

S10 36-303 Sampling, Survey and Society

Project #2: Graphical versus Numerical Presentation of

Quantitative Environmental Risk Information about Unexploded Ordnance (UXO)

Project group E

BARADARAN SHORAKA, MOHAMMAD (mbaradar@andrew.cmu.edu)

GALVAN, JOSE ALFREDO (jagalvan@andrew.cmu.edu)

LEONTIADIS, NEKTARIOS (nleontia@andrew.cmu.edu)

YANG, CHIA-HSUAN (chiahsuy@andrew.cmu.edu)

Background

A large amount of land in the U.S. is currently contaminated with unexploded ordnance (UXO). UXO contamination results from the failure of ammunition launched during military training exercises to explode as planned, leaving ordnance items that have the potential to detonate if disturbed. To date, risk assessments conducted to support decisions about the cleanup of UXO sites have used qualitative approaches. These qualitative assessments have been criticized for being too vague to effectively communicate risks related to UXO to members of the general public (Army Science Board, 1998; MacDonald, Knopman, Lockwood, Cecchine, & Willis., 2004; EPA, 2004; MacDonald, Small, & Morgan, 2008). Recently, MacDonald et al. (2008) developed the first systems-based approach for quantifying the risk of civilian exposure to UXO hazards. This development provides the first opportunity to communicate quantitative estimates of UXO risks to the general public.

We propose to evaluate alternative formats for communicating quantitative information about UXO risk to the general public, building on two lines of research: (1) the effect of presentation format on recipients' cognitive responses to risk communications; and (2) individual differences in numeracy.

Presentation format

Previous research suggests that, compared to numerical presentation formats, graphical presentation formats may make risks more salient, in the sense of increasing perceptions of risk and increasing risk avoidance (e.g., Stone, Yates, & Parker, 1997). Graphical presentation formats may also improve understanding of risk communication materials, compared to numerical presentation formats (Connelly & Knuth, 1998; Waters, Weinstein, Colditz, & Emmons, 2006). Further, it has been suggested that people understand frequency information better than probabilities. To our knowledge, however, no

previous studies have ever examined these issues simultaneously. Our research will attempt to fill that gap by presenting frequency and probability risk information in both graphical and numerical formats.

Numeracy

Recipients of risk communications tend to vary in their ability to understand risk numbers – also referred to as numeracy (Lipkus, Samsa, & Rimer, 2001; Peters, Västfjäll, Slovic, Mertz, Mazzocco, & Dickert, 2006). Many researchers have theorized that different presentation formats may be necessary for people with low versus high levels of numeracy (Fagerlin, Ubel, Smith, & Zikmund-Fisher, 2007; Lipkus & Hollands, 1999), and the most common advice is that the use of graphical techniques is particularly important for people with low numerical skills (e.g., Lipkus & Hollands, 1999; Gates, 2004; Paling, 2003). In general, however, the interaction between presentation format and numeracy is relatively unexplored.

Hypotheses

We propose to test the following hypotheses:

- 1- We predict that greater risk will be perceived among participants who receive the numerical presentation format, compared to those who receive graphical presentation format. We have no clear prediction for the effect of presenting people with frequency information vs. probability information on reported perceptions of risk, or its interaction with graphical vs. numerical presentation format.
- 2- We predict that understanding of risk will be better (a) among participants who receive the graphical presentation format, compared to those who receive the numerical presentation format, (b) among participants who receive the frequency information, compared to those who receive the probability information, and (c) an interaction effect, such that the graphical presentation format of frequency information is easiest to understand, and the numerical presentation format of probability information is hardest to understand.
- 3- We predict that the effects predicted in Hypothesis 1 and Hypothesis 2 will be stronger for participants with lower numeracy than for those with a higher numeracy.

Sample and design

Based on effect sizes observed in previous research comparing responses to graphical versus numerical displays, we plan to recruit 240 participants from community groups, who have been shown to vary widely in their numeracy scores (Bruine de Bruin, Fischhoff, Downs, Florig, Stone, Mandel, & Lerner, 2008). They will receive risk communication materials about UXO that will be adapted from MacDonald et al. (2008), using presentation formats used in the work of Stone and colleagues (1997, 2003). These people represent the society facing these UXO and one day should decide whether to reuse these fields contaminated with UXOs or not.

Based on the need to use a questionnaire, we can use one of the self-report such as Internet or asking the participants to fill the questionnaires by an interview. We will use a 2-by-2 between-subjects design, varying presentation format (graphical vs. numerical) and risk information (frequency vs. probability). That is, participants will be randomly assigned to receiving risk communication materials about UXOS in a graphical presentation format or in a numerical presentation format. They will also be randomly assigned to whether that information will be presented in a frequency or a probability format.

For example, following Stone and colleagues (1997, 2003), the graphical presentation format of frequency information will show six stick figures adding the words “out of 100” who may be hurt from entering a UXO-contaminated area. The graphical presentation format of probability information will show 100 stick figures, with six highlighted as being at risk. Similarly, the numerical presentation format of frequency information will present it as “6 out of 100.” Similarly, the numerical presentation format of probability information will present the risk of someone getting hurt from entering a UXO-contaminated area as “6%.”

Measures

To test our hypotheses, we propose to include measures of (1) perceived risk, (2) understanding of the risk materials, and (3) numeracy. Perceived risks will be measured by asking participants to place a tick mark on a linear scale ranging from 0% (=no chance) to 100% (=certainty), as well as 1-7 Likert scales, using the same end-point labels. Risk-related decision-making questions adapted from Stone et al. (1997, 2003) and from Bruine de Bruin et al. (2008) will be designed to measure the extent of professed risk aversion after exposure to the risk information. Finally, we will include both perceived and objective measures of understanding of the risk information, including self-ratings of how well participants understood the risk as well as true-false statements about the risk materials, following Bruine de Bruin et al. (2008). Individual differences in numeracy will be measured with a validated scale (Lipkus et al., 2001; Peters et al., 2006b).

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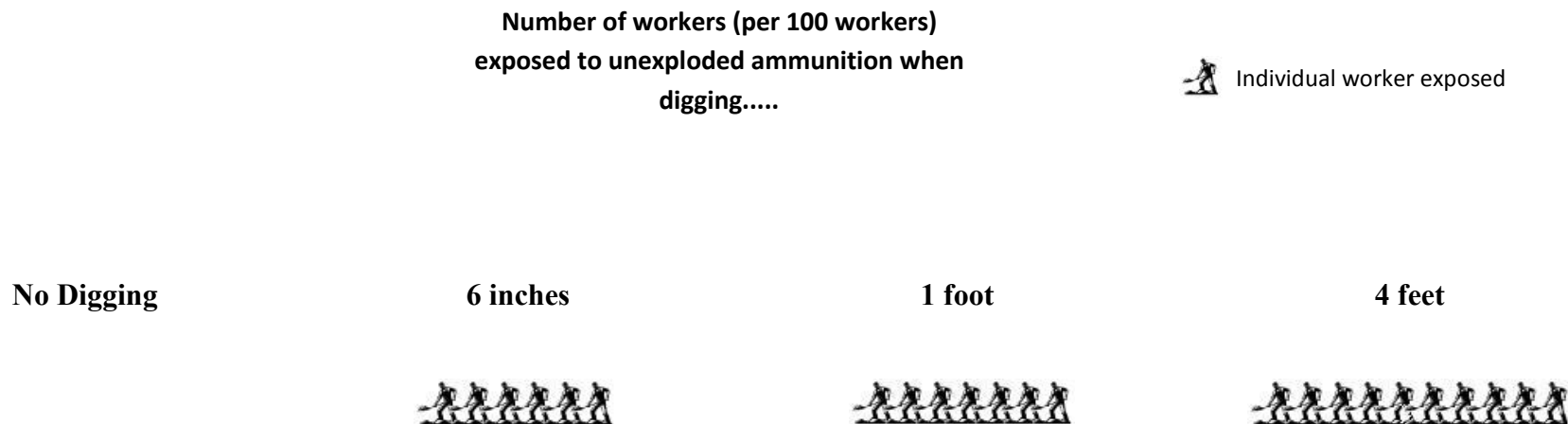
Ford Ord, California was an Army base from 1917 until 1994. Soldiers practiced firing ammunition in the fields there. They fired anti-tank projectiles, grenades, landmines, mortars, rockets, and other kinds of ammunition. This ammunition did not always explode when fired. Some of it may still be left in the ground. Any contact with it could cause an explosion.

Now, there is a new plan for 310 acres of the land. Monterey Peninsula College wants to construct buildings, roads, and parking lots there. Construction workers run the risk of coming across unexploded ammunition. They can be hurt or killed if it goes off.

Imagine you live in a community near Fort Ord. You need to decide if the risk is small enough to allow construction. The risk of workers hitting ammunition is larger if they dig deeper. Buildings require more digging than do parking lots. Without digging, there is a 0% chance that an individual worker will be exposed to ammunition. When digging six inches, an individual worker has a 6% chance of being exposed to ammunition during their time at this site. When digging one foot, an individual worker has a 7% chance of being exposed to ammunition during their time at this site. When digging four feet, an individual worker has a 10% chance of being exposed to ammunition during their time at this site.

If a worker is exposed to ammunition, the ammunition could explode. Experts disagree about the chance of the ammunition exploding. If the ammunition does explode, the worker could be hurt or killed.

The graph below displays the chance that an individual worker will be exposed to unexploded ammunition.



Assuming you are a construction worker living near this building site, think about how you felt when you read the information about unexploded ammunition. Use the scale below to indicate how you felt while reading the information, by circling your answer.

I felt worried when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt sad when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt happy when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt fearful when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt enraged when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt frightened when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before

I felt mad when I read the information about unexploded ammunition.

0	1	2	3	4	5	6	7	8
Did not feel the emotion the slightest bit								Felt the emotion even more than ever before