

# Public Opinion and Nuclear Use: Evidence from Factorial Experiments

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## Abstract

Does the public oppose nuclear use? Survey experimental research varying either the advantages or disadvantages of nuclear use has produced a wide range of results. Yet no study has examined how the military advantages and strategic and moral disadvantages of nuclear weapons interact. We explore this interaction and uncover a pattern that unifies the literature's seemingly disparate results: the persuasive power of nuclear weapons' military advantages is conditional on their disadvantages. We demonstrate this by independently randomizing both the advantages and disadvantages of nuclear use in (1) a  $2 \times 2$  factorial version of an influential design and (2) a novel adaptation of conjoint experiments that focuses on the most plausible comparisons between nuclear and conventional strikes. Our results support a new explanation for why the public can appear rigidly opposed to nuclear strikes in some circumstances and highly permissive in others.

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Does the public oppose nuclear use? The explosion of survey experimental research addressing this question has produced a wide range of results. When nuclear weapons are presented as offering substantial military advantages, majorities can be persuaded to endorse a nuclear strike over less effective conventional alternatives (Press et al. 2013; Sagan and Valentino 2017; Haworth et al. 2019). Meanwhile, studies that present nuclear use as carrying considerable costs—breaking international law (Carpenter and Montgomery 2020) or precedent (Post and Sechser n.d.) or causing horrific collateral damage (Koch and Wells 2020; Rathbun and Stein 2020)—find much lower support for nuclear strikes. These studies demonstrate that public preferences are affected by both the military advantages and the strategic and moral disadvantages of nuclear use, but do not investigate how these factors interact.

In this short article, we examine this interaction and demonstrate an unrecognized pattern that can unite seemingly disparate results: the persuasive power of nuclear weapons’ military advantages is conditional on the disadvantages that nuclear weapons face relative to conventional alternatives. We show this in two ways. First, we examine a  $2 \times 2$  factorial version of Press et al. (2013)’s seminal design. We find that a key potential advantage of nuclear weapons, their greater chance of success on the battlefield, has a non-constant effect on support for nuclear strikes. The addition of text that highlights nuclear weapons’ disadvantages in terms of civilian deaths, environmental destruction, and international condemnation not only reduces the average popularity of nuclear weapons, but reduces the marginal effect of military advantages. Second, we use a novel adaptation of conjoint experiments to take a more granular look at the interaction of advantages and disadvantages. We find further evidence that the persuasive effect of military advantages shrinks when nuclear weapons have moral and strategic disadvantages.

This pattern of non-constant effects helps bridge competing accounts of public preferences toward nuclear strikes. It is not simply that military advantages have positive effects (Press et al. 2013; Sagan and Valentino 2017) or that disadvantages have negative effects

(Carpenter and Montgomery 2020; Koch and Wells 2020; Post and Sechser n.d.; Sagan and Valentino 2017). Instead, the two factors interact: the negative consequences of nuclear weapons dampen the persuasive power of their military advantages. This explains how public opinion toward nuclear strikes could look like a rigid, unyielding taboo in some circumstances (Tannenwald 1999, 2007) while appearing alarmingly permissive in others.

## **Public Opinion and Nuclear Non-Use**

The non-use of nuclear weapons since 1945 is a defining feature of the nuclear age (Sagan 2004; Tannenwald 2007; Paul 2009). Despite agreement on the importance of non-use, the source and nature of this pattern of behavior remain central questions. Tannenwald (2007, 62) argues that nuclear non-use is the product of a widespread taboo: “any use of nuclear weapons is prohibited. That is, the normative prohibition has come to be an absolute one.” Others describe non-use as an elite “tradition” sustained by the moral and material consequences of nuclear use (Paul 2009; Quester 2006) and fear of setting a dangerous precedent (Sagan 2004). Disagreements over the role of public opinion in non-use led to a series of experiments designed to examine attitudes toward nuclear weapons. These experiments address a first order question about the role of public opinion: elites can plausibly be constrained by public opinion only if the public actually opposes nuclear strikes.

In a pioneering experiment “designed to vary the relative military utility of nuclear weapons,” Press et al. (2013, 197) find that when presented with a scenario about a hidden Al Qaeda nuclear lab, most respondents preferred a conventional strike over an equally effective nuclear strike that would cause an equal number of civilian deaths. Yet when the nuclear strike offered greater military effectiveness—but still caused no more civilian deaths—a majority preferred the nuclear option.

One concern is that the study de-emphasized the typical disadvantages of nuclear weapons, both explicitly (equal civilian deaths) and implicitly (no discussion of other side effects). Recognizing this, a second wave of studies examined the effects of nuclear weapons’ most notable disadvantages and found that highlighting these downsides reduced the alarm-

ingly high support for nuclear use found in Press et al. (2013). Carpenter and Montgomery (2020) find that prompting subjects to consider legal and ethical obligations to limit civilian casualties decreases support for nuclear use. Post and Sechser (n.d.) find greater opposition when subjects are shown elite cues about the danger of breaking the non-use precedent. Koch and Wells (2020) show that information regarding nuclear weapons' horrific collateral damage reduces support. Rathbun and Stein (2020) find that increasing the civilian casualties of nuclear strikes can reduce support for nuclear use in an observational component of their study, especially among those with liberal, other-regarding moral foundations. Indeed, Sagan and Valentino (2017) also found that higher civilian deaths lowered support despite generally high support for nuclear use in a Hiroshima-like scenario. This wide range of results suggests that both the advantages and disadvantages of nuclear use matter to the public.

No previously published study has examined how the costs and benefits of nuclear weapons interact.<sup>1</sup> After observing lower support in recent studies, we failed to replicate Press and colleagues' large effects in a pilot experiment that highlighted the drawbacks of using nuclear weapons.<sup>2</sup> From this, we hypothesized that *nuclear disadvantages reduce both baseline support for nuclear strikes and the persuasiveness of the marginal military advantage.*

This conditional effects hypothesis is consistent with a subtle implication of standard discrete choice models of choice between two alternatives (Train 2003; see Appendix E). When two options, A and B, are very similar, assigning an additional benefit to B can have a big effect in pushing people to choose B over A. However, when A has many advantages over B to start, giving an identical benefit to B has a smaller effect on choice. The large baseline advantage enjoyed by A is simply too great to surmount, making the marginal advantage for B less persuasive. This model provides a good fit to real-world data in economic settings (Andersson and Uboe 2010; Larsen et al. 2012) and helps explain why partisan and policy differences between candidates limit electoral punishment for violations of democratic norms (Graham and Svobik 2020). We apply this logic to the choice between nuclear and

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<sup>1</sup>See Table A.1 for a detailed look at prior experimental designs.

<sup>2</sup>Appendices D.2 and D.3 analyze the pilot study.

conventional strikes. When the differences between nuclear and conventional strikes are not salient or are presented as being small, assigning the nuclear option a military advantage can persuade many subjects to prefer that option. By contrast, when the unique harms of nuclear use are salient, the same military advantage should have a smaller effect on choice.<sup>3</sup>

## Research Design

Our study included two pre-registered experiments, a vignette and a modified conjoint design, that independently randomized both the military advantages and the negative side effects of nuclear weapons. In December 2019, we recruited 2,138 respondents through Lucid, an online platform that quota samples to Census benchmarks.

The vignette experiment extends the [Press et al. \(2013\)](#) design. Respondents read a faux-news article describing a threat of nuclear terrorism. The article describes two options for destroying the threat, one using conventional weapons and the other using nuclear weapons. The vignettes manipulated the features of these strikes in two ways: (1) the relative probability of success of the strike options ( $S \in \{0, 1\}$ ) and (2) their consequences in terms of civilian deaths, environmental destruction, and international backlash ( $D \in \{0, 1\}$ ). See Appendix B for details.

The modified conjoint experiment followed. Participants made choices in 12 randomly generated strike pairs. Each strike had six characteristics: (1) type of strike (conventional or nuclear), (2) chance of success (90 or 70 percent), (3) U.S. military casualties (minimal, low, or high), (4) civilian casualties (10, 100, 1,000), (5) environmental damage (minimal, moderate, high), and (6) approval of U.S. allies (few or most). Six of the 12 strike pairs are restricted to plausible scenarios. Nuclear weapons can never cause less environmental damage, civilian death, or disapproval from allies than a conventional strike, while the conventional strike can never be more effective or result in fewer U.S. military casualties. We focus on these more plausible comparisons below. Appendix D.5 presents similar results for

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<sup>3</sup>Notably, this prediction emerges despite the fact that advantages and disadvantages enter the model additively (see Appendix E). Our framework differs from the utilitarian framework presented by [Rathbun and Stein \(2020\)](#) only in that our account is attentive to the manner in which people aggregate their latent dis/utility from multiple factors into a preference.

the other six choices, in which all strike features were randomized independently.

Around the time of our study, Lucid experienced a rise in the share of respondents who are inattentive (Aronow et al. 2020). Across 33 replication studies, Peyton, Huber and Coppock (2021) show that this pattern of inattentiveness attenuated average treatment effects by about one-third. To compensate, we approximate attentiveness using the time each respondent spent reading the treatment vignette. We define inattentive respondents as those who spent an unusually short or long times on the page (less than one minute or more than ten; see Read et al. (2021) on “slow and inattentive” respondents). Appendix D.1 shows that the results are robust to alternative cutoffs.

## Results

*Vignette Experiment.* We first examine the vignette experiment results. Our key hypothesis is that the disadvantages of nuclear weapons reduce the persuasive power of nuclear advantages. To test the interaction between nuclear advantages and disadvantages, we use OLS to estimate the parameters in a pre-registered linear model,

$$Y_i = \beta_0 + \beta_1 S_i + \beta_2 D_i + \beta_3 S_i D_i + \epsilon_i, \quad (1)$$

where  $Y_i$  is an indicator for preferring the nuclear option and  $D_i$  and  $S_i$  are treatment indicators for greater destruction and better odds of success (as defined in Table B.1).

Table 1 presents our estimates. Using the full sample, we find modest support for our hypothesis. In the full sample, the conditional effect of military utility is negative and on the borderline of statistical significance ( $\hat{\beta}_3 = -6.5$ , s.e. = 4.6). This erases nearly half the persuasive effect of a better chance of success ( $\hat{\beta}_1 = 13.6$ , s.e. = 3.7). Among attentive subjects, the negative conditional effect of military utility is larger and attains statistical significance. More than half of the effect of military utility ( $\hat{\beta}_1 = 16.5$ , s.e. = 4.4) is erased by highlighting the disadvantages of nuclear use ( $\hat{\beta}_3 = -10.1$ , s.e. = 5.3).

For a further test based on vignette experiments, we combined our original data with comparable, previously published experiments (Appendix D.3). The results are even more stark: about three-quarters of the effect of military advantages ( $\hat{\beta}_1 = 23.5$ , s.e. = 1.8) is

Table 1: Regression analysis of vignette experiments.

	Full Sample		Attentive Sample	
	No Controls	Controls	No Controls	Controls
$\alpha$ Constant	0.184*** (0.023)	0.228*** (0.079)	0.182*** (0.029)	0.247** (0.106)
$\beta_1$ Better chance of success	0.144*** (0.038)	0.136*** (0.037)	0.168*** (0.048)	0.165*** (0.044)
$\beta_2$ More destructive	-0.084*** (0.029)	-0.064** (0.029)	-0.102*** (0.034)	-0.083*** (0.033)
$\beta_3$ Better chance $\times$ more destructive	-0.048 (0.049)	-0.065* (0.046)	-0.081* (0.059)	-0.101** (0.053)
Adj. R <sup>2</sup>	0.043	0.128	0.062	0.155
Num. obs.	2138	2138	1449	1449

OLS estimates. Robust SEs in parentheses. Controls and one-tailed tests pre-registered. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

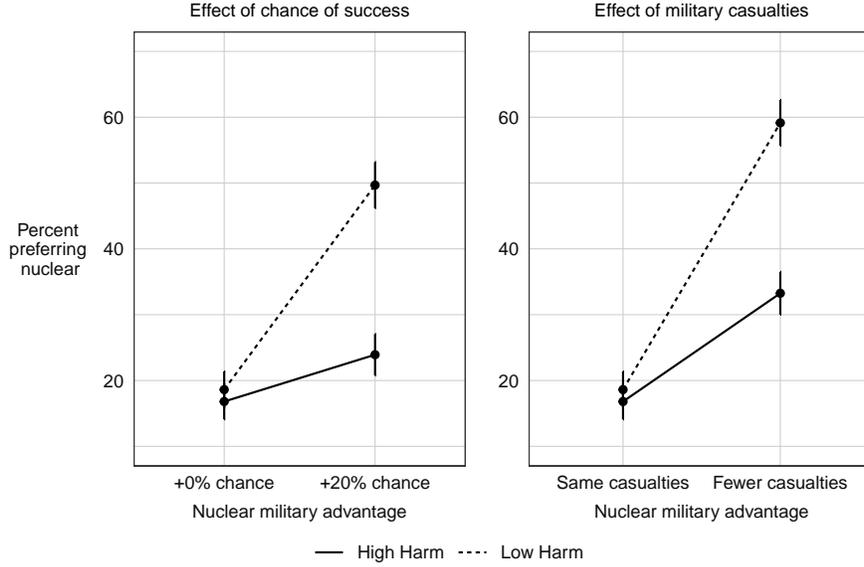
erased by emphasizing the disadvantages of nuclear strikes ( $\hat{\beta}_3 = -18.3$ , s.e. = 2.5).

*Choice Experiment.* For a more detailed look at the public’s preferences, we turn to our choice experiment. We illustrate our approach by focusing on two conditions. We label the first ‘high harm,’ with nuclear use reported to cause more civilian casualties, environmental damage, and international backlash than the conventional alternative. We label the second ‘low harm.’ Here, nuclear weapons are said to carry no explicit disadvantage in civilian deaths, environmental destruction, and international opprobrium relative to the conventional alternative. Figure 1 shows the effect of assigning nuclear weapons military advantages in these conditions. When nuclear weapons are ‘low harm’ (dashed lines), majorities may be persuaded to support nuclear use if it offers greater military effectiveness or reduces U.S. military casualties. But these effects are conditional on and muted by the negative side-effects of nuclear weapons. When nuclear strikes are ‘high harm’ (solid lines), with their usual disadvantages highlighted, the effect of military utility falls considerably.

To statistically test whether this pattern holds more generally, we pre-registered a linear model that quantifies how the effect of military utility varies with the number of disadvantages ascribed to a nuclear strike. We use OLS to estimate the parameters in

$$Y_{ij} = \alpha_0 + \delta_0 D_{ij} + \alpha_M M_{ij} + \alpha_S S_{ij} + \delta_M M_{ij} D_{ij} + \delta_S S_{ij} D_{ij} + \epsilon_i, \quad (2)$$

Figure 1: Effect of military advantages when nuclear weapons are low-harm vs. high-harm.



*Note:* Figure plots the percentage of respondents who chose a nuclear strike over a conventional strike (y-axis) as a function of the nuclear strike’s advantage or disadvantage relative to a conventional strike (x-axis).

where  $D_{ij}$  is a disadvantage index from 0 to 3, summing the disadvantages—high civilian casualties, environmental destruction, and international backlash—that a nuclear strike is randomly assigned in our choice task. Disadvantage index scores of 3 are equivalent to the ‘high harm’ conditions in Figure 1, while disadvantage index scores of 0 are equivalent to the ‘low harm’ condition. Scores of 1 or 2 are somewhere in between.  $M_{ij}$  indicates fewer U.S. military casualties, and  $S_{ij}$  indicates a greater chance of success. The  $\alpha$  and  $\delta$  parameters are the effects of advantages and disadvantages.  $\alpha_0$  is the probability that a respondent supports a nuclear strike that has no advantages or disadvantages.  $\alpha_M$  is the effect of an advantage on military casualties when there are zero disadvantages.  $\alpha_S$  is the effect of a greater chance of success. The main parameters of interest,  $\delta_M$  and  $\delta_S$ , respectively estimate whether the presence of disadvantages reduces the effect of the two advantages.  $\delta_0$  is the marginal effect of a disadvantage when no advantages are present.

We find strong support for our hypothesis that nuclear disadvantages reduce baseline support *and* the effect of military advantages. In Table 2, the negative estimate of  $\delta_0$  confirms lower baseline support. The negative estimates for  $\delta_M$  and  $\delta_S$  confirm reduced effect of

Table 2: Regression test for conditional effect of nuclear advantages and disadvantages.

	No controls	Controls
$\alpha_0$ Constant	0.221*** (0.017)	0.265*** (0.033)
$\delta_0$ Disadvantages (0-3 scale)	-0.021*** (0.008)	-0.026*** (0.006)
$\alpha_M$ Fewer military casualties	0.283*** (0.021)	0.279*** (0.014)
$\alpha_S$ Better chance of success	0.184*** (0.020)	0.165*** (0.013)
$\delta_M$ Disadvantages $\times$ fewer mil. casualties	-0.038*** (0.010)	-0.039*** (0.007)
$\delta_S$ Disadvantages $\times$ better chance	-0.044*** (0.010)	-0.035*** (0.007)
Adj. R <sup>2</sup>	0.096	0.124
Num. obs.	12166	12148
N Clusters	2054	2051

*Note:* Table presents OLS estimates of the parameters in (2). Standard errors clustered by respondent. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$  for pre-registered one-tailed tests.

military advantages. With the addition of each marginal disadvantage, the marginal effect of both military advantages falls by about 4 percentage points. When nuclear weapons are presented without their notable downsides (a disadvantage index of zero) the effects of fewer military casualties and a greater chance of success are estimated at 28 and 18 percent, respectively. When nuclear weapons are presented with their notable downsides (a disadvantage index of three) these effects fall to 16 and 5 percent.

A key implication of Table 2 is that when nuclear weapons are ascribed their typical disadvantages, nuclear strikes that have a greater chance of success *and* save military lives nevertheless fail to generate majority support. When all of the disadvantages are present, only about 38 percent of respondents prefer a nuclear strike that saves U.S. military lives and has a better chance of success. In a low-harm scenario, about 69 percent of respondents prefer a nuclear strike with both advantages.

## Conclusions

These results have important theoretical and policy implications. First, the logic of conditional effects suggests a framework for future research seeking to understand public opinion toward the use of military force. We show in Appendix D.5 that conditional effects are also observed in choices between two conventional strikes.

Second, the twin effects of low support and low persuadability produced by nuclear disadvantages can create a near-observational equivalence between a taboo and rationalist opposition based on strike features. When nuclear weapons have many disadvantages, solid majority opposition to nuclear strikes emerges even in the presence of tactical advantages. This means that when nuclear weapons are viewed as having large downsides, even a rational cost-benefit analysis should produce consistent, rigid opposition to nuclear strikes. This explains how one could perceive a taboo in some real-world situations despite evidence of public permissiveness in other situations.

Third, public resistance to military advantages depends on perceived disadvantages, suggesting that elite opinion leadership is crucial to creating any resistance the public may offer. Just as scientists and activist portrayals of severe nuclear side effects helped create the perceived public resistance to nuclear weapons described by [Tannenwald \(2005, 22\)](#), leaders who wished to downplay the side effects could succeed in breaking down resistance.

Fourth, the development of designs for “mini-nukes” with a fraction of the destructive power of current nuclear weapons ([Fearey et al. 2003](#)) could also work to reduce public opposition. If nuclear weapons’ disadvantages are essential to depressing both support and persuadability, it follows that technologies that decouple nuclear weapons from wanton destruction could make the public more receptive to the military benefits of nuclear use.

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