Thinking the Unthinkable: The Effects of Anchoring on Likelihood Estimates of Nuclear War[1]

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"Anchoring" results from insufficient adjustment up or down from an original—often arbitrary—starting value. Six sets of surveys were designed to assess the effects of anchoring on subjective likelihood estimates of a nuclear war. Based on responses from 1600 students, results indicated that: (a) likelihood estimates were strongly susceptible to anchoring; (b) neither likelihood estimates nor the effects of anchoring were significantly influenced by the ease with which respondents could imagine a nuclear war (outcome availability), by instructions to list the most likely path to nuclear war (path availability), or by casting the problem in terms of the avoidance, rather than the occurrence, of nuclear war; (c) the effects of anchoring extended to estimates concerning the efficacy of strategic defenses; and (d) likelihood estimates were affected by anchoring even after correcting for social demand biases. In estimating the likelihood of nuclear war and otherwise attempting to "think the unthinkable," many students responded in a manner consistent with denial; the paper concludes with a discussion of these individuals.

In front of you is a wheel of fortune. The perimeter is lined with an array of numbers, and after the wheel is given a spin, the needle lands on "65." You are confronted with a question: Is the percentage of African countries in the United Nations greater or less than 65? This is not a matter that you have thought much about; nonetheless, you are fairly sure that the percentage is less than 65.

What, you are next asked, is the *exact* percentage of African countries in the United Nations? After some thought, you respond with an estimate of 45%. A researcher records your response, thanks you for your time, and off you go.

Now you are another person, a person who has not yet answered questions about the United Nations, a person for whom the wheel of fortune will land on "10" rather than "65." After the wheel has stopped moving, the researcher asks: Is the percentage of African countries in the United Nations greater or less than 10? Greater, you say—certainly it must be greater. What is the *exact* percentage of African countries in the United Nations?

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After some thought, you respond with an estimate of 25%.

In fact, just such a procedure, yielding identical results, was conducted by Tversky and Kahneman (1974). Subjects who were randomly assigned to an experimental condition in which the needle landed on "65" subsequently gave a median estimate of 45%, whereas subjects for whom the needle landed on "10" gave a median estimate of 25%. Tversky and Kahneman called this phenomenon "anchoring" and explained it as the insufficient adjustment up or down from an orginal starting value, even at times an obviously arbitrary starting value.

Since 1974, the effects of anchoring have been documented in a variety of areas, ranging from estimates of the percentage of working mothers with children under five, to the proportion of Iranians who are Islamic, to the percentage of chemistry professors who are women, or even to the share of soap operas carried by NBC (Quattrone, Lawrence, Warren, Souza-Silva, Finkel, & Andrus, 1984). Nor is anchoring restricted to impersonal, numerical domains (Quattrone, 1982). For example, Quattrone et al. (1984) have shown that randomly assigned anchors, in the form of pro- or counter-attitudinal essays, can affect opinions about the SALT II Treaty. In exploring the link between anchoring and behavior change, Cervone and Peake (1986) have also demonstrated that arbitrary anchors can influence people's estimates of their personal efficacy, an estimate which in turn affects how persistent subjects are in performing various tasks.

Surprisingly, the effects of anchoring do not disappear with monetary incentives for accuracy (Tversky and Kahneman, 1974) or with outrageously extreme anchors (Quattrone et al., 1984). In one experiment, Quattrone et al. (1984) solicited point estimates (exact numerical estimates) after first asking subjects questions such as whether the number of Beatles records that had made the top ten fell above or below 100,025, whether the average price of a college textbook was more or less than $7128.53, or whether the average temperature in San Francisco was greater or less than 558 degrees Fahrenheit. Quattrone et al. found that instead of disregarding these high anchor values, subjects were anchored upward as much as when the high anchor value was more plausible. From this result, they concluded that anchoring is a robust phenomenon in which the magnitude of the effect grows with the discrepancy between the anchor and the "preanchor estimate" (the average estimate subjects make without explicit anchors), until the effect reaches an asymptotic level. If true, these findings are rich with implications for marketing, negotiation, survey research, and a number of other fields.

Unfortunately, most studies of anchoring have tended to focus on issues with which people have little familiarity or concern: the percentage of African nations in the United Nations, soap operas carried by NBC, female chemistry professors, and so forth. It is unclear whether estimates can be anchored

when people care deeply about the topic, when they have previously thought about the issue, or when they know the area fairly well. Perhaps the most extreme example of such an issue is the likelihood of nuclear war. In contrast to other topics in the anchoring literature, most people are very concerned about the likelihood of nuclear war and most have already thought and read about the subject. The question is, then, whether a manipulation as simple as providing a high or low anchor value can affect beliefs about whether there will be a nuclear war. To answer this question, six sets of surveys were distributed to more than 2,000 students between January, 1985, and May, 1987.

Survey 1:
Anchoring and the Likelihood of Nuclear War

Introduction and Method

Since nuclear weapons were first invented, the way that most researchers have assessed subjective likelihood estimates of a nuclear war has been to ask people whether, in a given time period, nuclear war is very likely, fairly likely, fairly unlikely, or very unlikely (e.g., see The Gallup Poll, 1984, January/February; Public Agenda Foundation, 1984; WAND Education Fund, 1986). However, in 1982, Gallup International conducted a multinational poll that presented respondents with a scale from 0 to 100 by increments of 10, asking individuals to choose the number that best represented the probability of world war breaking out within the following 10 years (World Opinion Update, 1983). The mean average for respondents from the United States was more than 40%, with a modal response of 50% and the suggestion of a bimodal distribution with a sizable number of respondents (11%) choosing zero.

Because the range of opinion extended from 0% to 100%, a low anchor of 1% and a high anchor of 90% were used in the present survey. Thus, the questionnaire asked respondents whether the chances of nuclear war between the United States and the Soviet Union were greater or less than 1% in the low-anchor condition, and greater or less than 90% in the high-anchor condition.[3] Once respondents had answered this question, they were asked to give their best estimate, in percentage terms, of the *exact* chances of a nuclear war. In a third, "no-anchor" condition, respondents were never presented with the first question and were simply asked to give their best point estimates.

The three variations of the survey—low-anchor (1%), no-anchor, and high-

[3]In contrast to most experimental studies of anchoring, in which anchor values appear to be selected arbitrarily or randomly, the anchor values used in this study may have been implicitly interpreted by respondents as plausible or commonly held likelihood estimates. Survey 6 examines the effects of anchoring when the anchor value is qualified by normative or expert dissent.

anchor (90%)—were randomly embedded within larger packets of surveys distributed to Stanford undergraduates enrolled in Introductory Psychology during January, 1985. One hundred eighty-five students, constituting a final return rate of approximately 70%, completed the questionnaire. The choice of high and low anchors, the population of respondents, the method of distribution, and the rate of return did not vary appreciably among the six sets of surveys described in this report; consequently, further discussion of these factors is omitted. Suffice it to say, though, that the 30% failure to return survey packets can be attributed to a number of factors beyond the present questionnaire, and very few students completed other surveys in the packet while ignoring the one on nuclear issues.

Results and Discussion

As shown in Table 1, likelihood estimates of a nuclear war were more than twice as high in the no-anchor and high-anchor groups as in the low-anchor group. Respondents who first were asked whether the chances of a nuclear war were greater or less than 1% subsequently averaged 9.1% in their own estimates. When asked whether the chances of a nuclear war were greater or less than 90%, however, students in the high-anchor condition averaged estimates of 20.7%, and respondents who were never provided with an anchor one way or another averaged 18.6%.[4] After transforming the percentage estimates to logarithms in order to stabilize the variances,[5] an *a priori* linear contrast among the three groups indicated significant differences, $F(1,176) = 8.67, p < .004$. Likelihood estimates of a nuclear war were indeed susceptible to anchoring.

Two other results are worth mentioning, not because of their relation to anchoring, but because they appeared throughout the six surveys and are interesting in their own right. First, the distribution of probability estimates was not entirely bell-shaped; small increases in frequency were apparent above likelihood estimates of 50% and below likelihood estimates of 1%.[6]

[4]Stanford students consistently set the chances of nuclear war far below the national average for Americans over the age of 18, a result also found by Yankelovich, Skelly, and White in their Fall, 1985, survey of 3,600 Stanford and Harvard alumni (Skelly, 1986). Thus, because a restricted range of estimates makes significant between-group differences less likely, the effects of anchoring are probably even greater among members of the general public than the effects reported here.

[5]Because some respondents estimated that the probability of nuclear war was literally zero, the transformation actually added one-hundredth of a percent to all estimates before computing logarithms, so as to avoid taking the logarithm of zero. Throughout all six sets of surveys, inferential tests concerning probability estimates were conducted on this logarithmic transformation of the raw data.

[6]As a precaution, Mann-Whitney and Kruskal-Wallis nonparametric tests were conducted, but they did not significantly alter any findings based on parametric tests.

Table 1

Subjective Likelihood Estimates of Nuclear War by Survey and Condition (in Percentages)

	Low anchor	No anchor	High anchor	Significance*
Survey 1	9.1	18.6	20.7	
($N = 185$)	(58)	(64)	(63)	$p < .004$
Survey 2	13.3	22.6	28.2	
($N = 565$)	(184)	(194)	(187)	$p < .001$
Survey 3	7.7	17.4	27.6	
($N = 165$)	(54)	(56)	(55)	$p < .001$
Survey 4	6.4	16.3	27.1	
($N = 201$)	(70)	(71)	(60)	$p < .001$
Survey 5	8.4	16.5	23.8	
($N = 115$)	(36)	(44)	(35)	$p < .007$
Survey 6	12.4	13.6	22.7	
($N = 243$)	(111)	(45)	(87)	$p < .002$
Total	10.8	19.1	25.7	
($N = 1474$)	(513)	(474)	(487)	$p < .001$

*All statistical significance levels are based on *a priori* linear contrasts using logarithmic transformations of percentage estimates.

Rather than perceiving nuclear war as possible but improbable, these respondents seemed to indicate either that nuclear war was *probable* or that it was *impossible*. Second, as shown in Table 2, women were far more pessimistic about the likelihood of nuclear war than were men.[7] Across all three anchor conditions, women set the odds of nuclear war significantly higher than did men, $M = 22.3\%$ versus $M = 11.0\%$, $t(183) = 3.27, p < .002$. This finding is consistent with patterns observed by several other researchers (cf. The Gallup Poll, 1983, December; The Gallup Poll, 1984, January/February; Miller, 1982, May 30; Nelson & Slem, 1985; Newcomb, 1986; Polyson, Stein, & Sholley, 1986).

[7]This difference is not attributable to anchoring. In none of the six sets of surveys did the ratio of male and female respondents significantly differ by experimental condition.

Survey 2:
Anchoring, Availability, and the Likelihood of Nuclear War

Introduction and Method

The results from the first set of surveys came as something of a surprise. After all, students were estimating the probability that they would die within the next 10 years, a conviction that most people would not regard as easily changed. Was it possible that the students, in general, did not think about nuclear war any more than they thought about the percentage of African nations in the United Nations, that they were unsure of their estimates, that they did not know about nuclear issues or did not regard nuclear disarmament as an important issue? Was it possible that they did not perceive a nuclear war as being more destructive than other wars or that they believed a nuclear war was personally survivable?

A second set of surveys was developed, in part to investigate these questions (see the Appendix for a list of questions and their exact wording), in part to replicate the anchoring effect found in the first survey, and in part to investigate whether "availability" might influence subjective likelihood estimates of a nuclear war. In 1973, Tversky and Kahneman defined "availability" as the estimation of frequency or probability by the ease with which instances or associations can be brought to mind. According to the theory of availability, the easier it is to bring instances or associations to mind, the higher their judged frequency or probability will be. For example, Carroll (1978) and Gregory, Cialdini, and Carpenter (1982) have shown that merely imagining a scenario, whether pleasant or unpleasant, is enough to increase subjective probability estimates that the scenario will occur, apart from demand characteristics or other factors.

The question remains, however, as to what the effect would be of imagining a catastropic event. It is possible that vividly imagining a nuclear war, while increasing availability, is sufficiently aversive to elicit some form of denial, thereby either canceling the presumed effect of heightened availability or actually reducing probability estimates. This process may have occurred when *The Day After*, a graphic movie portraying the effects of nuclear war, was broadcast on television; opinion polls immediately preceding and following the presentation revealed no significant differences in likelihood estimates of a nuclear war (cf. Kelly, 1983, December 5; World Opinion Update, 1984). To assess the effects of availability on probability estimates of nuclear war, one third of the second set of survey forms (the imagine-war conditions) was prefaced with the following: "Please take a few moments right now and imagine as vividly as possible what an all-out nuclear war would be like. Once you have created as vivid an image as you can, please go on to answer the following questions." Primarily as a control for the inclusion of imagery instructions, another third of the surveys (the imagine-peace conditions) substituted "what life would be like *without* the threat of an all-out nuclear war" in place of "what an all-out nuclear war would be like," and the remaining surveys (the no-image conditions) simply excluded the preface. Immediately following the preface in the imagine-war and imagine-peace conditions, respondents were asked, as a direct self-estimate of availability, how easy it was for them to imagine an all-out nuclear war or a life free of nuclear war.[8]

In summary, the second survey contained 9 major variations: 3 anchoring categories (low-anchor, no-anchor, and high-anchor) × 3 availability categories (imagine-war, imagine-peace, and no-image). Using the same methodology that was employed in the first survey, randomly distributed variations of the second survey were completed by 565 undergraduate students in April, 1985.

Results and Discussion

Once again, anchoring exerted a strong influence on likelihood estimates of a nuclear war. In a direct replication of the first survey, planned linear contrasts showed that estimates by the 94 students who were not initially asked to imagine the occurrence or avoidance of a nuclear war (the no-image category of the availability factor) were significantly anchored, $F(1,91) = 11.65, p < .002$. The mean likelihood estimate in the low-anchor condition was 6.8%, in the no-anchor condition 19.7%, and in the high-anchor condition 23.5%. As shown in Table 1, the same result held true for the sample at large. Overall, probability estimates in the low-anchor conditions averaged 13.3%, in the no-anchor conditions 22.6%, and in the high-anchor conditions 28.2%, $F(1,562) = 35.40, p < .001$. These results strongly confirm the central findings of the first set of surveys.

Beyond its effect on probability estimates, anchoring influenced a number of other variables. Students who were exposed to a high anchor subsequently reported knowing less about nuclear issues than students in either the low-anchor or no-anchor conditions, $F(2,562) = 8.23, p < .001$. Because the high anchor (90%) deviated so drastically from average estimates when no anchor

[8]A third factor—either casting the survey in terms of a nuclear war occurring or in terms of a nuclear war being avoided—was also explored in the second set of surveys, but it did not influence subjective likelihood estimates or other dependent measures to any significant degree. All told, respondents who were asked to estimate the probability of a nuclear war occurring within 10 years averaged 20.3%, whereas respondents who were asked to estimate the probability of *avoiding* a nuclear war for 10 years averaged 77.4% (equivalent to a 22.6% estimate of nuclear war and not significantly different from the first group).

was provided (22.6%), respondents in the high-anchor conditions may have inferred a lack of knowledge on their part. *A priori* contrasts also revealed that, when compared with respondents for whom no anchor was provided, students in both the low-anchor and high-anchor conditions reported thinking less about nuclear war, $F(1,562) = 9.64, p < .003$, feeling less happy at the time of the ratings, $F(1,562) = 4.94$, $p < .03$, and, marginally, feeling less confident of their estimates, $F(1,562) = 2.85$, $p < .10$. These results demonstrate not only the ecological validity of using percentages to describe the threat of nuclear war, but that anchoring can significantly influence a constellation of attitudes beyond simple probability estimates.

There also is some evidence suggesting that the students had previously thought and read about nuclear war and that they took the issue quite seriously. First, most respondents indicated that, to them, nuclear disarmament was an extremely important political and social issue. Second, 87% of all respondents rated their personal chances of living through an all-out nuclear war as poor, a figure substantially higher than the 43 to 60% found in national Gallup polls between 1961 and 1982 (The Gallup Poll, 1981, June; Kramer, Kalick, & Milburn, 1983). Third, 50% of the students predicted that an all-out nuclear war would destroy civilization as we know it, 16% predicted that our species would be destroyed, and 26% predicted that all life would perish. Only 8% of the respondents believed either that nuclear war would be no worse than past wars or that nuclear war, while worse than past wars, would not signal the end of civilization. In no case (including subsequent surveys) did self-rated "nuclear knowledgeability," amount of time spent thinking about nuclear issues, importance of disarmament, or destructiveness of nuclear war correlate significantly with the degree to which probability estimates were anchored.[9] Thus, whatever familiarity or concern respondents had with the issue did not reduce the effects of anchoring.

In contrast to anchoring, the availability manipulation did not significantly affect subjective likelihood estimates of a nuclear war. Respondents who were asked to vividly imagine an all-out nuclear war averaged probability estimates of 20.5%, compared with 21.9% for respondents who imagined a world free from the nuclear threat, and 22.0% for respondents who were asked to imagine neither nuclear war nor its absence. As predicted by the theory of availability, the self-reported ease with which respondents reported generating an image of nuclear war was significantly associated with subjective

[9]Anchoring is often measured by subtracting preanchor estimates from responses made after the presentation of an anchor value. Because preanchor estimates were not solicited in the present experiment, anchoring was roughly approximated by the amount that likelihood estimates in the high-anchor conditions exceeded the mean likelihood estimate for respondents who were given no anchor, and the amount likelihood estimates in the low-anchor conditions fell below the no-anchor mean likelihood estimate.

probability estimates, $r(93) = .20$, $p < .03$, but the relationship was not strong enough to produce significant between-group differences in probability estimates. Also as predicted, no significant relationship was found in the imagine-peace control group between the ease with which the absence of nuclear war was "imagined" and subjective likelihood estimates of living for 10 years without a nuclear war, $r(92) = .10$, *n.s.* However, the factor of availability did have one highly significant effect: self-ratings of mood were considerably lower after imagining an all-out nuclear war than in the imagine-peace and no-image conditions, $F(2,562) = 14.18$, $p < .001$. Judging from their mood ratings, students were apparently able to create vivid images of nuclear war, but once generated, these images had little effect on subjective likelihood estimates.

Beyond anchoring, two incidental results from the previous set of surveys were replicated. First, the distribution of probability estimates showed increases in frequency at the tails. Although only 5% of the respondents estimated the chances of nuclear war between 30 and 40%, 8% set the odds between 40 and 50%, and 11% believed that a nuclear war was more than 50%

Table 2

Sex Differences in Subjective Likelihood Estimates of Nuclear War (in Percentages)

	Females	Males	Difference	Significance*
Survey 1 ($N = 185$)	22.3 (92)	11.0 (93)	11.3	$p < .002$
Survey 2 ($N = 565$)	27.4 (219)	17.7 (346)	9.7	$p < .001$
Survey 3 ($N = 163$)	19.1 (78)	16.0 (85)	3.1	$p < .04$
Survey 4 ($N = 201$)	19.3 (90)	13.2 (111)	6.1	$p = .26$
Survey 5 ($N = 115$)	21.8 (52)	11.5 (63)	10.3	$p < .02$
Survey 6 ($N = 242$)	19.5 (111)	13.7 (131)	5.8	$p < .001$
Total ($N = 1471$)	22.7 (642)	15.1 (829)	7.6	$p < .001$

*All statistical significance levels are based on *t*-tests using logarithmic transformations of percentage estimates.

Table 3

Confidence Ratings as a Function of Subjective Likelihood Estimates of Nuclear War

	Likelihood estimate ≤ 1%	Likelihood estimate ≥ 1%	Difference	Significance
Survey 2*	6.80**	5.50	1.30	
($N = 565$)	(129)	(436)		$p < .001$
Survey 3	5.48	5.20	0.28	
($N = 163$)	(33)	(130)		$p = .51$
Survey 4	6.22	4.80	1.42	
($N = 201$)	(49)	(152)		$p < .001$
Survey 5	7.39	4.54	2.85	
($N = 115$)	(28)	(87)		$p < .001$
Survey 6	7.29	5.46	1.83	
($N = 243$)	(45)	(198)		$p < .001$
Total	6.68	5.26	1.42	
($N = 1287$)	(284)	(1003)		$p < .001$

*Confidence ratings were not elicited in the first set of surveys. **All confidence ratings are based on an unlabeled 9-point scale (see Appendix).

likely. Even more extreme, almost one fourth of all respondents (23%) believed that the chances of a nuclear war were 1% or less. When compared with other respondents, these students were significantly more confident of their probability estimates, $t(563) = 5.85, p < .001$ (see Table 3), they reported thinking less about nuclear war, $t(563) = 2.84, p < .005$, and they considered nuclear disarmament to be less important, $t(563) = 3.93$, $p < .001$. This pattern of responses is consistent with the mechanism of denial, but because nuclear war presumably will happen either once or not at all, subjective likelihood estimates cannot constitute proof of denial. Additional evidence related to denial will be considered in discussing later surveys.

The second incidental finding replicated in the second set of surveys was that women viewed the probability of nuclear war as approximately 10% higher than did men, $M = 27.4\%$ for women and 17.7% for men, $t(563) = 4.68$, $p < .001$. In particular, men had a greater tendency than women to give likelihood estimates of 1% or less, $\chi^2(1) = 12.23, p < .001$, and consistent with past research (e.g., Plous & Zimbardo, 1984, November), men were more confident of their probability estimates, $t(563) = 5.89, p < .001$ (see Table 4), and reported knowing more about nuclear issues, $t(563) = 8.72, p < .001$. Of course, self-reports about knowledgeability are not the same as knowledgeability itself, and it is interesting to note in this regard that, for all their self-reported confidence and familiarity with nuclear matters, men did not report thinking about nuclear war more than did women, $t(563) = .63, p = .53$.

Survey 3: Anchoring and the Paths to War

Introduction and Method

Just as the effects of anchoring were surprising after the first set of surveys, the seeming unimportance of an availability manipulation was a surprise

Table 4

Sex Differences in Confidence of Subjective Likelihood Estimates of Nuclear War

	Females	Males	Difference	Significance
Survey 2*	5.11**	6.23	1.12	
($N = 565$)	(219)	(346)		$p < .001$
Survey 3	4.82	5.66	0.84	
($N = 163$)	(78)	(85)		$p < .02$
Survey 4	4.28	5.86	1.58	
($N = 201$)	(90)	(111)		$p < .001$
Survey 5	4.87	5.54	0.67	
($N = 115$)	(52)	(63)		$p = .18$
Survey 6	5.25	6.27	1.02	
($N = 243$)	(111)	(132)		$p < .001$
Total	4.94	6.06	1.12	
($N = 1287$)	(550)	(737)		$p < .001$

*Confidence ratings were not elicited in the first set of surveys. **All confidence ratings are based on an unlabeled 9-point scale (see Appendix).

after the second. However, some evidence suggests that imagery *per se* may not affect likelihood estimates as much as the reasons subjects generate for the outcomes they imagine (Ross, Lepper, & Hubbard, 1975; Ross, Lepper, Strack, & Steinmetz, 1977; Sherman, Skov, Hervitz, & Stock, 1981; Sherman, Zehner, Johnson, & Hirt, 1983). Once the paths that lead to an outcome are made available, according to such a theory, probability estimates for the event increase; put simply, it may be "path availability," rather than "outcome availability," which exerts the greatest influence over subjective likelihood estimates.

In part to assess the effects of path availability on likelihood estimates of nuclear war and in part to replicate certain new findings from the second set of surveys, a third group of surveys was distributed to Stanford students during October, 1985. Once again the standard three anchoring categories were used, but this time, half of the surveys (the scenario conditions) were prefaced with the following free-response question: "If an all-out nuclear war were to occur in the next 10 years, what is the most likely way it would be triggered?" Space was provided for respondents to write in a brief scenario. In the no-scenario conditions, the free-response question was simply omitted. In all, then, the third set of surveys contained six randomly distributed variations: 3 anchoring categories (low-anchor, no-anchor, and high-anchor) $\times 2$ path availability categories (scenario and no-scenario). One hundred sixty-five students returned a completed survey.

Results and Discussion

The effects of anchoring were even more dramatic than in the previous two surveys. As Table 1 shows, respondents who were provided with a low anchor averaged a probability estimate of 7.7%, those who were provided with no anchor averaged 17.4%, and those with a high anchor averaged 27.6%, nearly four times as great as low-anchor estimates. In a 3 (anchoring) $\times$ 2 (path availability) analysis of variance on logarithmic transformations of likelihood estimates, the main effect for anchoring was highly significant, $F(2,153) = 21.95, p < .001$. When compared with students who were given no explicit anchor, students who were provided with high or low anchors did not, as before, significantly differ in confidence or the amount of time spent thinking about nuclear war. However, *a priori* comparisons did show that they reported knowing less about nuclear issues, $F(1,156) = 5.80, p < .02$. As with the second set of surveys, students who were provided with surprisingly extreme anchors may have inferred that their knowledge of nuclear matters was incomplete.

Unlike anchoring, path availability did not significantly influence likelihood estimates. In fact, the direction of the main effect ran counter to what

was predicted. Respondents who first were asked to generate the most likely path to nuclear war averaged 15.0% in their probability estimates, compared with 19.7% for respondents who were never asked to generate a scenario, $F(1, 153) = 1.09, p = .30$. The only significant main effect due to path availability was that students in the scenario conditions were less confident of their likelihood estimates than were students in the no-scenario conditions, $F(1, 153) = 4.69, p < .04$. This difference in confidence may again be the result of "thinking the unthinkable," or it may be a generalized response from the uncertainty surrounding the question of which path to nuclear war is most likely.

As in the previous two surveys, likelihood estimates were not distributed normally and sex differences were apparent. More than 20% of all respondents set the odds of nuclear war at 1% or less, and these respondents once again reported thinking significantly less often about nuclear war than did other students, $t(161) = 2.85$, $p < .005$. They were also somewhat more confident of their probability estimates, more likely to be male (seven of the eight respondents who estimated the chances of nuclear war as zero were male), and slightly less inclined to view nuclear disarmament as important, though these differences did not reach conventional levels of significance. Women estimated the probability of nuclear war significantly higher than did men, $M = 19.1\%$ for women and 16.0% for men, $t(161) = 2.17, p < .04$, they were significantly less confident of their estimates, $t(161) = 2.43, p < .02$, and they reported knowing less about nuclear issues, $t(162) = 3.86, p < .001$. These results strongly corroborate findings from the first two surveys.

Survey 4: Anchoring and Outcome Availability Revisited

Introduction and Method

In the previous two surveys, availability of the path to an outcome or of the outcome itself did not materially affect likelihood estimates of a nuclear war. The possibility still remains, however, that many respondents were unwilling or unable to create vivid images of nuclear war. The fourth set of surveys was designed to assess the effects of availability on likelihood estimates and anchoring without giving respondents a choice as to the image created.

In addition to the standard anchoring manipulation, the fourth set of surveys contained three outcome availability categories: vivid-image, statistical-information, and no-image-or-information. In the vivid-image conditions, surveys were prefaced with the following paragraph: "In his classic book *Hiroshima*, John Hersey described the following gruesome encounter with several victims of the atom bomb:

Their faces were wholly burned, their eye sockets were hollow, the fluid from their melted eyes had run down their cheeks . . . their mouths were mere swollen, pus-covered wounds, which they could not bear to stretch enough to admit the spout of a teapot.

Today, nuclear warheads with hundreds of times the force of the Hiroshima bomb are targeted on Palo Alto and its surrounding communities. Please take a few moments right now and imagine as vividly as possible what an all-out nuclear war would be like. Once you have created as vivid an image as you can, please go on to answer the following questions." The purpose in quoting such a graphic description of Hiroshima was to be certain that respondents formed a vivid image of the effects of nuclear war.

In contrast, surveys in the statistical-information conditions began with the following preface: "In his classic book *Hiroshima*, John Hersey cited the following early casualty estimates:

78,150 people had been killed, 13,983 were missing, and 37,425 had been injured. No one in the city government pretended that these figures were accurate—though the Americans accepted them as official—and as the months went by . . . statisticians began to say that at least a hundred thousand people had lost their lives.

Today, nuclear warheads with hundreds of times the force of the Hiroshima bomb are targeted on Palo Alto and its surrounding communities. Please take a few moments right now to contemplate these statistics, and go on to answer the following questions." In keeping with past research (see Nisbett & Ross, 1980, pp. 55–59 for a review), statistical information was not predicted to increase availability. Students in the statistical-information conditions and students in the no-image-or-information conditions (in which prefaces were omitted) served primarily as comparison groups for students in the vivid-image conditions. Crossing the factor of anchoring (low-anchor, no-anchor, and high-anchor) with the factor of outcome availability (vivid-image, statistical-information, and no-image-or-information), nine variations of the fourth survey were randomly distributed in January, 1986, and 201 students completed a survey.

Results and Discussion

As seen in Table 1, the effects of anchoring were virtually identical to those found in the previous set of surveys. Students exposed to a low anchor averaged 6.4% in their likelihood estimates of nuclear war, compared with 16.3% for students in the no-anchor conditions and 27.1% for students in the high-anchor conditions. In a 3 (anchoring) × 3 (outcome availability) analysis of variance on logarithmic transformations of likelihood estimates, these differences produced a highly significant main effect, $F(2,179) = 22.95$, $p < .001$. As with the second set of surveys, *a priori* comparisons also showed that respondents in the high- and low-anchor conditions were significantly less confident of their estimates, $F(1,185) = 6.30$, $p < .02$, and reported knowing less about nuclear issues, $F(1,185) = 6.70$, $p < .02$. Taken together, these results strongly replicate the effects of anchoring found in the previous two surveys.

Also replicated was the apparent unimportance of vivid imagery. Students in the vivid-image conditions set the odds of nuclear war at an average of 17.8%, not significantly different from 15.0% in the statistical-information conditions and 16.3% in the no-image-or-information conditions, $F(2,179) = .27$, $p = .76$. The availability manipulation failed to produce significant differences in other survey variables as well.

As before, nearly one fourth (24%) of all respondents believed that the probability of nuclear war was 1% or less. Although these individuals reported thinking about nuclear war less often than other respondents, the difference, unlike the previous two surveys, did not approach statistical significance, $t(199) = .87$, $p = .38$. In a successful replication of the second set of surveys, however, these individuals did report relatively greater confidence in their likelihood estimates, $t(199) = 3.44$, $p < .001$, and did view nuclear disarmament as relatively less important, $t(195) = 2.39$, $p < .02$.

The fourth set of surveys also revealed many of the same sex differences that were observed earlier. Men set the chances of nuclear war lower than did women, $M = 13.2\%$ for males and 19.3% for females, though this difference fell below conventional levels of significance when computed using logarithmic transformations, $t(199) = 1.12$, $p = .26$. In addition, men were far more confident of their estimates than were women, $t(199) = 4.52$, $p < .001$, and reported knowing far more about nuclear issues, $t(198) = 5.03$, $p < .001$. In most respects, then, the fourth set of surveys confirmed what was found in the second and third surveys.

Survey 5:
Anchoring, the Likelihood of War, and Strategic Defense

Introduction and Method

Whether respondents are asked to imagine nuclear war, the absence of nuclear war, or nothing at all, whether they are asked to list the most likely path to war or not asked to do so, whether they are asked to consider the probability of nuclear war occurring or the probability of avoiding nuclear

war, anchoring powerfully influences subjective likelihood estimates. The robustness of this result raises the interesting possibility that anchoring might affect other issues related to nuclear war, such as bargaining positions in arms control negotiations, annual budgetary appropriations for defense programs, requirements for a minimal nuclear deterrent, or technical estimates of how successful strategic defenses might be in protecting against missile attacks. In a fifth set of surveys, the generalization of anchoring was explored with regard to the latter issue—the degree to which strategic defenses might be effective against nuclear attack.

Half of the surveys began by explaining that "the Strategic Defense Initiative or SDI is a research program to develop a system to destroy incoming nuclear missiles before they reach their targets." Surveys in the high- and low-anchor conditions next asked respondents the following question: "Suppose the United States deployed the best defensive system that money could buy. If the Soviet Union launched an all-out nuclear attack against the United States, do you think the percentage of Soviet missiles that reached their targets would be greater or less than 90% (1%)?" For respondents who were questioned about strategic defenses but were provided with no anchor, this question was excluded. Respondents in all three of these conditions were then asked: "In an all-out nuclear attack against the U.S., what percentage of Soviet missiles would reach their targets despite the best American defensive system money could buy?" After giving a point estimate, respondents were asked how confident they were of their answers, how much they had thought about strategic defense or SDI, how much they knew about the Strategic Defense Initiative, how important nuclear disarmament was, and how destructive an all-out nuclear war would be.

In the other half of the surveys, students were presented with the same standard anchors and questions used in previous surveys (see the Appendix), and no mention was made of strategic defenses. The inclusion of these surveys made it possible to compare the present sample of students with past samples, to be sure that world events or other intervening factors had not significantly changed the population with respect to the variables under study. As before, the six survey variations (low-anchor, no-anchor, and high-anchor conditions concerning either strategic defense or the likelihood of nuclear war) were randomly distributed within a larger packet of surveys. Two hundred thirty-nine students completed a survey, 124 on strategic defenses and 115 on the likelihood of nuclear war.

Results and Discussion

Once again, anchoring exerted a significant effect on likelihood estimates of nuclear war, $F(1,112) = 7.67, p < .007$. Respondents in the low-anchor condition set the chances of nuclear war at an average of 8.4%, in the no-anchor condition at 16.5%, and in the high-anchor condition at 23.8%. As in past surveys, one fourth (24%) of all respondents estimated that the probability of nuclear war was 1% or less, and these respondents were relatively more confident of their estimates, $t(113) = 5.56, p < .001$, and reported knowing somewhat more about nuclear issues, $t(113) = 1.88, p = .06$. Women again set the odds of nuclear war significantly higher than did men, $M = 21.8\%$ for women and 11.5% for men, $t(113) = 2.38, p < .02$, reported knowing less about nuclear issues, $t(113) = 3.67, p < .001$, and although they were not significantly less confident of their estimates, $t(113) = 1.36, p = .18$, women viewed an all-out nuclear war as more destructive than did men, $t(113) = 2.23$, $p < .03$. These results are very much in keeping with the results from past surveys.

For respondents who were surveyed about strategic defenses, the effects of anchoring were even more pronounced. Students who were provided with a low anchor estimated that under the best of conditions, nearly one fourth (23.5%) of Soviet missiles would penetrate strategic defenses; students with no explicit anchor estimated that two of every five Soviet missiles (40.3%) would get through; and students provided with a high anchor estimated that the majority (56.6%) of all missiles would reach their targets. An *a priori* linear contrast showed these differences to be highly significant, $F(1,120) = 15.70$, $p < .001$. Although the difference between a one-quarter and a one-half failure rate in strategic defenses would be indistinguishable in the event of an actual nuclear war, these results do establish the effects of anchoring on *perceptions* of strategic defense.

As with students who estimated the likelihood of nuclear war, respondents who believed that strategic defenses would be highly effective (a failure rate of 10% or less; $N = 25$) were more confident of their estimates than others, $t(122) = 2.01, p < .05$, and were less inclined to view nuclear disarmament as important, $t(122) = 2.61, p < .02$. Also reminiscent of past results, men were more confident of their estimates than were women, $t(122) = 3.54, p < .001$, and reported knowing more about the Strategic Defense Initiative than did women, $t(122) = 3.41, p = .001$. Together, these differences extend earlier findings on the likelihood of nuclear war to the related domain of strategic defense.

Survey 6: Are the Effects Really Due to Anchoring?

Introduction and Method

Although arbitrary anchor values can strongly affect likelihood estimates of nuclear war and the success of strategic defenses, the question remains as

to whether these effects are actually due to anchoring alone. Perhaps respondents implicitly assume that any value with which they are provided—whether 1% or 90%—constitutes a reasonable estimate of the likelihood of nuclear war. If so, anchor values may tacitly function as persuasive appeals, subtly pressuring respondents to accept a given value as accurate. In order to investigate the role of persuasion and social demand biases, a sixth and final set of surveys was developed.

In the first two versions of the survey, respondents were told that "Some people say that the chances of a nuclear war between the U.S. and the Soviet Union in the next ten years are at least 1% (or 99% in the high-anchor condition). Others say that those are the chances of *avoiding* a nuclear war in the next ten years. What do you believe? In percentage terms, please estimate as precisely as possible the chances of a nuclear war between the U.S. and the Soviet Union during the next ten years." By wording the item this way, any implicit suggestion concerning the correctness of the anchor value was removed.

In the next two versions of the survey, social pressures to adopt the anchor value were not only eliminated, but expert opinion was actually cited in favor of rejecting the anchor value. These surveys began with the following statement: "Some people say that the chances of a nuclear war between the U.S. and the Soviet Union in the next ten years are at least 1% (or 99% in the high-anchor condition). Many political analysts say, however, that those are the chances of *avoiding* a nuclear war in the next ten years." Thus, if anchor values influence likelihood estimates by persuading respondents that a given value is plausible (or if respondents shift their estimates in the direction of a presumed audience, as found by Newtson & Czerlinsky, 1974), then students responding to these surveys should join the political analysts in rejecting the anchor they are given. Conversely, if probability estimates continue to be anchored, then the effects of anchoring cannot be explained in terms of persuasion or social demand biases.

As with previous surveys, a no-anchor comparison group and a number of nuclear-related questions were included in the sixth set of surveys (see the Appendix). The five survey variations (low-anchor/no-bias and high-anchor/no-bias [in which the anchor value is accepted by some people and rejected by others], low-anchor/opposite-bias and high-anchor/opposite-bias [in which experts disagree with the anchor value], and the standard no-anchor condition) were then randomly distributed and completed by 245 students in January and May of 1987.

Results and Discussion

Even after controlling for the effects of persuasion and social demand biases, anchoring strongly influenced likelihood estimates of a nuclear war.

Collapsing across the no-bias and opposite-bias conditions, planned linear contrasts using logarithmic transformations were highly significant, $F(1,232) = 10.33$, $p < .001$. Respondents in the low-anchor conditions averaged likelihood estimates of 12.4%, those in the no-anchor condition averaged 13.6%, and those in the high-anchor conditions averaged 22.7%. As in past surveys, susceptibility to anchoring was not significantly correlated with the frequency students reported thinking about the chances of a nuclear war, the concern they expressed about the likelihood of nuclear war, the opinions they held regarding the importance of disarmament, or the knowledge of nuclear issues they reported having. Also in keeping with previous surveys, respondents who received no anchor were somewhat more confident of their probability estimates than respondents who were given an anchor, $F(1,232) = 3.44, p = .07$.

Looking at the no-bias and opposite-bias conditions separately, the results were much the same. Respondents in the low-anchor/no-bias condition averaged probability estimates of 11.2%, whereas respondents in the high-anchor/no-bias condition averaged 26.1%. These figures are strikingly similar to the overall averages of 10.3 and 26.4 for the previous five sets of surveys. Furthermore, even a social demand bias opposing the anchor value did little to attenuate the effects of anchoring. Students in the low-anchor/opposite-bias condition averaged likelihood estimates of 13.5%, as compared with 20.5% for students in the high-anchor/opposite-bias condition, $t(111) = 2.38, p < .02$. In short, these results contradict an interpretation of anchoring based on implicit persuasion or social demand biases.

Once again, approximately one of every five respondents (19%) rated the likelihood of nuclear war as 1% or less. These students were more confident of their estimates than other students, $t(241) = 5.04, p < .001$, reported thinking less frequently about the chances of nuclear war, $t(241) = 2.56$, $p < .02$, expressed less concern about the likelihood of nuclear war, $t(241) = 2.32, p < .03$, and tended more often to be male, $\chi^2(1) = 10.86$, $p < .001$. In general, males set the chances of nuclear war lower than did females, $M = 13.7\%$ for men and 19.5% for women, $t(240) = 3.51, p < .001$. They also showed more confidence in their estimates, $t(241) = 3.50, p < .001$, and rated their knowledge of nuclear issues more highly, $t(242) = 4.04$, $p < .001$. These results replicate findings from several of the earlier surveys.

General Discussion

In six sets of surveys, involving 46 variations and 1,474 respondents over a period of more than two years, anchoring exerted a strong influence on likelihood estimates of a nuclear war. Students who were initially asked whether the probability of nuclear war was greater or less than 1% subse-

quently gave lower point estimates than students who were not provided with an explicit anchor. At the same time, students who were first asked whether the probability of nuclear war was greater or less than 90% (or 99%) later gave estimates that were higher than those given by students who were not given an anchor. The effects of anchoring—and indeed, likelihood estimates themselves—were not explainable in terms of persuasion or social demand biases and were not significantly influenced by instructions to imagine an all-out nuclear war, to imagine a life free from the threat of nuclear war, or to list the most likely path to nuclear war. Moreover, they were not influenced by casting the estimates in terms of avoiding nuclear war rather than predicting its occurrence, familiarity with nuclear issues, or concern about nuclear war. The effects of anchoring were often apparent at an individual level when, for example, respondents who were provided with an anchor of 1% estimated the probability of nuclear war at 1.5% or 2%, or respondents who were provided with an anchor of 90% set the odds at 85% or 87%.

As a means of eliciting likelihood judgments about the "unthinkable," probability point estimates seemed to work quite well. From inadvertent scribblings and scratchings—sometimes only to change an estimate from 1% to 2%—students revealed an ability to make fine discriminations in percentage responses. These estimates, though conservative by national standards, also correlated with other nuclear attitudes and revealed sex differences consistent with past research, lending support to the ecological validity of probability point estimates as a method of assessing subjective likelihood (for further evidence, see Plous, 1987).

Of course, these results are limited by a number of factors, not least of which is the population from which the respondents were drawn. Not only do college students differ from the general public, but Stanford undergraduates differ from college students in general. Alternate populations might be less familiar with making probability estimates or might otherwise react quite differently. On the other hand, the relatively restricted range of estimates displayed by Stanford students and the extreme destructiveness they foresaw in an all-out nuclear war suggest that the effects of anchoring on Stanford students may have been a conservative estimate of the effects found among members of the public at large. In any event, generalizations from these findings must be made cautiously; thus far, all that can be said with certainty is that subjective likelihood estimates of nuclear war have been consistently anchored in one population.

In addition to extending the population of respondents, directions for future research might substitute non-numeric likelihood estimates for numeric ones, assess the delayed effects of anchoring, or extend the domain of nuclear topics beyond strategic defense and the likelihood of nuclear war. As alluded to earlier, budgetary appropriations from one year may anchor

appropriations for the next, initial arms control positions may unwittingly anchor later ones, and current deployments may anchor beliefs about what constitutes a minimal nuclear force adequate for deterrence. In the face of 50,000 nuclear weapons, it is often forgotten that the doctrine of mutual assured destruction was originally based on the capability to deliver 400 nuclear bombs (Myrdal, 1982, p. 118).

At the very least, the present results suggest that public speakers, writers, pollsters, and other researchers must be sensitive to the effects of anchoring. Questions that include arbitrary numerical references such as "Would you support a U.S. attempt to build a defensive system against nuclear missiles and bombers [if it were] able to shoot down 90% of all Soviet nuclear missiles and bombers?" (national poll cited in Graham & Kramer, 1986) or arbitrary scales of measurement (cf. Farah, 1985; World Opinion Update, 1983) may have unintended effects. At the same time, factors of proven importance such as outcome availability or path availability may not be critical in all cases of frequency and probability estimation. When the predicted event is highly aversive, as is the subject of nuclear war, denial may cancel or overwhelm the effects of availability.

Protocols for as many as 20% of the respondents were consistent with some form of denial, but because subjective likelihood estimates of nuclear war cannot be calibrated with relative frequency information, it is difficult to say anything conclusive. For example, one student who was typical of these respondents set the odds of nuclear war at .00001%, indicated the highest possible confidence in her estimate, claimed to know quite a bit about nuclear issues, contended that all life would perish in an all-out nuclear war and that her own chances of survival were poor, yet she also rated nuclear disarmament as one of the least important political and social issues and reported hardly ever thinking about nuclear war. Denial? Not if nations retain nuclear weapons and a nuclear war never occurs.

In other instances, the case for denial was stronger. Some of the students sent back questionnaires with expletives and hostile remarks, refusing to make a likelihood estimate. One student—highly confident of his low probability estimate—regarded nuclear disarmament as one of the least important political and social issues and, with undisguised contempt, listed the most likely path to nuclear war as "a nuclear protester trying to show the likelihood of an accident will try to set off or wreck a base." Several students coupled low probability estimates with high confidence, infrequent thoughts about nuclear war, a belief that nuclear disarmament was unimportant, and contentions either that an all-out nuclear war would not destroy civilization or that their chances of living through an all-out nuclear war were very good (a particularly striking denial given the highly-targeted geographic location of respondents).

Finally, the unsolicited comments of some respondents, while not constitut-

ing irrefutable evidence, suggested a degree of denial. One respondent wrote, for example, that "thinking about this just scares me and makes me feel really impotent." Another, who rarely thought about nuclear war, regarded nuclear disarmament as one of the least important issues, professed to know as much about nuclear issues as the rating scale would allow, and set the chances of nuclear war quite low, gave himself the highest marks in confidence and added parenthetically: "I took Poly Sci 35" (International Politics).

Perhaps the most telling comment, however, was a two-sentence remark made by a respondent who was clearly struggling to "think the unthinkable." She estimated the probability of nuclear war at 50%, believed that nuclear war would destroy our entire species—herself included—and regarded nuclear disarmament as one of the most important political and social issues.

"Why don't I know anything about it then?" she wrote in the survey margins.

"Beats me," she answered.

Future research on the subjective likelihood of nuclear war could hardly ask for a more intriguing question.

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Appendix

Survey Questions Following Point Estimate[10]

(2, 3, 4, 5, 6) How confident are you of this estimate? (Circle *one* number)

Not Confident At All 1 2 3 4 5 6 7 8 9 Very Confident

(2, 3, 4) How often do you think about nuclear war? (Circle *one* number)

Hardly Ever 1 2 3 4 5 6 7 8 9 Very Frequently

(5, 6) In the past year, how often have you thought about the chances of a nuclear war? (Circle *one* number)

Hardly Ever 1 2 3 4 5 6 7 8 9 Very Frequently

(5) In the past year, how often have you thought about strategic defense or SDI? (Circle *one* number)

Hardly Ever 1 2 3 4 5 6 7 8 9 Very Frequently

(2, 3, 4, 5, 6) How much would you say that you know about nuclear issues? (Circle *one* number)

Very Little 1 2 3 4 5 6 7 8 9 Quite a Bit

continued

Appendix *Continued*

(5) How much would you say that you know about the Strategic Defense Initiative? (Circle *one* number)

Very Little 1 2 3 4 5 6 7 8 9 Quite a Bit

(1, 2, 3, 4, 5, 6) As political and social issues go, how important is nuclear disarmament to you?

____ It's the single most important issue
____ It's one of the most important issues
____ It's of moderate importance
____ It's one of the least important issues
____ It's the single least important issue
____ No opinion

(1, 2, 3, 4, 5) How destructive do you think an all-out nuclear war would be? (Check the *one* answer that seems most probable to you)

____ No worse than past wars
____ Worse than past wars, but civilization would continue
____ Civilization as we know it would be destroyed
____ Our entire species would be destroyed
____ All life would perish
____ No opinion

(2, 3, 4) If we should happen to get into an all-out nuclear war, what do you think your own chances would be of living through it? (Check the *one* answer closest to your views)

____ Very good ____ Just 50–50 ____ Poor ____ No opinion

(6) How deeply do you care about the likelihood of nuclear war? (Circle *one* number)

Very Little 1 2 3 4 5 6 7 8 9 Quite a Bit

[10]Numbers in parentheses indicate survey set in which the question appeared.