviors that reduce the likelihood of experiencing the threat. Positive affect has also been linked to increased risk taking and negative affect to decreased risk taking. Metaphor sources may decrease positive affect or increase negative affect, resulting in increased vaccination intentions. Alternatively, metaphors may be used in discussions of medical and health issues because they provide an increased sense of personal control. For example, individuals may feel powerless against cancer, especially when they are advised to “watch and wait,” but they may feel empowered to take action, any action, when cancer is metaphorically linked to war (re: Nixon’s “War on Cancer”) and casts the patient in a soldier, rather than bystander, role. In a similar way, describing the flu metaphorically may increase an individual’s sense of personal control and spur him or her to action (re: get vaccinated). Finally, research from the cognitive sciences suggests that metaphors are used to increase understanding. Consequently, describing the flu metaphorically may increase the extent to which individuals believe that they understand how the flu works and the actions that they should take to prevent the flu.

STUDY 1

Study 1 was designed as an initial test of whether novel metaphors would increase individuals’ intentions to get vaccinated against the flu. Novel metaphors were chosen for this initial study due to their ability to help individuals think differently about the metaphor target. Measures of risk and severity were also included to test whether metaphors might increase vaccination intentions through changes in perceptions of risk or severity.

Methods

Participants

Participants were University of Iowa undergraduates enrolled in an introductory psychology class who received credit towards the research requirement for the course. Data were collected from March to April 2012. Institutional review board approval
was obtained for each study prior to conducting the study.

Procedure
Participants began the study by reading a short description of the rising prevalence of the flu (see “Materials” below). The flu was described literally (a “virus that infects the body”) or metaphorically (a “wild beast that preys on the body” or a “riot that revolts against the body”). After reading the description, participants indicated the likelihood that they would get vaccinated during the upcoming flu season and responded to the perceived risk and severity measures (see “Measures”). Participants concluded the study by providing their flu and vaccination experiences and demographic information (potential moderators), reporting what they thought the purpose of the study was (“What do you think this study is about?”), and were debriefed.

Materials
The description and metaphors of the flu used in study 1 were derived from a previous set of studies in which crime was described as a “wild beast” or a “virus.” In our description, the flu became the metaphor target, and “beast” and “riot” (as opposed to crime) were the metaphor sources. While diseases, especially cancer, have been metaphorically described as animals or as internal unrest, these metaphors are not commonly used with the flu. See the Appendix for the full scenarios and metaphors.

Measures

Vaccination intentions. Participants indicated the likelihood that they would get vaccinated in the upcoming flu season (2012–2013) on a scale from 0% to 100%.

Absolute risk. Participants indicated the likelihood that they would get the flu in the upcoming flu season on a 9-point scale ranging from “will definitely not get the flu” to “will definitely get the flu.”

Comparative risk. Participants indicated the perceived likelihood of getting the flu in the upcoming flu season relative to the average person on a 9-point scale ranging from “definitely less likely” (–4) to “definitely more likely” (+4), with a midpoint of “equally likely” (0).

Severity. Participants indicated to what degree they thought getting the flu would impact their life should they get the flu. Participants could select 1 of 9 options ranging from “It would not impact my life at all” to “I would get so sick I would die.”

Flu and flu vaccination experience. Participants indicated whether they had the flu the previous year, whether they had gotten a flu vaccination the previous year, and how often they get flu vaccinations (never, occasionally, or always).

Results
A total of 167 participants completed the study. There were roughly equal numbers of participants in each group (control: n = 55; beast: n = 57; riot: n = 55). The sample had an average age of 19 years (s = 1 year, range = 18–25 years) and was 51% female, and 68.9% identified themselves as European American. There was 34.7% of the sample that reported getting vaccinated against the flu in the previous year, while 23.4% reported having the flu the previous year. Regarding vaccination frequency, 35.3% of the sample reported that they never get vaccinated against the flu, 43.7% reported occasionally getting vaccinated, and 21.0% reported always getting vaccinated. The suspicion check question at the end of the study revealed that no participants inferred the purpose of the study.

An ANOVA revealed a significant group difference in vaccination intentions (F2,164 = 3.16, P = 0.02). Including age, gender, and ethnicity as covariates in an ANCOVA did not significantly change the main results. The effects

<p>| Table 1 Vaccination Intentions and Perceptions of Risk and Severity in Study 1 |
|---------------------------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th></th>
<th>Virus (Control)</th>
<th>Beast (n = 57)</th>
<th>Riot (n = 55)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccination intentions</td>
<td>41.4 (31.5)</td>
<td>53.2 (34.8)</td>
<td>56.4 (32.9)</td>
</tr>
<tr>
<td>Absolute risk</td>
<td>4.2 (1.7)</td>
<td>4.2 (2.2)</td>
<td>4.5 (2.1)</td>
</tr>
<tr>
<td>Comparative risk</td>
<td>4.4 (1.7)</td>
<td>4.4 (2.4)</td>
<td>4.3 (2.0)</td>
</tr>
<tr>
<td>Severity</td>
<td>3.2 (1.3)</td>
<td>3.3 (1.4)</td>
<td>3.8 (1.2)</td>
</tr>
</tbody>
</table>

Note: Vaccination intention values in percentages. All other values based on scale response. All values shown as the mean (standard deviation).
of metaphor use on behavioral intentions to get vaccinated were not moderated by whether participants had the flu the previous year \((P = 0.47)\), were vaccinated during the previous year \((P = 0.37)\), or vaccination frequency \((P = 0.55)\).

There were no significant group differences on perceptions of absolute and comparative risks \((Ps > 0.77)\) (Table 1). There was a significant group difference for perceptions of severity, with participants perceiving the outcome of getting the flu to be more severe in the riot condition relative to the beast and control conditions \((Ps < 0.05)\). Because metaphor use had a systematic effect on vaccination intentions, but not perceptions of severity, it is unlikely that the impact of metaphors on vaccination intentions was the result of changes in perceived severity. While metaphor use did not impact these potential mediators, vaccination intentions were significantly correlated with perceived absolute risk \((r = 0.20, P = 0.01)\) and comparative risk \((r = 0.27, P < 0.001)\) but not severity \((r = -0.04, P = 0.61)\).

**STUDY 2**

In study 1, participants exhibited higher vaccination intentions when the flu was described metaphorically rather than literally. Study 2 was conducted to examine whether the effects found among college undergraduates in study 1 replicate in a more generalizable sample. Additionally, to test whether metaphors might influence behaviors linked to vaccinations, a behavioral outcome measure was included in which participants indicated whether they wanted to receive an e-mail reminder to get vaccinated. Measures of global positive and negative affects were also included to determine whether metaphors might increase negative affect, leading to greater vaccination intentions.

**Methods**

**Participants**

Participants were recruited via Amazon’s Mechanical Turk (MTurk). MTurk is a service in which individuals complete online studies posted by researchers in return for a small monetary payment (https://www.mturk.com). Previous research has demonstrated that data obtained from MTurk participants do not significantly differ in reliability compared to data obtained from participants run in the laboratory.\(^{31,32}\) Participant qualifications included living in the United States and having a 95% study approval rating (percentage of studies that the individual participated in where the researcher approved payment). Participants were compensated \$0.10 upon completion of the study. Data were collected from August to September 2012.

**Procedure**

The procedures of study 2 were identical to those used in study 1 with the exception of 3 additional questions. After indicating the likelihood of getting vaccinated in the upcoming flu season, participants indicated whether they would like to receive an e-mail reminder to get vaccinated during the upcoming flu season (no/yes). While participants were under the impression that they would receive an e-mail reminder, participants did not actually provide e-mail addresses or receive an e-mail reminder. Participants also completed 2 items that indicated how positive and how negative that they currently felt (“Please indicate how positive (negative) you feel right now.”), with 1 = “not at all positive” (negative) and 10 = “extremely positive” (negative), after the other secondary measures. These affect measures were included to examine the possibility that the impact of metaphors is due to changes in global affect.

**Results**

A total of 300 participants completed the study. An error in the initial survey coding, which was corrected upon discovery, prevented participants from being assigned to the riot metaphor condition. Consequently, the number of participants in each group is not equal (control: \(n = 93\); beast: \(n = 130\); riot: \(n = 77\)). The sample had an average age of 35 years \((s = 13\) years, range = 18–71 years) and was 55.6% female, 67.2% identified themselves as European American, and a majority of the sample (84.0%) reported having at least some college education. There was 29.0% of the sample that reported getting vaccinated against the flu in the previous year, while approximately 15.7% of the sample reported having the flu the previous year. Also, 50.0% of the sample reported that they never receive flu vaccinations, with the remainder of the sample evenly split between participants who occasionally get vaccinated (24.3%) or always get vaccinated (24.0%). Further, 1.7% of the sample did not report their vaccination frequency. The suspicion check question at the end of the study revealed that no participants inferred the purpose of the study.

Unlike study 1, the ANOVA revealed no group differences in vaccination intentions \((P = 0.37)\). Additional ANOVAs revealed no significant group differences in e-mail requests \((P = 0.10)\) or any of
the hypothesized mediators ($P < 0.31$) (Table 2), with the exception of positive affect ($P = 0.04$), but the difference was between the riot and beast metaphor conditions ($P = 0.01$). The planned contrasts comparing the 2 metaphor conditions to the control condition revealed similar results, with no significant differences in any of the measures. However, there was a significant interaction between metaphor use and vaccination frequency for both vaccination intentions ($F_{2,289} = 3.08, P = 0.05, \eta^2_p = 0.02$) and e-mail reminder requests ($F_{2,289} = 3.98, P = 0.02, \eta^2_p = 0.03$). Critically, participants who reported occasionally getting flu vaccinations also reported higher vaccination intentions in the metaphor conditions ($x_{\text{metaphor}} = 59.8\%$) than the control condition ($x_{\text{control}} = 43.2\%$) (Figure 1), while there were no differences between the 2 conditions for participants who reported never getting vaccinated ($x_{\text{metaphor}} = 23.2\%$; $x_{\text{control}} = 27.5\%$) and those who report always getting vaccinated ($x_{\text{metaphor}} = 87.5\%$; $x_{\text{control}} = 87.0\%$). Participants in the occasional vaccination group also had a higher rate of requests to receive an e-mail reminder to get vaccinated in the metaphor conditions (20%) than the control condition (8%). Curiously, participants in the metaphor conditions who never or always get the flu vaccine showed a marked decrease in requests to receive an e-mail reminder (Figure 2). Vaccination frequency did not moderate the relationship (or lack thereof) between metaphor use and any of the hypothesized mediators ($P > 0.18$). The impact of metaphors on vaccination intentions and e-mail requests was not moderated by having the flu ($P > 0.17$) or getting the flu vaccine ($P > 0.33$) during the previous year.

While the metaphors did not significantly impact any of the proposed mediators, vaccination intentions were significantly correlated with perceptions of the absolute risk ($r = 0.31, P < 0.001$), comparative risk ($r = 0.28, P < 0.001$), and severity of the flu ($r = 0.14, P = 0.02$). E-mail requests were correlated, albeit more weakly, with perceptions of the absolute risk ($r = 0.19, P = 0.001$) and comparative risk ($r = 0.14, P = 0.02$) of getting the flu but not flu severity ($r = 0.03, P = 0.59$).

### STUDY 3

Studies 1 and 2 provide evidence that using novel metaphors increase vaccination intentions, particularly among those who have a mixed history of receiving vaccines. Study 3 was designed to test the impact of 2 new metaphors on vaccination intentions. On the one hand, the results of studies 1 and 2 could be a consequence of using novel metaphors, which might have a tendency to be more noticeable or surprising to participants. Would conventional conceptual metaphors, which often go undetected due to their common usage, also increase vaccination intentions? To test this possibility, one of the new metaphors

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**Table 2** Vaccination Intentions, Perceptions of Risk and Severity, and Affect in Study 2

<table>
<thead>
<tr>
<th></th>
<th>Virus (Control) ($n = 93$)</th>
<th>Beast ($n = 130$)</th>
<th>Riot ($n = 77$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccination intentions</td>
<td>47.5 (37.5)</td>
<td>49.9 (38.8)</td>
<td>42.2 (36.9)</td>
</tr>
<tr>
<td>E-mail requests</td>
<td>17.0 (38.1)</td>
<td>15.0 (35.5)</td>
<td>6.0 (24.8)</td>
</tr>
<tr>
<td>Absolute risk</td>
<td>4.1 (2.0)</td>
<td>4.0 (2.0)</td>
<td>3.9 (2.1)</td>
</tr>
<tr>
<td>Comparative risk</td>
<td>4.0 (2.0)</td>
<td>3.9 (2.0)</td>
<td>3.7 (2.1)</td>
</tr>
<tr>
<td>Severity</td>
<td>3.8 (1.5)</td>
<td>3.9 (1.5)</td>
<td>4.1 (1.4)</td>
</tr>
<tr>
<td>Positive affect</td>
<td>7.3 (2.4)</td>
<td>7.5 (2.1)</td>
<td>6.7 (2.0)</td>
</tr>
<tr>
<td>Negative affect</td>
<td>3.3 (2.4)</td>
<td>3.1 (2.2)</td>
<td>3.4 (2.3)</td>
</tr>
</tbody>
</table>

Note: Vaccination intention and email request values in percentages. All other values based on scale response. All values shown as the mean (standard deviation).
(army) was derived from the conceptual metaphor “illness is war.” Furthermore, both of the metaphors used in the previous studies convey a sense of dangerousness and risk. To test the hypothesis that the impact of metaphors in the previous studies was a result of the dangerous imagery associated with the metaphor sources, one of the new metaphors in study 3 was a negative, but relatively nondangerous, novel metaphor (weed). Study 3 also tested whether the findings of the previous studies could be the result of the metaphors being viewed as more emotive.

Methods

Participants

Participants were recruited via MTurk using the same participant qualifications as study 2 and compensated $0.30 upon completion of the study. Data were collected during August 2013.

Procedure

The procedures of study 3 were identical to those used in study 2 with 4 exceptions. First, there were 4 conditions in total. In addition to the control and beast metaphor conditions, the flu was metaphorically described as “an attacking army that invades the body” or a “weed that spreads quickly through the body” (see Appendix). Due to the fact that the beast and riot conditions did not differently influence vaccination intentions (our primary outcome measure) in the previous studies, the riot condition was dropped from study 3. Second, the 2-item affect measures were replaced with the Positive and Negative Affect Schedule (PANAS), which is a more extensive and validated measure of affect. Third, measures of perceived personal control and understanding of the flu were added to assess whether changes in these measures mediated the relationship between metaphor use and vaccination intentions. Finally, towards the end of the study, participants indicated how positive or negative and how safe or at risk a number of words—including the words virus, beast, riot, army, and weeds—made them feel. This measure was included to test whether metaphors are perceived as more emotive than the literal description of the flu (“virus”).

Measures

PANAS. Participants indicated the extent to which they currently felt a certain emotion (20 emotions) on a 1-to-5 scale, ranging from “very slightly” to “not at all” to “extremely.”

Personal control. Participants indicated to what extent they agreed with the following statements, “The events in my life are mainly determined by my own actions” and “I am not in control of most things that occur in my life,” on a 7-point scale ranging from “strongly disagree” to “strongly agree.” These responses were highly correlated (r = −0.59), so the responses were combined for analyses.

Understanding of the flu. Participants indicated to what extent they “understand how the flu works (e.g., How the flu infects someone? How the flu makes you sick?)” on a 7-point scale ranging from “no understanding” to “complete understanding.”

Affective reactions. Participants used a 9-point scale to indicate how positive or negative each word made them feel from “extremely negative” (1) to “extremely positive” (9), with a midpoint of “neither positive or negative” (5). This list of 12 words included positive (e.g., baby), neutral (e.g., rectangle), and negative (e.g., darkness) words in addition to the critical words.

Perceived dangerousness. Participants indicated how safe or at risk each word made them feel on a 9-point scale ranging from “extremely at risk” to “extremely safe.”

Results

There were 301 participants who completed the study. There were roughly equal numbers of participants in each group, with slightly more participants in the control (n = 86) and weed (n = 84) conditions compared to the beast (n = 71) and army (n = 60) conditions. The sample had an average age of 33 years (s = 12 years, range = 18–73 years) and was 41.2% female, 71.4% identified themselves as European American, and a majority of the sample (84.6%) reported having at least some college education. There was 27.9% of the sample that reported getting vaccinated against the flu the previous year, while 11.1% reported having the flu the previous year. Also, 51.2% of the sample reported that they never receive flu vaccinations, with the remainder of the sample evenly split between participants who occasionally get vaccinated (26.9%) or always get vaccinated (21.9%). The suspicion check question at the end of the study revealed that no participants inferred the purpose of the study.

An ANOVA revealed a significant group difference in vaccination intentions (F_{3,297} = 2.75, P = 0.04). Consistent with the overall patterns of the previous
studies, a least significant difference post hoc comparison revealed that vaccination intentions were higher in the beast condition (\( \bar{x} = 47.3\%\), \( s = 38.4\%\)) relative to the control condition (\( \bar{x} = 34.2\%\), \( s = 36.2\%\)) \((P = 0.03, \ d = 0.35)\). The other comparisons revealed that vaccination intentions were also higher for the army (\( \bar{x} = 49.7\%\), \( s = 38.2\%\)) \((P = 0.01, \ d = 0.42)\) and weed (\( \bar{x} = 46.4\%\), \( s = 38.8\%\)) \((P = 0.03, \ d = 0.33)\) conditions relative to the control condition. More interestingly, there were no significant differences in vaccination intentions between the 3 metaphor conditions \((Ps > 0.61)\). A planned contrast comparing the 3 metaphor conditions to the control condition revealed that metaphor use led to higher vaccination intentions \((t_{297} = 2.85, P = 0.005)\). Including age, gender, education, and ethnicity as covariates in an ANCOVA did not significantly change the main results. The effects of metaphor use on vaccination intentions were moderated by whether participants were vaccinated in the previous year \((P = 0.05, \ \eta_p^2 = 0.01)\), such that metaphor use had an impact on individuals who had not gotten vaccinated in the previous year \((\bar{x}_{\text{control}} = 16.5\%; \ \bar{x}_{\text{metaphor}} = 32.1\%\)\), while metaphor use had no impact on individuals who had gotten vaccinated in the previous year \((\bar{x}_{\text{control}} = 85.5\%; \ \bar{x}_{\text{metaphor}} = 85.9\%\)\), which is most likely the result of a ceiling effect among the individuals who had gotten vaccinated in the previous year that was not present in the previous studies. Metaphor use was not moderated by whether the participants had the flu the previous year \((P = 0.13)\) or vaccination frequency \((P = 0.37)\).

While there was a robust effect of metaphors on vaccination intentions, there was no effect of metaphors on e-mail requests in this study \((P = 0.30)\). Additionally, this lack of effect was not moderated by whether individuals had the flu the previous year \((P = 0.08)\), gotten vaccinated the previous year \((P = 0.71)\), or vaccination frequency \((P = 0.94)\). The marginally significant effect for previous flu experience suggests that metaphors increased e-mail requests for individuals who did not get the flu in the previous year \((\bar{x}_{\text{control}} = 6.7\%; \ \bar{x}_{\text{metaphor}} = 11.7\%\)\) but decreased e-mail requests for individuals who did have the flu the previous year \((\bar{x}_{\text{control}} = 30\%; \ \bar{x}_{\text{metaphor}} = 13\%\)\).

Subsequent ANOVAs involving the hypothesized mediators revealed no impact of metaphor use on any of the mediators \((Ps > 0.21)\), including the positive \((P = 0.21)\) and negative \((P = 0.74)\) affect subscales of the PANAS, or the additional measures of perceived personal control \((P = 0.31)\) and perceived understanding of the flu \((P = 0.43)\) (Table 3). While metaphor use did not significantly impact any of the proposed mediators, vaccination intentions were significantly correlated with perceived absolute risk \((r = 0.26, P < 0.001)\), comparative risk \((r = 0.19, P = 0.001)\), severity \((r = 0.15, P = 0.01)\), understanding of the flu \((r = 0.20, P < 0.001)\), and positive affect \((r = 0.18, P = 0.002)\). Vaccination intentions were not correlated with perceived personal control \((r = 0.05, P = 0.35)\) or negative affect \((r = -0.02, P = 0.68)\). In contrast to vaccination intentions, e-mail requests were unrelated to all of the proposed mediators \((rs = -0.004 to 0.07)\), with the exception of perceived absolute risk \((r = 0.19, P = 0.001)\) and positive affect \((r = 0.18, P = 0.002)\).

The affect and dangerousness ratings of “virus” and the metaphor words were analyzed using separate repeated-measures ANOVAs. As a reminder, lower values indicate that the participant had a stronger negative reaction or felt more at risk in response to the word. A repeated-measures ANOVA revealed a significant group difference in affective ratings between the words \((P < 0.001)\). Interestingly, participants had a much stronger negative reaction to the

### Table 3 Vaccination Intentions and Hypothesized Mediators in Study 3

<table>
<thead>
<tr>
<th>Virus (Control) (n = 86)</th>
<th>Beast (n = 71)</th>
<th>Army (n = 60)</th>
<th>Weed (n = 84)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccination intentions</td>
<td>34.2 (36.2)</td>
<td>47.3 (38.4)</td>
<td>49.7 (38.2)</td>
</tr>
<tr>
<td>E-mail requests</td>
<td>9.0 (29.2)</td>
<td>13.0 (33.5)</td>
<td>17.0 (37.6)</td>
</tr>
<tr>
<td>Absolute risk</td>
<td>3.8 (1.9)</td>
<td>3.9 (1.9)</td>
<td>4.1 (1.8)</td>
</tr>
<tr>
<td>Comparative risk</td>
<td>3.8 (2.0)</td>
<td>4.2 (2.3)</td>
<td>3.9 (1.9)</td>
</tr>
<tr>
<td>Severity</td>
<td>3.7 (1.4)</td>
<td>3.9 (1.4)</td>
<td>3.9 (1.1)</td>
</tr>
<tr>
<td>Positive affect</td>
<td>25.8 (8.1)</td>
<td>28.7 (9.3)</td>
<td>26.6 (8.3)</td>
</tr>
<tr>
<td>Negative affect</td>
<td>14.0 (6.0)</td>
<td>13.0 (5.7)</td>
<td>13.5 (5.6)</td>
</tr>
<tr>
<td>Personal control</td>
<td>4.3 (0.7)</td>
<td>4.1 (0.6)</td>
<td>4.2 (0.5)</td>
</tr>
<tr>
<td>Understanding</td>
<td>4.9 (1.4)</td>
<td>5.0 (1.4)</td>
<td>5.1 (1.4)</td>
</tr>
</tbody>
</table>

Note: Vaccination intention and email request values in percentages. All other values based on scale response. All values shown as the mean (standard deviation). Exception: Positive and negative affect values shown as sum (standard deviation).
DISCUSSION

The results of these 3 studies provide the first empirical evidence that metaphors could be used to change health-related behavioral intentions. Metaphors increased vaccination intentions in studies 1 and 3 and produced an increase in vaccination intentions among individuals who occasionally receive flu vaccinations in study 2. Study 3 demonstrated that the effects of metaphors on vaccination intentions occurred regardless of the specific metaphor that was used, with novel and conventional metaphors all increasing vaccination intentions. Yet, in spite of the consistency of the observed effects of these various metaphors, we do not believe that these data provide evidence that all metaphors are created equal. Instead, the present findings make the case that there are many metaphors (e.g., those that are more or less familiar, or more or less severe or negative) that may ultimately prove to be useful tools in health communication.

While the effect of metaphors on vaccination intentions was clear, the reason why metaphors influence vaccination intentions is not. Five possible mediators were tested across the 3 studies—perceived risk, severity, affect, control, and understanding—but the effect of metaphor use on vaccination intentions could not be explained by any of these factors. Additionally, far from being more emotive, individuals actually perceived the metaphors as being less negative and dangerous than the word “virus.” Future research could examine whether metaphors that are more tailored towards a specific mediator (e.g., severity) produce mediation effects.

While the primary results of the current studies are compelling, there were some limitations to the current studies. First, our samples were convenience samples, so our samples are unlikely to be completely representative of the general population. Specifically, the MTurk samples were comparable to the general population in terms of gender, age, and ethnicity but were more highly educated. Despite this, including these demographic variables as covariates did not significantly alter the main results. Second, the current studies measured vaccination intentions but not actual vaccination behavior. However, behavioral intentions are quite predictive of actual behaviors, with a recent meta-analysis showing a correlation of 0.61 between intentions and behaviors in health contexts specifically. While this suggests that metaphors may increase vaccination behavior, this is an empirical question that should be addressed in future research. Third, the e-mail request measure failed to demonstrate any systematic effects. One plausible reason may be that the measure was unrelated to measures associated with preventative behavior. Overall, across the 3 studies, vaccination intentions were significantly correlated with measures typically associated with engaging in preventative behavior: perceived risk and severity. Yet, e-mail requests were either less strongly correlated or completely uncorrelated with these measures, suggesting that e-mail requests were not as good of a behavioral measure of interest in getting vaccinated as we originally thought.

Despite these limitations, this work has the possibility of generating multiple lines of future research. As discussed above, additional research could be conducted to determine exactly how metaphors shape vaccination intentions. It is possible that metaphors might be influencing vaccination intentions via mechanisms that are less commonly associated with risk research, such as by changing implicit attitudes or increasing elaboration about the flu and/or vaccines while thinking about their vaccination intentions. Other research could examine whether there is an additive effect of describing both the flu and the flu vaccine (or antibodies) metaphorically. Another interesting question is whether metaphors could be used to influence other domains of medical and health decision making. Given how strongly individuals tend to feel about vaccines, metaphors might actually have a greater impact in less contentious domains, such as taking vitamins.

The current studies provide empirical evidence that metaphors could be used to improve health and medical decision making. While the exact mechanism remains unknown, from a public health perspective, studying the impact of metaphors on health-related behaviors may be more important than determining the exact mechanism by which metaphors influence behavioral intentions. Specifically, including metaphors in decision aids or information packets could provide a very cost-efficient way to increase vaccinations. If the effects of the current studies generalize to other health behaviors, metaphors could provide a new, no-cost method.
to boost the effectiveness of informational campaigns that seek to improve engagement in health behaviors.

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