Organizational Behavior and Human Decision Processes
Vol. 81, No. 1, January, pp. 115–131, 2000
doi:10.1006/obhd.1999.2868, available online at http://www.idealibrary.com on IDEAL®

Verbal and Numerical Expressions of Probability: "It's a Fifty–Fifty Chance"

Wändi Bruine de Bruin

Department of Social and Decision Sciences, Carnegie Mellon University; and Department of Technology Management, Eindhoven University of Technology, Eindhoven, The Netherlands

Baruch Fischhoff

Department of Social and Decision Sciences, Carnegie Mellon University

and

Susan G. Millstein and Bonnie L. Halpern-Felsher

Department of Pediatrics, University of California, San Francisco

When estimating risks, people may use "50" as an expression of the verbal phrase "fifty–fifty chance," without intending the associated number of 50%. The result is an excess of 50s in the response distribution. The present study examined factors determining the magnitude of such a "50 blip," using a large sample of adolescents and adults. We found that phrasing probability questions in a distributional format (asking about risks as a percentage in a population) rather than in a singular format (asking about risks to an individual) reduced the use of "50." Less numerate respondents, children, and less educated adults were more likely to say "50." Finally, events that evoked feelings of less perceived control led to more 50s. The results are discussed in terms

This research was funded by the National Institute of Allergies and Infectious Disease (NIAID, Grant IU19AI38513), the National Institute of Child Health and Human Development (NICHD, Grant H934412), and the U.S. National Science Foundation through the Center for the Integrated Assessment of the Human Dimensions of Global Change at Carnegie Mellon University, cooperative agreement number SBR-9521914. We benefited from advice, comments, and help from Peter Ayton, Michael Biehl, Robyn Dawes, Paul Fischbeck, Andy Parker, and two anonymous reviewers. The opinions expressed are those of the authors.

Address correspondence and reprint requests to Wändi Bruine de Bruin, Department of Technology Management, Eindhoven University of Technology, Tema 0.01, P.O. Box 513, 5600 MB Eindhoven, The Netherlands. Fax: +31 40 244 9875. E-mail: W.J.A.Bruine.de.Bruin@tm.tue.nl.

0749-5978/00 $35.00

of what they reveal about how people express epistemic uncertainty.

Probabilities are a standard way to describe situations of uncertainty and risk. The ability to use probabilities in a consensual way is essential if people are to comprehend the risks that they face and to communicate effectively their beliefs to one another. Researchers and decision analysts also depend on people's ability to express probabilistic beliefs in terms of numerical probabilities (Morgan & Henrion, 1990; von Winterfeldt & Edwards, 1986). One form of miscommunication arises when people use the phrase "fifty–fifty," or even the associated number "50," without intending 50%. Rather, saying "50" may reflect epistemic uncertainty (Gärdenfors & Sahlin, 1982) or an inability to translate one's feelings into a number (Bruine de Bruin, 1998; Fischhoff & Bruine de Bruin, 1999). Fischhoff and Bruine de Bruin (1999) present examples of such usage of "fifty–fifty," drawn from open-ended interviews with a diverse sample of teens (see also Fischhoff, Downs, & Bruine de Bruin, 1998). Table 1 shows some examples of "fifty–fifty" used in major American newspapers. The first three do not have a clear numerical interpretation; in the remaining examples, though, it is unclear whether "fifty–fifty" was meant as a number or as a verbal statement of epistemic uncertainty.

When asked for probabilities, uncertain respondents may find that saying "50" allows them to give a number, as requested, without feeling that they have committed themselves to a specific answer. Suggestive evidence of this strategy can be found in the response distributions of studies asking respondents to assess the probabilities of risks, such as getting lung cancer from smoking (Viscusi, 1993), becoming the victim of a burglary (Dominitz & Manski, 1997), developing breast cancer (Black, Nease, & Tosteson, 1995), having no health insurance (Dominitz & Manski, 1997), or being unemployed in the next year (Dominitz & Manski, 1997). Respondents in these surveys were asked to generate a probability between 0 and 100%. Such an open-ended response format is well suited to phone administration, employed by most of the cited studies. However, it allows, and perhaps even encourages, respondents to "regress" to thinking about probabilities in easier verbal terms, including "fifty–fifty."

People's preference for verbal probability terms (such as "possibly," "likely," and, we argue, "fifty–fifty") rather than numerical ones has both developmental and historical roots. Children initially approach mathematical expressions in terms of everyday language, gaining understanding of the formal terms only as they learn more math (Gelman, 1990; Karmiloff-Smith, 1992; Resnick, 1986). Nonetheless, adults still prefer to give verbal probability expressions rather than numerical ones (Wallsten, Budescu, Zwick, & Kemp, 1993). Historically, even scientists produced verbal descriptions of uncertainty—before they unraveled the concept of numerical probability (Bernstein, 1998; David, 1962; Hacking, 1975).

This does not mean, however, that adults have no understanding of numerical

TABLE 1

Quotes from The New York Times and The Washington Post

Larry Robideaux Jr., the trainer of the speed horse Fox Trail, watched today as 11 rather evenly matched colts were entered in Saturday's $1 million Travers Stakes and observed: "Everyone has a *50–50 chance* of winning this race."

(*The New York Times*, Durso, 1993, August 19)

The House Assassinations Committee was told yesterday that there was a *50–50 chance* of a shot having been fired at President Kennedy from the so-called "grassy knoll" in Dallas' Dealey Plaza, but the odds seemed to crumble rapidly under prolonged questioning.

(*The Washington Post*, Lardner, 1978, September 12)

What is a *50–50 chance* [of an earthquake] anyway? Often it means nothing more than either something will happen or it won't. It should go without saying that either everything will happen or it won't, whether the chance is 50–50 or 1 in 3 million. I say the odds against an earthquake on Monday are overwhelmingly good.

(*The Washington Post*, Mitchell, 1990, November 30)

The American competitors [in pole vaulting] include defending champion Dan Ripley, indoor record holder at 18-3 3/4. "I have a *50–50 chance* of 18 feet," said Ripley, who won here last year at 18-1 1/4. "In the vault you can't say, you'll do it. It's too up in the air (pause for laughter). If you make 18 feet, the record would only be four inches higher. That's not much higher."

(*The Washington Post*, Fachet, 1977, January 14)

Saying that he didn't want to be in the salary bargain basement if he continued with the Redskins, John Riggins declared last night that he would return to the team only if given a significant future pay raise. . . . "I'd say it's a *50–50 chance* that I'll retire," said Riggins, who earns $300,000 a year. "I just think there is time left. Anything can happen. I'm not setting any limits. A lot depends on what kind of feedback I get."

(*The Washington Post*, Attner, 1980, August 6)

"There is a *50–50 chance* that this is the Titanic," said millionaire oilman Jack Grimm of Abilene, Tex., who financed the $1 million expedition to locate the wreck.

(*The Washington Post*, Omang, 1980, August 17)

As the jury selection process dragged on today, the prosecutor in the Susan Smith murder trial said he would be willing to let the presiding judge determine her fate if she pleaded guilty to drowning her two sons. But that deal would offer Mrs. Smith only a *50–50 chance* of avoiding the electric chair, legal experts said, and she would have much better odds of escaping the death penalty if she took her chances with a jury of 12. In the sentencing phase of capital murder trials in South Carolina, the jury's recommendation for death must be unanimous. She needs only one reluctant juror to save her life.

(*The New York Times*, Bragg, 1995, July 14)

Note. In each quote, italics have been added to the phrase "50–50 chance."

probabilities. In fact, they actually discriminate better among numerical communications than among equivalent verbal probability expressions (Behn & Vaupel, 1982; Biehl & Halpern-Felsher, 1999; von Winterfeldt & Edwards, 1986). Because numbers provide a more precise mode of risk communication, people prefer to receive numerical probabilities—at the same time as they like to use verbal terms for communicating their own uncertainty (Erev & Cohen, 1990). Epistemic uncertainty may exacerbate a general preference for inherently ambiguous verbal probability expressions. When risks are unfamiliar, choosing a precise probability can be difficult or even impossible. Requiring specific numerical probability judgments forces individuals who experience epistemic uncertainty to make statements for which they lack evidence. This would violate the rules of conversation, as those apply to experiments (e.g., Schwarz, 1996). Alternatively, saying “50” (as a proxy for “fifty–fifty”) seems sufficiently vague to express these feelings, while still fulfilling the request for a number (Teigen, 1988).

When respondents say “50” without intending its numerical interpretation, their beliefs can be misunderstood. In the studies of risk perception cited above, “fifty–fifty” answers may have artifactually inflated respondents’ aggregate estimates of the events’ small probabilities. The high estimates of smoking risks have been taken seriously enough to be used in U.S. tobacco litigation. Defendants have claimed that these responses show people overestimating these probabilities, even without the information about adverse health effects that tobacco companies were charged with hiding. Similar claims about the accuracy of lay risk judgments are commonly invoked in other political and legal debates (Breyer, 1993; National Research Council, 1989, 1996, 1999). Probability judgments play, of course, a central role in decision analyses (von Winterfeldt & Edwards, 1986). As a result, understanding the meaning of “50” has practical as well as theoretical implications.

Presenting a probability scale with a full set of numerical responses reduces the use of “50,” compared to open-ended response modes requiring respondents to fill in a blank with a probability (Bruine de Bruin, 1998; Fischhoff & Bruine de Bruin, 1999). Explicit scales may both remind respondents of their “obligation” to give a numerical response and provide a relatively easy way of doing so.

The study reported here further examines the conditions affecting the use of “50” as an expression of people’s verbal or numerical thinking about uncertain events. To that end, we manipulate response mode. We also take advantage of natural differences in the perceptions of control evoked by risky events and individual differences in numeracy, education, and age.

The response mode manipulation varies whether events are described in singular terms (e.g., “Marcia jogs every day. What is the probability that she will get a minor injury today while jogging?”) or distributional ones (e.g., “Think of all the people in the United States who jog every day. What percentage will get a minor injury today while jogging?”). According to Kahneman and Tversky (1982b), singular probability questions emphasize features specific to the individual case. Drawing such distinctions requires producing verbal reasons for the event happening (e.g., she might not warm up properly) or not (e.g., she knows her route well enough to avoid ditches.) The probability answer, then, reflects the relative strength of those reasons (Tversky & Koehler, 1994). Conversely, distributional probability questions evoke a more numerical, analytic, and deliberate judgment process (Kahneman & Tversky, 1982a, 1982b; Reeves & Lockhart, 1993; Sloman, 1996; Tversky & Koehler, 1994). Because singular questions evoke a more verbal process (than do distributional ones) we hypothesized that they would make verbal probability expressions, like "fifty–fifty chance," more accessible. Unlike most verbal probability terms, this phrase has a readily available numerical translation (i.e., "50"). Hence, we expect singular probability questions to elicit more "50" responses. To test this hypothesis, respondents in the distributional condition estimated the "percentage" of individuals in a population who would experience a risk, whereas respondents in the singular condition assessed a "chance." Thus, the distributional version further encouraged a numerical approach, the calculation of relative frequencies, by asking for a "percentage" (Fiedler, 1988).

One other likely determinant of epistemic uncertainty is individuals' perceived control over their environment. Without feelings of mastery, people suffer from stress and helplessness, even depression (e.g., Langer, 1977). Hence, when probability questions ask about events perceived as relatively uncontrollable, respondents might be less willing, or able, to dwell on the topic or to tempt fate by making an explicit prediction. Indeed, studies in survey design have suggested that question threat affects the rate of nonresponses, including "don't know" answers (Bradburn et al., 1979). If respondents experience unresolved epistemic uncertainty, then saying "50" (as a proxy for "fifty–fifty") would offer a similar—relatively quick and effortless—"escape."

Individual differences in numeracy have been found to predict performance on risk-judgment tasks (Black et al., 1995; Schwartz, Woloshin, Black, & Welch, 1997). Therefore, we hypothesized that less numerate respondents would find probability questions more difficult, thereby increasing their feelings of epistemic uncertainty and tendency to think in verbal terms. As a result, respondents with a limited understanding of probabilities should be more likely to use "50" as a shorthand for the verbal phrase "fifty–fifty." In order to test this hypothesis, we included a direct measure of numeracy and two natural predictors (or confounds) of numeracy—age and education.

The data reported here involved respondents with a wide range of educational backgrounds. We predicted that among adults, those with greater education and, hence, more opportunity to learn about probabilities (and other mathematical topics) would be less likely to use verbal probability expressions and say "fifty–fifty." Making a prediction with regard to age was less obvious. Historically, research in developmental psychology found that young children have difficulty recognizing the chance character of events (Piaget & Inhelder, 1975). Only by age 12 or so do children calculate proportions when making probability judgments. If so, then older children should rely less on verbal phrases like "fifty–fifty chance" than younger ones do. Adults, with mature cognitive skills and more experience with probabilities, should use even fewer 50s. More recent research in developmental psychology has found, however, that children perform some probability tasks better than adults do (Davidson, 1995; Jacobs & Potenza, 1991). These studies indicate that exposure to Western culture and education (e.g., Sharp, Cole, & Lave, 1979), as well as growing cognitive skills, may increase the use of judgmental heuristics with age. If so, then children, who have not yet learned the meaning of the phrase "fifty–fifty," should produce fewer 50s. These contradicting views are tested in this article.

In sum, we hypothesized that conditions encouraging verbal expressions of probability and feelings of epistemic uncertainty will increase the use of "50." Thus, more "50" responses should be observed with (a) singular (vs distributional) question formats, (b) events judged to be less controllable, (c) less (vs more) numerate respondents, and (d) less (vs more) educated respondents. Regarding the effects of age per se, we had conflicting predictions.

METHOD

Participants

Young individuals were drawn from a survey conducted with 433 fifth, seventh, and ninth graders recruited from schools in northern California. For each respondent, parental consent was obtained. The sample included 62 girls and 63 boys from the fifth grade, 74 girls and 74 boys from the seventh grade, and 96 girls and 64 boys from the ninth grade. Average ages were 10.8 (SD = .44), 12.7 (SD = .46), and 14.8 (SD = .42) for the fifth, seventh, and ninth graders, respectively. The questions were also answered by 144 adults, 54 men and 90 women, recruited from several sources, including one of the school districts, a medical school, a professional psychology school, and a 4-year college. The average age of these adults was 25.0 (SD = 2.3). Sixteen adults had a high school diploma, 2 had finished vocational school, 100 were college graduates, 25 had a professional or a graduate degree, and 1 adult did not provide her education. Children and adults received $10 and $15 for their participation, respectively. In addition, snacks were served during the survey sessions.

Measures and Procedure

Respondents completed a written risk perception survey with open-ended probability questions covering a variety of events. Because the data were collected for different purposes, the survey's principal investigators (Susan Millstein and Bonnie Halpern-Felsher) were, at the time, blind to the hypotheses evaluated in this article. The within-subjects design repeated subsets of questions in different parts of the survey, asking for the probability of 16 events occurring to respondents themselves, 19 to a hypothetical person, and 7 to members of a population (i.e., "all the people in the United States"). Table 2 shows the events appearing in each of the three sections. Comparisons across conditions were restricted to events appearing in each format.

The instructions asked respondents to consider each question separately, even if its topic had appeared before, hoping to elicit judgments that were as independent as possible. Respondents rated how much control they saw themselves having over 13 of the events, using a 5-point scale anchored at 1 = no control at all and 5 = total control (see Table 2). Finally, numeracy was assessed with six questions, asking which of two people, showing different

TABLE 2

Questions Asked about Events Used in the Risk Perception Survey

	Probability of event happening to			
Event	Respondents themselves	Hypothetical person (Singular)	Population (Distributional)	Perceived control
Minor injury from jogging	X	X	X	X
Dying from heart attack	—	X	—	—
Dying from lung cancer	—	X	—	—
Getting STD from sex without condom once[a]	X	X	X	X
Getting HIV from sex without condom once[a]	X	X	—	X
Getting pregnant from sex without birth control once[a]	X	X	X	X
Dying if in earthquake	X	X	X	X
Dying if in tornado	X	X	X	X
Dying if in hurricane	X	X	X	X
Dying if in lightning storm	X	X	X	X
Getting STD from sex without condom 6 times[a]	—	X	—	—
Getting STD from sex without condom once[a]	—	X	—	—
Getting STD from sex without condom with 6 partners[b]	—	X	—	—
Getting STD from sex without condom with 8 partners[b]	—	X	—	—
Smoker dying from heart attack	—	X	—	—
Smoker dying from lung cancer	—	X	—	—
Not winning raffle (1 of 100 tickets)	X	X	—	—
Winning raffle (1 of 100 tickets)	X	X	—	X
Not winning raffle (5 of 100 tickets)	—	X	—	—
Winning raffle (5 of 100 tickets)	—	X	—	—
Drinking whiskey and throwing up	X	—	—	X
Getting into accident driving drunk	X	—	—	X
Getting into accident with drunk driver (being a passenger)	X	—	—	X
Getting STD (partner has one)[a]	X	—	—	—
Getting HIV (partner has STD)[a]	X	—	—	—
Serious injury from jogging	X	—	—	X

[a] The fifth graders did not receive this question.
[b] The fifth and seventh graders did not receive this question.

frequencies of a given behavior, had the greater chance of experiencing a particular outcome (e.g., winning a raffle, getting into a drinking-and-driving accident). Respondents' answers were scored as correct (= 1) or incorrect (= 0), resulting in a numeracy score that could range from 0 to 6.[1]

RESULTS

Singular vs Distributional Event Descriptions

Seven questions were repeated in both a singular and a distributional format (Table 2). Figure 1 displays the percentage of 50s among the low-probability

[1] Six additional survey questions about winning a raffle—with stated relative frequencies—were intended as measures of numeracy. However, because these were phrased as probability questions (asking for the chance for respondents themselves and for a hypothetical person), we also examined

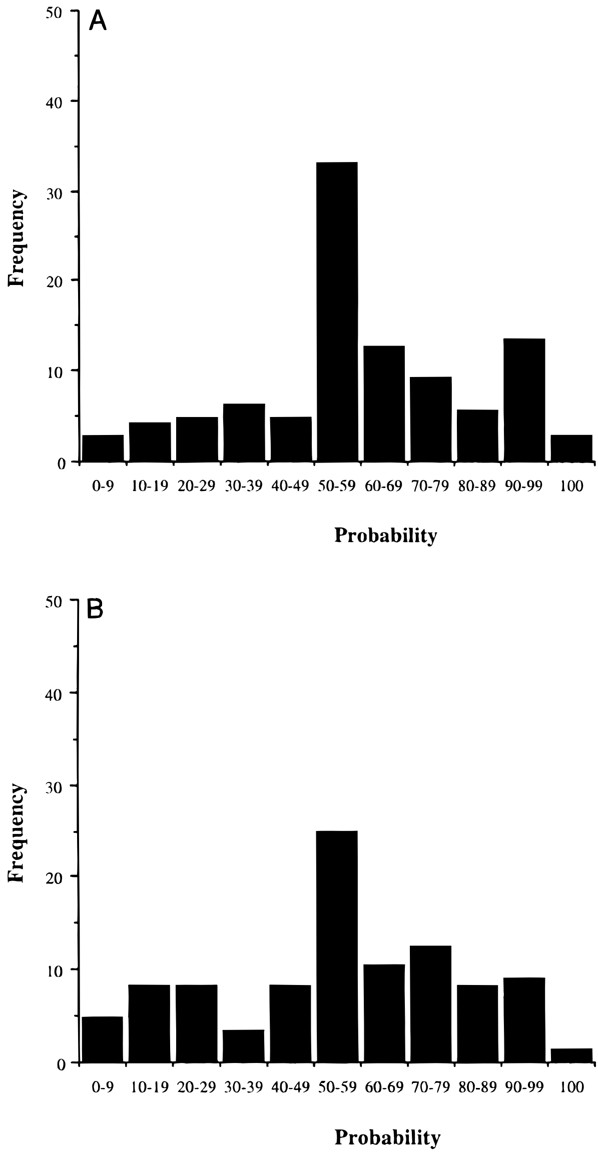
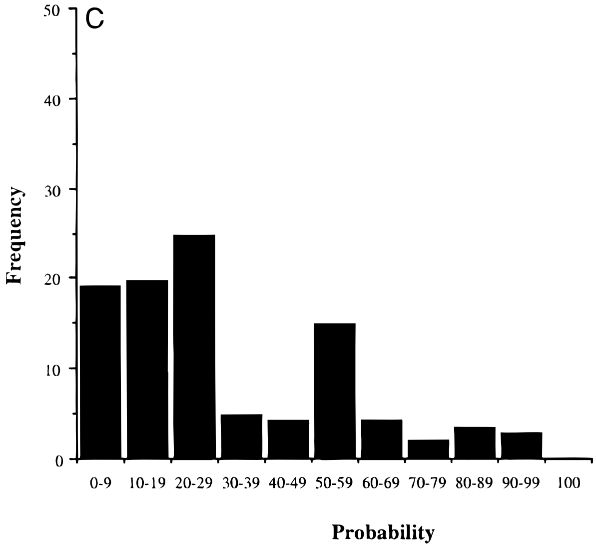


FIG. 1. Probabilities for getting pregnant from having sex without birth control once for the youngest group answering that question (i.e., seventh graders) in the singular (A) and the distributional conditions (B) and for adults in the singular (C) and distributional conditions (D). (*Note*. The grouping of responses into categories followed the convention in such studies. In the central categories, the percentage of 50s among responses in the 50–59 category was 91.5% in A, 83.3% in B, 100% in C, and 92.3% in D.)

whether they elicited "50." Although judged probabilities for these (unlikely) events were low, they still showed "50 blips."



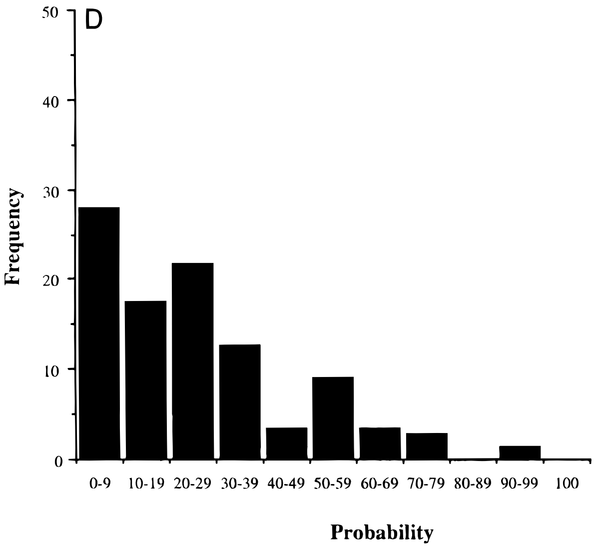


FIG. 1—*Continued*

responses for one of these questions, "getting pregnant from having sex without birth control once," as assessed by the youngest and oldest groups of respondents who answered both the singular and the distributional version of that question (i.e., seventh graders and adults).[2] As expected, more 50s were observed with the singular than with the distributional questions. The same was true for the other events, except for "dying if in a lightning storm," which showed no difference, and "minor injury from jogging," which had a significant difference in the opposite direction. The first two columns of Table 3 show the

[2] Most responses were multiples of 10. As a result, shifting the intervals to be centered at, for example, the multiples of 10 would have little effect on the overall pattern.

TABLE 3

Use of "50" Given in Response to Singular and Distributional Questions

Event	Use of "50"			Excess 50s (determined by beta function)	
	Singular	Distributional	McNemar χ^2 (2)	Singular	Distributional
Minor injury from jogging	8.3%	12.2%	5.38*	5.8%	7.5%
Dying if in lightning storm	3.5	3.2	—[b]	1.2	1.3
Dying if in earthquake	9.7	5.1	10.08**	5.3	1.3
Dying if in hurricane	8.6	5.1	5.64*	5.4	0.7
Dying if in tornado	9.6	5.7	7.22**	5.5	1.2
Average of five nonsex questions	7.9	6.2	−2.51*,[c]	4.6	2.4
Getting an STD from sex without a condom once[a]	18.6	13.7	4.60*	11.6	6.6
Getting pregnant from sex without birth control once[a]	20.5	16.0	3.48+	12.5	9.2
Average of two sex questions	19.5	14.8	−2.60**,[c]	12.05	7.9

[a] The fifth graders did not receive this question.
[b] Because there were not enough observations to fill each cell of the McNemar chi-square, a binomial test was used.
[c] A Wilcoxon test, comparing the number of 50s each respondent used in each condition, produced this z statistic.
+ $p < .10$.
* $p < .05$.
** $p < .01$.

number of 50s used with the singular and the distributional versions of each question, pooling respondents of all ages. The third column presents the results of McNemar tests for within-subject comparisons of dichotomous variables (i.e., whether respondents used "50" for each question). A Wilcoxon test, comparing the overall proportion of "50," confirmed this pattern of responses in the set as a whole ($z = -2.51$, $p < .05$, for the five nonsex questions; $z = -2.60$, $p < .01$, for the two sex questions; both tests pooling all age groups).

Even though the probabilities in the two conditions are logically the same, respondents also gave higher mean probabilities for the singular than for the distributional version of each question ($z = -10.27$, $p < .001$, for minor injury from jogging; $z = -7.60$, $p < .001$, for dying if in a lightning storm; $z = -6.49$, $p < .001$, for dying if in an earthquake; $z = -10.92$, $p < .001$ for dying if in a hurricane; $z = -12.09$, $p < .001$, for dying if in a tornado; $z = -6.40$, $p < .001$, for getting an STD; $z = -2.33$, $p < .05$, for getting pregnant). For low-probability events, higher probability judgments shift the distribution toward the center of the scale. That shift—rather than the increased accessibility of the phrase "fifty–fifty" with singular questions—could have accounted for some of the increased frequency of "50." Visual inspection of most distributions (e.g., Fig. 1) clearly shows a "50 blip" in the singular condition, suggesting inappropriate use of "50" by at least some respondents. In order to separate the increased

TABLE 4

Within-Subject Kendall's Correlations (τ) between Use of "50" and Ratings of Perceived Control

Event description	Mean	*SD*	Sign test (*z*)
Respondents themselves	−.36	.44	8.25***
Hypothetical person	−.23	.44	6.09***
Population	−.22	.35	8.47***

Note. Use of "50" was coded as 1, otherwise, 0. Perceived control ranged from 1 (no control at all) to 5 (total control).
*** $p < .001$.

use of "50" from the effects of shifting distributions, we created an operational definition of "50 blip" relative to the full response set. Specifically, we fit a beta function to each distribution and subtracted the expected proportion of responses in the 50–59 category (based on the distribution as a whole) from the proportion actually observed (Bruine de Bruin, 1998; Bruine de Bruin, Fischbeck, Stiber, & Fischhoff, 1999).[3] Thus, this measure gives a rough indication of the number of excess 50s—over and above those expected in the best-fit distribution. The two right-hand columns of Table 3 show that there were more excess "50" responses with the singular versions of the questions than with the distributional ones except for one event, minor injury while jogging.

Perceived Control

Kendall's nonparametric correlation (τ) was calculated for each individual, across items, between ratings of controllability, and whether they said "50." The means of these within-subject correlations were negative, indicating that respondents were more likely to say "50" when they perceived less control (Table 4). We also calculated Kendall's τ for each question across individuals. Significant within-question correlations were found for dying if in a lightning storm ($\tau = -.11$, $p < .01$, for respondents themselves; $\tau = -.08$, $p < .05$, for a hypothetical person; $\tau = -.08$, $p < .05$, for the population), dying if in an earthquake ($\tau = -.08$, $p < .05$, for respondents themselves; $\tau = -.08$, $p < .05$, for a hypothetical person), getting a minor injury while jogging ($\tau = -.09$, $p < .05$, for respondents themselves), and getting an STD ($\tau = -.10$, $p < .05$, for respondents themselves). A significant positive correlation emerged for

[3] Although other distributions might have been used, beta functions are often recommended for estimating proportions (Law & Kelton, 1982). The procedure calculates the expected percentage of observations in a category based on the shape of the distribution. For the beta correction used here, all excess observations from the 50–59 category were interpreted as 50s. The overall fit of the beta distribution to the observed data was relatively good (Bruine de Bruin, 1998; Bruine de Bruin et al., 1999). Other functions, with an equally good fit, should show similar patterns regarding the contrast in the use of "50" between the singular and distributional conditions.

TABLE 5

Mean Percentage of 50s by Adults' Educational Level

Event description	No college degree (n = 18)	College graduate (n = 100)	Professional or graduate degree (n = 25)	Kruskal–Wallis χ^2 (2)
Respondents themselves	10.96	5.86	4.80	5.67†
Hypothetical person	11.40	5.06	6.00	6.91*
Population in general	9.52	2.02	3.43	10.31**

† $p < .10$.
* $p < .05$.
** $p < .01$.

the one positive event—winning a raffle ($\tau = .11$, $p < .001$, for respondents themselves; $\tau = .16$, $p < .001$, for a hypothetical person).

Numeracy

Across groups, numeracy was positively correlated with age ($r = .27$, $p < .001$) and education ($r = .26$, $p < .001$).[4] Partial correlations, controlling for age and education, showed a significant negative relationship between numeracy score and use of "50" for respondents themselves, a hypothetical person, and the population ($r = -.14$, $p < .001$; $r = -.25$, $p < .001$; $r = -.22$, $p < .001$).

Education

Table 5 shows the use of "50" as a function of adult educational level. We pooled adult respondents into the 18 without a college degree, the 100 with one, and the 25 with a professional degree. Education reduced the number of "50" responses. Adults without a college education were most likely to employ 50s.

Children vs Adults

Because the two sex questions were not given to the fifth graders (Table 2), analyses for age differences in the use of "50" with sex and nonsex questions were conducted separately. Significant differences among age groups were found for the nonsex questions, with older respondents providing fewer 50s ($\chi^2(3) = 19.15$, $p < .001$, for themselves; $\chi^2(3) = 27.20$, $p < .001$, for a hypothetical person; $\chi^2(3) = 51.81$, $p < .001$, for the population). Comparing seventh graders, ninth graders, and adults on the sex questions also showed fewer 50s for older respondents, whether judging probabilities for themselves ($\chi^2(3) = 12.25$, $p < .01$), for a hypothetical person ($\chi^2(3) = 29.31$, $p < .001$), or for the

[4] All adults were assigned a grade level of 25.

population ($\chi^2(3) = 14.44$, $p < .01$). Four additional sex questions about a hypothetical person were presented only to ninth graders and adults (Table 2)—they showed no significant difference in the proportion of 50s.

We created a difference measure by subtracting each respondent's use of "50" in the singular condition (asking about risks to a hypothetical person) from that in the distributional condition (asking about risks as a percentage in a population). No significant group differences were found, indicating that each group used "50" more frequently in the singular than in the distributional condition and did so to the same degree.

DISCUSSION

Respondents were more likely to use "50" when approaching probabilities in the singular mode, consistent with the hypothesis that singular questions prompt a verbal reasoning process (Kahneman & Tversky, 1982b), priming phrases such as "fifty–fifty." Conversely, the numerical cues provided by distributional questions may draw attention away from verbal responses and sharpen respondents' thinking. Distributional questions have been found to focus attention on population statistics because they represent multiple outcomes that are not apparent in the singular case. As a result, they elicit lower estimates (Tversky & Koehler, 1994).

Whereas a verbal approach may hamper respondents' ability to think about numerical probabilities, feelings of epistemic uncertainty may decrease respondents' willingness to do so. In this study, respondents more frequently assigned 50s to events with lower perceived control. This would be consistent with using "50" as an "escape" strategy in order to avoid contemplating negative and uncontrollable events. We found significant negative relationships with the within-subject correlations between perceived control and use of "50" and with three of the within-question correlations. The correlation for one positive event, winning a raffle, showed the opposite sign. However, given the large number of tests and generally weak correlations, these question-level results should be treated as suggestive.

Use of "50" also decreased with properties of individuals that should make them more adept at using probabilities: age, education, and numeracy. Reduced use of 50s among adults supports theories that predict better performance with age (e.g., Piaget & Inhelder, 1975). Thus, children may learn the numerical interpretation of "fifty–fifty" only *after* using it as an expression of epistemic uncertainty.

Age, education, and numeracy are, of course, correlated with one another. Partial correlations, however, revealed that numeracy showed a negative relationship with "50" usage, independent of age and education. Thus, although older, more educated, respondents should have had more opportunity to learn about probabilities, there was enough variation among them to show a separate relationship between numeracy and use of "50." Even experts with advanced college degrees in engineering have been found to produce "50 blips" when answering open-ended probability questions within their own field (Bruine de Bruin, 1998; Bruine de Bruin et al., 1999).

Changes in the proportions of 50s are naturally confounded with shifts in the overall probability distribution. Examination of the singular distributions almost always revealed an apparent excess of 50s, wherever they were centered. In order to formalize this impression, we applied a beta correction technique. It showed that, relative to the entire response distribution, there was a greater excess of 50s with the singular than with the distributional questions. Interestingly, even questions with explicit relative frequencies (e.g., winning a raffle with 1 or 5 tickets of 100) still elicited blips at "50." This suggests that respondents may have approached these questions as word rather than as math problems.

In sum, the excess of "50" responses increases with singular probability questions and less controllable events as well as with younger individuals and those having less education. Fischhoff and Bruine de Bruin (1999) also found greater use of "50" with open-ended response modes than with explicitly numerical ones. Although one cannot change respondents' age and education, one might increase numerical thinking (and reduce verbal thinking) by (a) phrasing probability questions in distributional (rather than singular) terms[5] (Kahneman & Tversky, 1982a) and (b) providing an explicit numerical probability scale (rather than using open-ended probability questions).

However, doing so might come at the price of suppressing respondents' natural way of thinking (Windschitl & Wells, 1996). If individuals have difficulty resolving their epistemic uncertainty or thinking about probability questions, one might want to know that rather than force a resolution. In such cases, "fifty–fifty" may reflect how respondents are actually thinking about the events in question, thus providing a window into qualitative aspects of their beliefs. This would account for the blips of excess 50s observed even with some distributional questions (e.g., Figs, 1B and 1D), some items using explicit numeric responses, and some highly educated individuals (Bruine de Bruin, 1998).

One limitation to these data is that we have not directly shown that the verbal phrase "fifty–fifty" is responsible for respondents saying "50." Rather, we have provided evidence that conditions encouraging epistemic uncertainty and verbal thinking increase the (excessive) use of "50." These effects emerge, with statistical significance, even though the rate of 50s is relatively small—averaging, as in previous studies (Bruine de Bruin, 1998; Fischhoff & Bruine de Bruin, 1999), around 10% of responses to all questions.

Of course, not all feelings of epistemic uncertainty need emerge as "50." People may also use "fifty–fifty" as an anchor for their estimation process. Then, they could make an adjustment from that starting point, depending on whatever beliefs they have (beyond their initial feelings of not knowing what to say.) If the adjustment is insufficient (Tversky & Kahneman, 1974), then

[5] Some questions do not lend themselves to being described in the distributional mode. For example, people may think differently about probabilities for themselves and for, say, 100 people like themselves (Bruine de Bruin, 1998; Weinstein, 1980).

such an anchor would create a centering bias (Poulton, 1989). If this is the case, then the probability answer cannot be taken literally. Providing an easily accessible "don't know" option might reduce this bias (Bruine de Bruin, 1998; Fischhoff & Bruine de Bruin, 1999).

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Received April 29, 1999