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Assessing small non-zero perceptions of chance: The case of H1N1 (swine) flu risks

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Abstract

Feelings of unwarranted invulnerability, seen in judgments of 0% risk, can reflect misunderstandings of risk and risk behaviors, suggesting increased need for risk communication. However, judgments of 0% risk may be given by individuals who feel invulnerable, and by individuals who are rounding from small non-zero probabilities. We examined the effect of allowing participants to give more precise responses in the 0–1% range on the validity of reported probability judgments. Participants assessed probabilities for getting H1N1 influenza and dying from it conditional on infection, using a 0–100% visual linear scale. Those responding in the 0–1% range received a follow-up question with more options in that range. This two-step procedure reduced the use of 0% and increased the resolution of responses in the 0–1% range. Moreover, revised probability responses improved predictions of attitudes and self-reported behaviors. Hence, our two-step procedure allows for more precise and more valid measurement of perceived invulnerability.

Keywords

Risk perceptions; expectations; visual linear scale; magnifier scale; H1N1 flu

Because many life decisions are made under uncertainty, the ability to assess the likelihood of future life outcomes is an essential component of decision-making competence (Bruine de Bruin, Parker, and Fischhoff 2007a; Parker and Fischhoff 2005). When faced with a choice, individuals need to understand the likelihood of experiencing the various risks and benefits related to each option, and decide which risks are worth taking to obtain the potential benefits. Having the ability to use probabilities will also help them to better understand communications that aim to explain these risks and benefits, and ultimately make better decisions.

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However, judging probabilities may be a daunting task, as suggested by the disproportionate number of respondents using 50% as a potential indication of not knowing what probability to use (Bruine de Bruin et al. 2000; Fischhoff and Bruine de Bruin 1999). Nevertheless, adolescents and adults seem to be able to judge valid probabilities for various significant events happening in their lives (Bruine de Bruin, Parker, and Fischhoff 2007b; Fischhoff et al. 2000; Hurd and McGarry 1995 2002; Smith, Taylor, and Sloan 2001). For example, the probability of getting (someone) pregnant the next year, as judged by respondents to the 1997 National Longitudinal Study of Youth (NLSY), is significantly correlated to concurrent self-reports of their sexual activity (Fischhoff et al. 2000), as well as their having gotten (someone) pregnant, as self-reported a year later (Bruine de Bruin, Parker, and Fischhoff 2007b).

Probability judgments tend to be better predictors of future behaviors than yes/no questions about intentions, because they allow more variability (Juster 1996). Probability judgments may improve the ability of other available measures to predict future events, because they allow individuals to summarize observable and unobservable factors affecting future life events. For example, young women's probability judgments of having Chlamydia are significantly correlated with whether or not they subsequently test positive for that sexually transmitted infection, even after controlling for information that their health care providers collect about their age, demographic background, and sexual history (Bruine de Bruin et al., 2010). These results hold when examining probability judgments as reported on the full 0–100% scale, or when dichotomizing them in terms of whether they reflect a 0% or a non-zero risk.

When examining perceptions of risk, it may be especially important to distinguish respondents who perceive themselves as having a 0% risk from those who see themselves as having any risk at all. Indeed, individuals who judge themselves to be at 0% risk may feel invulnerable to the risk under consideration (Millstein and Halpern-Felsher 2002; Quadrel, Fischhoff, and Davis 1994). Judgments of 0% may thus reflect *certainty* about facing no risk, such that the qualitative difference between 0% and 1% is much larger than the qualitative difference between, say, 10% and 11%, even though the quantitative difference is the same (Tversky and Kahneman 1981). As a result, individuals may put particularly high value on reducing risks to zero (Ritov, Baron, and Hershey, 1993).

A sense of invulnerability may be defensible among individuals who have not put themselves at risk at all. For example, individuals who never exposed themselves to a specific risk (e.g., having unprotected sex) may accurately perceive having a 0% probability for experiencing related negative outcomes (e.g., unwanted pregnancy). However, judgments of 0% may sometimes reflect serious misunderstandings that can have negative consequences. Indeed, a longitudinal study showed that young women who do not get pregnant after having unprotected sex once are more likely to conclude that they are infertile -- and hence, have a 0% risk of unwanted pregnancies -- which then leads to more episodes of unprotected sex (Downs et al. 2004). Similarly, perceptions of 0% risk may be more common among individuals who have faced no negative consequences after a one-time experience with a risky behavior, such as drunk driving or having unprotected sex (Millstein and Halpern-Felsher 2002). Overall, individuals who perceive themselves as having a 0%

risk may mistakenly perceive themselves as invulnerable, take unwarranted risks, fail to engage in protective behaviors, ignore risk communications, and be most in need of intervention.

Unfortunately, self-reported risks of 0% may be an imperfect measure of perceived invulnerability. Individuals may give judgments of 0% risk as a result of rounding from a small non-zero risk (McClelland, Schulze, and Coursey 1993). If some of these individuals do not actually feel invulnerable to the risk, then such imprecise use of 0% will introduce error into the measurement of risk perceptions in general and invulnerability in particular.

Rounding to 0% may reflect features of the response modes as well as the respondents. First, commonly used response modes, such as visual linear scales ranging from 0–100%, may encourage rounding to 0%, because they do not provide explicit options in the low-probability range. As a result, respondents may conclude that such level of precision is unnecessary (e.g., Fischhoff, Welch, and Frederick 1999). Second, imprecise use of 0% may be especially likely among respondents with lower levels of education, as a generally proxy for small risks – while also using 100% when they think the event is likely, or 50% when they do not know exactly what number to use (Bruine de Bruin et al. 2000; Lillard and Willis 2001). Indeed, response distributions of probability judgments tend to show heaping at 0% and 50%, even for questions about low-risk events (Bruine de Bruin et al. 2000; Fischhoff et al. 2000; Fischhoff and Bruine de Bruin 1999; Lillard and Willis 2001).

To allow for more precise responses in the 0–1% range, a so-called magnifier scale has been recommended for assessments of small-probability events (Woloshin et al. 2000). It presents a visual linear 0–100% scale, with a magnifier enlarging the number of options in the 0–1% range on a loglinear scale. In a validation study (Woloshin et al. 2000), judged probabilities as expressed on the magnifier scale were more accurate than those reported on a traditional visual linear scale ranging from 0–100%. Yet, the two scales were rated as similarly easy to use, had similar test-retest reliability, and showed similar correlations with other measures of risk perception. Although the magnifier scale has been criticized for introducing an artificial response bias towards low probabilities, it may help knowledgeable respondents to better express low-probability beliefs (Gurmankin et al. 2005).

To date, it has not yet been examined whether the magnifier scale helps to distinguish respondents who feel invulnerable and perceive an actual risk of 0% from those who perceive small non-zero risks. Providing more explicit options in the 0–1% range should make it easier for respondents to express small non-zero risks, and reduce rounding to 0%. If so, magnifying the 0–1% range should make it more likely that 0% responses reflect actual feelings of invulnerability -- as seen in a lack of concern about the risk, and unwillingness to engage in protective behaviors – and hence, an increased need for intervention.

Here, we aimed to distinguish individuals who perceive a 0% risk from those who use 0% to express perceptions of small non-zero risks. We examined whether presenting more options in the 0–1% range (a) reduced the use of 0% responses, especially by individuals with lower levels of education, and (b) improved the validity of 0% responses, in terms of correlations with measures of concern, as well as self-reports of and expectations for engaging in

protective behaviors. Probability questions asked about the chances of getting H1N1 (swine) flu over the next month and the chances of dying conditional on infection with H1N1 (swine flu). At the time of the survey, May and June of 2009, both of these events presumably had small objective probabilities.

Because the magnifier scale has been criticized for artificially reducing assessed probabilities by drawing attention to the magnified low-probability range (Gurmankin et al. 2005), we examined the effect of enlarging the 0–1% range *after* respondents provided their initial response on a standard 0–100% visual linear scale. Thus, initial responses were given before drawing any attention to the magnified low-probability range. That is, for each flu risk perception question, respondents judging probabilities in the 0–1% range of the visual linear scale subsequently received a follow-up question providing more explicit responses in that range. We expected that the follow-up question would reduce the use of 0% due to rounding from small near-zero probabilities – thus allowing respondents to give more precise responses. Moreover, we expected that such increased precision would lead to better validity, in terms of stronger correlations of 0% (versus non-zero) responses with judgments of concern, vaccination intentions, as well as self-reported precautions.

1. Method

1.1. Sample

The survey was conducted between May 26th 2009 and June 8th 2009. Respondents were members of RAND's American Life Panel (ALP), who were recruited from the 2007 sample of the Michigan Survey of Consumers (MS), which was constructed using random digit dialing. MSrespondents were asked to participate in a long-term research project with RAND. A snowball technique was used to grow the ALP, with participants referring friends or acquaintances. A detailed description of the panel appears at https://mmicdata.rand.org/alp/index.php/Main_Page. Among active ALP members (N=2694), defined as those who have completed at least one survey since June of 2008, 76.8% (N=2069) completed our survey. Of those, 44.4% had no post high school degree, 51.3% made less than the median of \$60k/year, 9.7% were nonwhite, and 58.5% were female. Respondents were between 18 and 91 years old ($M=50.13$, $SD=14.85$).

1.2. Measures

1.2.1. Flu risk perception and follow-up questions—The introduction to the flu risk perception questions explained the 0–100% range, explicitly encouraging the use of non-round numbers and numbers after the decimal point.¹ Subsequently, the initial flu risk perception questions asked (a) “What do you think are the chances that you will get H1N1 (swine) flu in the next month?” (b) “If you do catch the H1N1 (swine) flu, what do you think are the chances that you will die from it?” They answered by clicking on a 0%-100% linear scale that provided a tick mark for every integer, or typing a response in an accompanying text box, which accepted non-integer numeric responses.

For each flu risk perception question, respondents initially judging probabilities in the 0–1% range were told, “We would like to get extra information about the last question.” They then

received the follow-up question, which used the same wording as the initial question, and provided the response options 0%; more than 0% and less than or equal to .001% (1/100,000); more than .001% (1/100,000) and less than or equal to .01% (1/10,000); more than .01% (1/10,000) and less than or equal to .1% (1/1,000); more than .1% (1/1,000) and less than or equal to 1% (1/100); and 1%. These response options were displayed vertically in ascending order.

1.2.2. Demographic measures—Respondents self-reported their highest level of education, as well as their birth day and year, gender, race, and income category.

1.2.3. Validation measures—The survey included three validation measures. First, respondents answered “how concerned are you that you might get sick from H1N1 (swine) flu?” by selecting “very concerned,” “somewhat concerned,” “not very concerned,” or “not at all concerned,” with the first three responses being coded as being concerned (=1) and the fourth response as not being concerned (=0).² Second, respondents checked whether they had taken “special precautions to protect yourself against H1N1 (swine) flu,” including increased frequency of hand washing, bought antiviral medication, bought any type of face mask, avoided public gatherings and contact with others, avoided travel, stockpiled food/water, stockpiled prescription drugs, other (please specify), and none, coded as any (=1) versus none (=0). Third, respondents answered “If a vaccine becomes available for the H1N1 (swine) flu this fall, what are the chances that you would get the vaccine?” on a visual linear scale ranging from 0% to 100%.

1.3. Question order

Demographic information was reported when respondents first signed up for the panel. The present survey started by asking whether respondents were concerned that they might get sick with H1N1 (swine) flu. Subsequently, they reported the specific precautions they had taken to protect themselves against it. They also answered questions unrelated to our

¹Now we will ask you some questions about future behaviors and uncertain outcomes. In each case, try to think about the whole range of possibilities and think about how likely they are to occur. In these questions, we will ask you about the percent chance of something happening. The percent chance must be a number from 0 to 100. You can also give numbers after the decimal point. Here are some descriptions corresponding to different chances of something happening:

- Absolutely will not happen= 0 % chance
- A very small chance= Less than 1% chance
- A small chance= 2 to 15 % chance
- A reasonable chance= 15 to 40 % chance
- A pretty even chance= 40 to 60% chance
- A big chance= 60 to 85 % chance
- A very big chance= 85 to 98 % chance
- Almost certain= More than 99% chance
- Absolutely certain= 100% chance

You can also think of percent chances as the number of times something happens out of 100.

²To facilitate interpretations of our results, we dichotomized ratings on the 4-point scale of concern about getting H1N1 to reflect expressing any level of concern versus none at all. Overall, similar results ($\alpha=.05$) were obtained when using the full range of responses or the dichotomized measure.

hypotheses (and not analyzed here). Probability questions appeared at the end, asking respondents to judge the probability of getting vaccinated against H1N1 (swine) flu, getting sick with H1N1 over the next month, and dying if H1N1 (swine) flu is contracted.

2. Results

2.1. Distributions of initial responses on the visual linear scale

Figure 1a shows the distribution of initial responses for getting H1N1 (swine) flu, as reported on the visual linear scale, with 33.4% giving responses in the 0–1% range. That is, 22.6% of respondents used 0%, 10.4% used 1%, and .4% used a response between 0% and 1%. Although the median was only 5% ($M=9.5\%$, $SD=13.8$), a seemingly disproportionate 3.8% of respondents answered 50%, potentially because they did not know exactly what number to use – which likely would have been even higher if we had used an open-ended fill-in-the-blank response mode instead of a visual linear scale (Fischhoff & Bruine de Bruin, 1999; Bruine de Bruin et al., 2002). Figure 1b shows a similar pattern for dying if H1N1 (swine) flu is contracted, with 28.2% initially using the 0–1% range of the visual linear scale. Specifically, 17.3% of respondents used 0%, 10.4% used 1%, and .5% used a response in between 0% and 1%. Similar to the pattern above, 7.4% of respondents reported a 50% chance of dying conditional on infection, despite the low overall median of 5% ($M=13.8\%$, $SD=18.5$).

2.2. Effect of the follow-up question on the use of 0% responses

Sign tests examined whether the follow-up question changed the use of 0% among respondents who initially answered 0%, 1% or in between on the visual linear scale (Siegel and Castellan, 1988). As expected, receiving more explicit response options with the follow-up question reduced the use of 0% responses from 67.8% to 53.9% for getting swine flu ($z=-8.33$, $p<.001$), and from 61.3% to 49.8% for the risk of death conditional on infection ($z=-6.70$, $p<.001$).³ When considering the full sample, including those who originally used a response over 1% on the visual linear scale, and did not receive the follow-up question, reduced the use of 0% responses from 22.6% to 18.0% for getting swine flu ($z=-8.33$, $p<.001$) and from 17.3% to 14.0% for dying conditional on infection ($z=-6.70$, $p<.001$).⁴

Table 1 suggests that the follow-up question improved the resolution of responses in the 0–1% range, with respondents who initially answered 0% on the visual linear scale being more likely to revise to a non-zero response than vice versa. For perceptions of getting the swine flu over the next month, 24.1% of respondents who initially used 0% switched to a small non-zero response after being given the follow-up question. By comparison, only 7.7% of respondents who initially gave a small non-zero response revised their answer to 0% on the

³Because all respondents who initially gave a response in the 0–1% range on the visual linear scale received the follow-up question, we were unable to systematically examine the effect of having seen the follow-up with the first probability question on responses to the second probability question. Respondents who received the follow-up due to answering in the 0–1% range on the visual linear scale with the first question were more likely than others to do so again with the second question (51.4% vs. 16.6%, $\chi(1)=275.18$, $p<.001$), likely reflecting a tendency to use small probabilities. Respondents who received the follow-up question with the first question were slightly more likely to use numbers behind the decimal point on the visual linear scale with the second question (1.3% vs. .1%, $\chi(1)=11.69$, $p<.001$) even when excluding those who had already done so with the first question (1.0% vs. .1%, $\chi(1)=8.15$, $p<.01$).

⁴Because the sign tests ignores ties and examines only the direction of observed differences between the two measures, the overall statistic and significance level are the same for the full sample and the reduced sample initially responding in the 0–1% range.

follow-up question ($\chi(1)=26.77$, $p<.001$). The same pattern was found in responses for dying from the swine flu conditional on infection (23.0% vs. 6.7%, $\chi(1)=26.41$, $p<.001$). Table 1 shows that respondents who initially gave a small non-zero response on the visual linear scale (typically 1%) also revised their answers, but to another non-zero response.

2.3. Relationship between education and use of 0%

As indicated above, 44.4% of participants had no post high school degree. Table 2 shows the relationship between education and initial use of (a) 0% and (b) 50% on the visual linear scale as seen in the full sample. As expected, respondents without a post high school degree were more likely to give responses of 0% when they were initially asked to express their flu risk perceptions on the visual linear scale. They were also more likely to use 50% responses on the visual linear scale, replicating previous results suggesting that both the use of 0% and 50% may result from not knowing precisely what number to use (Lillard and Willis 2001).

The subsequent analyses consider only the reduced sample of respondents who initially responded 0%, 1%, or in between, on the visual linear scale. Table 3 shows that, in that reduced sample, those without a post high-school degree were more likely than those with higher levels of education to initially use 0% (versus a small non-zero response) on the visual linear scale. After receiving the follow-up question that expanded the 0–1% range, those without a post high school degree were still more likely to use a 0% response.

2.4. Relationship between use of 0% and validation measures

Validation measures included reports of concern (yes=72.6%), self-reports of engaging in any precaution (yes=53%), most notably increased hand washing (yes=51%), and the judged probability of getting vaccinated for H1N1 ($M=50.0$, $SD=36.2$). Table 4 analyzes the initial probability responses as given by the full sample on the visual linear scale. It suggests that dichotomizing responses to reflect whether respondents used 0% or another probability in the 0–100% range led to relatively little loss of predictive ability. That is, initial full-range responses on the visual linear scale were positively correlated with expressing concern, reporting a precautionary action like increased hand washing, and judged probability of getting vaccinated. After dichotomizing probability judgments, correlations with these validation measures were similar or of only slightly reduced magnitude – suggesting that the zero versus non-zero distinction has concurrent validity.

Table 5 focuses on the reduced sample of respondents who initially used 0%, 1%, or a number in between, on the visual linear scale. It shows weak correlations between the use of 0% (versus another probability in the 0–1% range) and the validation measures. Thus, whether respondents use 0% or another non-zero response in the 0–1% responses range of the visual linear scale may contain little to no relevant information about their perceptions of invulnerability, as measured via expressions of concern, vaccination intentions, or the self-reported adoption of other precautions. However, correlations between using 0% (versus another probability in the 0–1% range) became stronger and significant when considering responses to the follow-up question.⁵ Thus, responses to the follow-up question appear to contain relevant information about respondents' perceptions of invulnerability, such that

those who answered 0% were less concerned about H1N1 (swine) flu and were more likely to have taken a precaution such as increased hand washing and getting vaccinated.

Table 6 shows the results of logistic regressions predicting whether or not respondents expressed concern and whether or not they self-reported having taken precautions, as well as a linear regression predicting judged probabilities of getting vaccinated. These analyses were conducted on the full sample – replacing responses on the visual linear scale with any revisions that were given with the follow-up question. For each flu risk perception question, using 0% with the more explicit follow-up question was significantly related to these validation measures, even after controlling for initial use of 0% on the visual linear scale, as well as for education level and other demographic characteristics. There were no concerns about multicollinearity, with tolerance being .34 and VIF being 2.97 for initial and revised use of 0% with getting H1N1 (swine flu), and .31 and 3.24 for dying if H1N1 (swine) flu is contracted. Thus, providing more explicit response options in the 0–1% range improved the predictive validity of reported 0% (versus small non-zero) responses – possibly because it allowed respondents to avoid answering 0% when they intended to express a small non-zero probability.

3. Discussion

Because many decisions are made under uncertainty, assessing the likelihood of future events is an essential component of decision-making competence, and, arguably, of experiencing good decision outcomes (Bruine de Bruin, Parker, and Fischhoff 2007a; Parker and Fischhoff 2005). When evaluating individuals' risk judgments, it is especially important to distinguish between those who perceive 0% risk from those who perceive non-zero risk. Perceptions of 0% risk may reflect unwarranted feelings of invulnerability, which can lead to excessive risk taking (Downs et al. 2004; Millstein and Halpern-Felsher 2002). However, some 0% responses may instead reflect rounding from small non-zero probabilities (McClelland et al., 1993). If such rounding does not reflect respondents' actual beliefs, it will introduce error in the measurement of perceived risk and invulnerability.

Here, we used a two-step procedure to elicit probability judgments that allowed respondents to increase the precision of responses in the 0–1% range, resulting in increased validity of 0% vs. non-zero responses. First, respondents gave their probability judgments on a visual linear scale ranging from 0–100%. Second, those giving responses in the 0–1% range of the visual linear scale received the opportunity to make revisions on a loglinear scale for that range. About a quarter of respondents who initially used 0% on the visual linear scale revised to other probabilities in the 0–1% range in the follow-up question. By comparison, respondents who had initially given a non-zero response in the 0–1% range (typically 1%) of the visual linear scale were less likely to switch to 0% in response to the follow-up question, though many did switch to another non-zero response. That pattern of results suggests that

⁵For the two dichotomized validation measures, chi-square tests show that respondents who used 0% with the follow-up question were significantly less likely to express concern about H1N1 (40.3% vs. 62.3%, $\chi(1)=33.02$, $p<.001$) and significantly less likely to report having taken precautions (34.7% vs. 42.5%, $\chi(1)=4.39$, $p<.05$). These relationships were less pronounced in responses expressed on the visual linear scale (45.1% vs. 61.7% expressed concern, $\chi(1)=16.65$, $p<.01$; 37.0% vs. 41.0% reported taking precautions, $\chi(1)=1.03$, $p>.10$)

respondents who responded 0% or 1% on the visual linear scale had been rounding from small non-zero probabilities -- and that they were better able to express these small non-zero probabilities when they received more explicit response options with the follow-up question.

Allowing respondents to increase the precision of responses in the 0–1% range improved predictive validity of their responses, with follow-up responses of 0% (versus a small non-zero probability in the 0–1% range) being more predictive of being unconcerned about getting H1N1, being less likely to take precautions such as increased hand washing, and having lower vaccination intentions, as well as adding to the predictive ability of the initial 0% responses on the visual linear scale. Thus, the increased precision of responses in the 0–1% range, as observed with the follow-up question, is most likely not an artificial consequence of experimental demand (Fischhoff et al. 1999). If that were the case, some respondents would have changed responses away from 0% despite perceiving the risk to be essentially 0%. Such behavior would have introduced noise and reduced the relationship between perceptions of 0% risk and expressing concern, taking precautions, and the judged likelihood of getting vaccinated.

Thus, presenting the follow-up question improved the measurement of small non-zero perceptions of chance. When initially presented with the visual linear scale, 22.6% of all respondents judged a 0% probability of getting H1N1 (swine) flu and 17.3% judged a 0% probability for dying conditional on infection. After being given the opportunity to revise their initial responses with the follow-up questions, the use of 0% responses was reduced to 18.0% for getting H1N1 (swine) flu and 14.0% for dying conditional on infection. Because the survey was conducted before widespread circulation of H1N1 and before a corresponding vaccine became available, respondents were unlikely to have any information suggesting their immunity. Hence, their feelings of invulnerability to H1N1 could lead them to put themselves at risk for contracting it, as seen in the correlations between perceiving 0% risk and being less concerned, judging a lower likelihood of getting vaccinated, and being less likely to take precautions.

Using 0% was more likely among respondents with lower levels of education, who may find it more challenging to assess probabilities with precision (Lillard and Willis, 2001). Even when afforded the opportunity to give a more precise response, respondents with lower levels of education remain more likely to use 0%. Hence, individuals with lower levels of education may be more likely to perceive themselves as being invulnerable, and be certain about their 0% response. That explanation is not in contradiction with the finding that individuals with lower levels of education also used more 50% responses, possibly to indicate uncertainty about what number to give (Bruine de Bruin et al. 2000; Fischhoff et al. 2000; Fischhoff and Bruine de Bruin 1999). Their choice of using 0% or 50% may depend on whether they feel certain or uncertain about being able to avoid a low-probability risk – perhaps as a result of not fully understanding the concept of risk or probability. Additionally, if they felt certain about experiencing the risk, they might use 100% to express that belief of vulnerability. Indeed, most risk perceptions studies find blips at 0% and 50%, in assessments of low-risk events (Bruine de Bruin et al. 2000; Fischhoff et al. 2000; Fischhoff and Bruine de Bruin 1999). An excess of 100% responses may be observed in questions about more likely events (Lillard & Willis, 2001).

Our two-step procedure allowed respondents to give more precise responses in the 0–1% range. They did not receive the follow-up question with the more explicit response options until after they had first indicated a response of 1%, 0%, or in between, on the visual linear scale. Using this new procedure should avoid emphasizing the lower end of the scale, and the artificial reducing of reported probability judgments, compared to directly presenting a magnifier over the 0–1% range of the visual linear scale (Gurmankin et al., 2005). At the same time, this procedure does increase respondent burden, in the sense of increasing the time and number of responses needed to complete the survey, but only for those giving initial responses in the 0–1% range (about one third of our sample). Hence, the increased precision and validity should be weighed against those costs. Using the more precise two-step method is recommended when assessing small near-zero risks that may be rounded to 0%, when building predictive models of protective behaviors, or when targeting interventions specifically at individuals who perceive themselves to be invulnerable.

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Figure 1.

Initial open-ended response distributions for (a) “What do you think are the chances that you will get H1N1 (swine) flu in the next month?” and (b) “If you do catch the H1N1 (swine) flu, what do you think are the chances that you will die from it?”

Percent of respondents who used each response to the follow up question, after initially responding in the 0–1% range on the visual linear scale.

Table 1

Response to follow-up question	Getting H1N1 (swine) flu		Dying H1N1 (swine) flu is contracted	
	0% on visual linear scale	Other response in 0–1% range on visual linear scale	0% on visual linear scale	Other response in 0–1% range on visual linear scale
0%	75.9% (355)	7.7% (17)	77.0% (275)	6.7% (15)
More than 0% and less than or equal to .001%	17.7% (83)	45.9% (102)	17.1% (61)	42.2% (95)
More than .001% and less than or equal to .01%	1.5% (7)	9.5% (21)	2.2% (8)	11.6% (26)
More than .01% and less than or equal to .1%	1.1% (5)	6.3% (14)	.8% (3)	5.8% (13)
More than .1% and less than or equal to 1%	1.3% (6)	10.8% (24)	.0% (0)	12.0% (27)
1%	2.6% (12)	19.8% (44)	2.8% (10)	21.8% (49)
Total of non-zero categories	24.1% (113)	92.3% (205)	23.0% (82)	93.3% (210)
Total	100.0% (468)	100.0% (222)	100.0% (357)	100.0% (225)

Note to Table 1: Almost all non-zero responses on the visual scale were 1% (96.4% for getting H1N1; 95.1% for dying if H1N1 is contracted)

Table 2
Percent of respondents without (vs. with) a post high school degree using 0% and 50% on the visual linear scale.

	Getting H1N1 (swine) flu			Dying if H1N1 (swine) flu is contracted				
	N	Respondents without post high school degree	Respondents with post high school degree	Chi-square	N	Respondents without post high school degree	Respondents with post high school degree	Chi-square
Use of specific response (vs. other response between 0–100%)								
Use of 0%	2065	26.4%	19.6%	13.79 ***	2065	19.2%	15.6%	4.82 *
Use of 50%	2065	5.6%	2.4%	13.65 ***	2065	9.9%	5.4%	15.41 ***

Note: *** p<.001;

* p<.05

Percent of respondents without (vs. with) a post high school degree using 0% in reduced sample initially responding in the 0–1% range of the visual linear scale.

Table 3

	Getting H1N1 (swine) flu				Dying if H1N1 (swine) flu is contracted			
	N	Respondents without post high school degree	Respondents with post high school degree	Chi-square	N	Respondents without post high school degree	Respondents with post high school degree	Chi-square
Use of 0% (vs. other response between 0–1%)								
On visual linear scale	690	77.3%	59.8%	23.89***	580	72.1%	53.3%	21.17***
With follow-up question	690	60.4%	48.4%	9.86**	580	62.7%	40.5%	27.94***

Note: *** p<.001;
** p<.01

Table 4

Pearson correlations (p-values) between probability responses as initially provided on the 0–100% scale and other measures.

Probability response	Getting H1N1 (swine) flu				Dying if H1N1 (swine) flu is contracted			
	N	Concerned about getting H1N1	Taken any precaution	Judged probability of getting vaccine	N	Concerned about getting H1N1	Taken any precaution	Judged probability of getting vaccine
Judged probability (in 0–100% range)	2067	.27***	.20***	.27***	2067	.21***	.15***	.19***
Dichotomized response (0% vs. other response between 0–100%)	2067	-.33***	-.18***	-.26***	2067	-.28***	-.16***	-.23***

Note: *** p<.001.

Pearson correlations (p-values) between use of 0% and other measures, in reduced sample initially responding in the 0–1% range of the visual linear scale.

Table 5

	Getting H1N1 (swine) flu				Dying if H1N1 (swine) flu is contracted			
	N	Concerned about getting H1N1	Taken any precaution	Judged probability of getting vaccine	N	Concerned about getting H1N1	Taken any precaution	Judged probability of getting vaccine
Use of 0% (vs. other response between 0–1%)								
On visual linear scale	690	-.16**	-.04	-.11**	582	-.14**	-.07	-.16***
With follow-up question	690	-.22***	-.08*	-.17***	582	-.21***	-.09*	-.20***

Note: *** p<.001;
** p<.01;
* p<.05.

Table 6

Regression models predicting concern, precautions, and judged probability of getting vaccinated.

Predictor variable	Getting H1N1 (swine) flu			Dying if H1N1 (swine) flu is contracted		
	Concerned about getting H1N1 (OR)	Taken any precaution (OR)	Judged probability of getting vaccine (β)	Concerned about getting H1N1 (OR)	Taken any precaution (OR)	Judged probability of getting vaccine (β)
Use of 0% (vs. other response between 0–100%) on visual linear scale	.37***	.55**	-.14***	.52**	.55**	-.12**
Use of 0% (vs. other response between 0–100%) with follow-up question	.37***	.60*	-.15***	.31***	.64	-.12**
Education (post-high school degree)	.72**	.89	.03	.73**	.90	.03
Age	1.01**	1.01*	.19***	1.01*	1.01	.18***
Gender (female)	1.31*	1.72***	.00	1.28*	1.70***	.00
Race (nonwhite)	1.90**	1.49*	.03	1.85**	1.45*	.03
Income (more than \$60k)	.74**	.86	.01	.81	.89	.03
R ²	.19	.08	.11	.14	.07	.09
N	2058	2057	2057	2058	2057	2056

Note to Table 6: Logistic regression models predicted whether or not respondents reported concerns and whether or not they reported precautions; linear regression models predicted their judged probability for getting vaccinated.

*** p<.001;

** p<.01;

* p<.05.

Tolerance was .34 and VIF was 2.97 for initial and revised use of 0% with getting H1N1 (swine flu), and .31 and 3.24 for initial use of 0% with revised responses of dying if H1N1 (swine) flu is contracted.