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Understanding Americans' Perceptions of Nuclear Weapons Risk and Subsequent Behavior

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Since the end of the Cold War, widespread discourse about nuclear weapons risk has disappeared, resulting in a lack of awareness of nuclear threats among U.S. citizens. Yet recent events have made nuclear weapons risk salient again, and some experts believe the risk of nuclear attack is higher today than it was during the height of the Cold War. Across two surveys of more than 1,500 American citizens, we demonstrate that most individuals do not think about nuclear weapons risk or the possibility of nuclear attack. We find evidence that age and media usage are important individual characteristics that affect perceptions of nuclear risk, apathy about the topic, as well as related behavioral intentions and actions. These types of relationships warrant greater scholarly attention, as improved understanding has implications for policy makers, the emergency management community, and directly for citizens.

Keywords: nuclear weapons, nuclear risk, risk perception

The current public understanding of nuclear weapons is woefully inadequate (Blendon, Benson, Desroches, & Weldon, 2003; Kenausis, Berstein, Redwine, & Hynes, 2018). Many Americans, but particularly those born after the Cold War, seem to lack awareness about most topics related to nuclear weapons. There are currently nearly 15,000 nuclear weapons and 1,800 metric tons of weapons-usable nuclear materials stored around the world (Arms Control Association, 2018). Yet few Americans grasp the size of current stockpiles, the actors who have nuclear weapons capabilities, have knowledge about the risk of a nuclear attack, or recognize the best course of action to take in the event of a nuclear detonation. Despite this general lack of awareness of nuclear issues and threats, "nuclear weapons have been in existence throughout the adult lives of nine out of ten Americans" (Herron & Jenkins-Smith, 2014, p. 111).

Recently, the topic of nuclear threat has been made increasingly salient due to a series of heated exchanges between U.S. President Trump and Kim Jong Un of North Korea and subsequently to two widely covered nuclear summits between the two nations. In early January 2018, Kim Jong Un declared, "The United States should know that the button for nuclear weapons is on my table"

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(Vitkovskaya, 2018, p. 2). Trump responded, "I too have a Nuclear Button, but it is a much bigger & more powerful one than his, and my Button works!" (Vitkovskaya, 2018, p. 5).

In addition to the increased coverage of nuclear issues in the news, there is growing concern among experts that nuclear threat is higher today than it was during the Cold War. In 1947, the *Bulletin of the Atomic Scientists* created the Doomsday Clock to provide a yearly assessment of the world's vulnerability to catastrophe, originally focused predominately on nuclear weapons. Today, the key assessments are based on threats from nuclear weapons, climate change, and new technologies. In 2018, the board moved the Doomsday Clock to two minutes to midnight, noting the looming threats of nuclear war and climate change (Mecklin, 2018). The last time the Doomsday Clock has been this close to midnight is 66 years ago, when the United States. and the Soviet Union started testing hydrogen bombs in 1953 (Bever & Ohlheiser, 2019).

Following the end of World War II through the Cold War, a substantial body of research examined perceptions of nuclear risk (Fiske, 1986; Russo & Lyon, 1990). Since then, both scholarly research and popular attention to perceived nuclear threat has dramatically decreased, with most of the contemporary research focusing on attitudes toward nuclear energy (Jones, Elgueta, & Eiser, 2016). Furthermore, related research on risk perception typically arises following major nuclear disasters such as Chernobyl (Midden & Verplanken, 1990) and Fukushima (Crettaz von Roten, Clémence, & Thevenet, 2017). Yet few studies from the past three decades have investigated general perceptions of the threat of a nuclear attack. As such, there is an ample gap in our understanding of current perceptions of nuclear risk.

Whether by intent, unauthorized, and/or accidental, any nuclear weapons use could dramatically change the world. In what follows, we examine U.S. citizens' nuclear weapons risk perceptions and subsequent behavior. In particular, we focus on the impact of media usage and age on risk perception, apathy, and the actions individuals might take in response to nuclear weapons threats. First, we review the relevant literature and outline several hypotheses.

Nuclear Risk Perceptions

Broadly, members of the public have been shown to have a limited understanding of biological, chemical, and radioactive hazards (Blendon et al., 2003; Wray et al., 2008; Zweigenhaft, 1984). However, with the aforementioned heated exchanges between President Trump and Kim Jong Un, the two nuclear summits between the United States and North Korea, the false missile alert in Hawaii, and the end of the Obama-era Iran nuclear deal, nuclear weapons are back in the news (Rucker, Denyer, & Nakamura, 2019). Nonetheless, it remains unclear how the resurgence of attention to nuclear threats is affecting risk perceptions and behavior.

Social amplification theory posits that different amplifiers such as the media, government agencies, and scientists determine public perceptions of risk. Thus, if one has no personal experience with a risk, individuals seek out information from others or the media (Kasperson et al., 1988). In accordance with this theory, some studies report associations between risk perception and media

coverage (Wahlberg & Sjoberg, 2000). Given the increasing coverage of nuclear issues in the media, we hypothesize the following:

H1: As individuals' media usage increases, their perceived risk of a nuclear attack will increase.

In addition to media use, previous polls have demonstrated age-related divisions in how Americans perceive nuclear threats. For example, the Pew Research Center found that 78% of Americans ages 50 and older are very concerned about North Korea having nuclear weapons, compared with 42% of 18-to-29-year-olds (Poushter, 2017). The lasting effects of the Cold War may partially explain this discrepancy across age groups. For a generation of Americans, the tangible and existential fear associated with nuclear weapons was ever present and mainstream. The powerful imagery used in the aftermath of atomic warfare stoked nuclear fear through the Cold War and led to long-term shifts in perceptions and behavior among Baby Boomers (born 1946–64; Weart, 2012).

Many from the Baby Boomer generation grew up during the era of Civil Defense, a government-sanctioned effort to prepare civilians for nuclear war and increase survivability by reducing avoidable casualties (Homeland Security National Preparedness Task Force, 2006). Children were taught "duck and cover" drills at school as a way to protect themselves in the case of a nuclear attack. A thorough analysis of more than 50 studies, conducted between 1945 through the mid-1980s, found that individuals thought the risk of nuclear war was between somewhat unlikely (one-third chance of nuclear war) and a toss-up, about a 50/50 lifetime chance (Fiske, 1986; Fiske, Pratto, & Pavelchak, 1983; Withey, 1954). The experience of Baby Boomers is in stark contrast to Millennials (born 1981–96) and Generation Z (born 1997–2012), who grew up largely unaware of the history and danger posed by nuclear weapons, and as a result, are largely complacent in this domain (Dimock, 2019). Indeed, research has found that younger adults have limited knowledge of nuclear weapons, such as their destructive power or how many nuclear weapons exist in the world (Kenausis et al., 2018).

Therefore, we expect that age will be an important demographic characteristic when assessing perceptions of nuclear threat risk. Nonetheless, when it comes to perceptions of risk, our hypothesized direction of the effect is due largely to an expected time horizon effect based on the wording of the questions used in this study. Specifically, we asked respondents to estimate the risk of a nuclear attack "in your lifetime." Therefore, we expect that older Americans will, on average, base their estimates on a shorter time frame because of their older age, thus decreasing their estimated risk. Relatedly, because older adults lived through the Cold War, their estimated risk may be influenced by the perception that if a nuclear attack did not occur during the height of the Cold War, it would be less likely to occur today. Therefore, our second hypothesis follows:

H2: As age increases, individuals' estimated risk of nuclear attack "in their lifetime" will decline.

For most people, nuclear war is not a salient issue (Fiske, 1986) and therefore deserves little attention or thought. Past research has indicated, on average, that individuals do not report thinking about nuclear war (Fiske et al., 1983; Schuman, Ludwig, & Krosnick, 1986) or worrying about nuclear war (Kramer, Kalick, & Milburn, 1983). Moreover, nuclear war is often conceptualized as involving utter

destruction with virtual no chance of survival (Fiske, 1986). Theoretically, a belief that the probability of dying is high or harboring a fatalistic view of the likelihood of survival could mean there is little value or utility in putting forth effort to think about the topic or how to save oneself or others. Indeed, the elimination of nuclear risk from Americans' lived experience has relegated nuclear issues into a near mythical realm, one that has led to both fatalism and apathy.

Despite this broad evidence of a lack of concern or effort on the part of citizens, we also expect age to play a key role in individuals' degree of apathy. As discussed previously, generational experience with nuclear weapons and nuclear disaster preparedness (e.g., Civil Defense) varies widely; unlike perceived risk estimates, which are likely bound by individual time horizons, age should have a significant negative impact on feelings of apathy about nuclear topics. In other words, younger Americans should have a higher degree of apathy about nuclear topics than older Americans because of their lack of familiarity with the topic. Thus, we hypothesize the following:

H3a: As age increases, individuals' degree of nuclear apathy will decline.

Relatedly, research has gone a step further and shown that psychosocial factors are related to individuals' involvement in disaster preparedness and that cognitive factors such as perceived threat and ability to cope can determine an individuals' behavior (Slovic, 2002). Decades of research on fear appeals suggest that strong fear appeals with low-efficacy messages produce the greatest defensive responses (Witte & Allen, 2000). Because individuals respond more defensively to fear appeals with little information about how to reduce the risks, those with greater exposure to media may respond defensively (e.g., greater apathy) to information about nuclear risk. Given the fatalistic response that often occurs when Americans think about nuclear threats, apathy should increase when exposed to more media (Becker, 2004), as a way to psychologically protect oneself from a fear-inducing situation. As such, we hypothesize the following:

H3b: As media use increases, individuals' degree of nuclear apathy will increase.

Taken together, H3a and H3b suggest that indifference or a lack of concern about nuclear weapons risk should decrease as Americans get older, whereas it should increase with overexposure to the media.

Taking Action: Under What Conditions?

What is the relationship between perceptions about nuclear risk and subsequent action? Perceptions of risk may help partially explain who thinks about and prepares for the possibility of a nuclear attack. For instance, research on climate change suggests that perceived risk is related to behavioral intentions and may have a primary influence on behavior (Arlt, Hoppe, & Wolling, 2011). As such,

H4a: As individuals report greater perceived risk of a nuclear attack, they will be more likely to take action.

H4b: As apathy increases, individuals will be less likely to take action.

Methods

To gain a better understanding of Americans' current perceptions about nuclear weapons risk and subsequent behaviors, we fielded two nationally diverse online surveys.

Participants and Procedure

Both surveys were administered online through Qualtrics, and participants were recruited by Research Now/Survey Sampling International (SSI). Time 1, fielded April 25–May 2, 2018, included 2,050 participants (55% women) ranging in age3 from 18 to 90 years (M = 45.1 years, SD = 16.8 years). Time 2, fielded June 27–July 11, 2018, included 1,479 participants (55.4% women) ranging in age from 18 to 90 years (M = 45.3 years, SD = 16.8 years).

The average completion time for the survey was 15.7 minutes during Time 1 and 17.5 minutes for Time 2. Across both samples, participants were removed for reporting technical difficulty, for being less than 18 years old, for not being U.S. citizens, and for completing the survey in less than three minutes. The sample matches closely to U.S. Census benchmarks (see Table 1). The university's Institutional Review Board approved the current studies (2018-017[N]) before any data collection.

Table 1. Sample Properties.

	Time 1	Time 2	Census benchmark[1]
Gender			
Men	44.9%	44.6%	49.2%
Women	55.1	55.4	50.8
Race and ethnicity			
One race	97.2%	98.2%	97.1%
White	80.2	80.8	72.4
Black/Afr. Amer.	10.6	9.7	12.6
Amer. Indian, Alask	1.0	0.9	0.9
Asian	5.4	5.4	4.8
Native Amer., Pacif. Isl.	0.1	0.5	0.2
Other	2.6	2.6	6.2
Two or more races	2.8	1.8	2.9
Hispanic or Latino	12.8%	10.9	16.3%
Not Hispanic or Latino	87.2	89.1	83.7
White alone	68.9	74.0	63.7
Age			
18–24	11.8%	12.3%	13.0%
25–44	40.2	39.5	35.0
45–64	30.3	31.7	34.8
65+	17.7	16.5	17.1
Region			
Northeast	19.3%	19.4%	17.9%
Midwest	21.5	20.8	21.7
West	22.3	22.1	23.3
South	36.9	37.7	37.1
Education			
No high school	2.1%	2.0%	14.8%
High school	20.7	19.1	28.5
Some college	35.9	32.3	28.9
Bachelor's degree	26.4	28.7	17.6
Advanced degree	15.0	17.9	10.3
Partisanship[2]			
Democrat	44.5%	48.9%	48.0%
Independent	14.0	8.8	8.0
Republican	41.5	42.3	44.0
Sample size	2,050	1,479	

[1] Census Bureau, 2010.

[2] Pew Research, 2016.

Measures

Effort thinking about nuclear risk. Participants were asked: "How much effort would you say you have put into thinking about the possibility of a nuclear attack and how to prepare for it?" on a 5-point scale, from *no effort at all* to *a great deal of effort*.

Nuclear risk perception. Participants were asked "How likely do you believe it is that you will be affected by a nuclear attack in your lifetime? Below, please use the sliding scale (0 to 100) to indicate your best estimate of the risk." Participants could choose any number from 0 to 100 (with labels 0 = *never*, 50 = *equally likely as unlikely*, 100 = *certain*).

Nuclear apathy. Participants were asked about their apathy toward nuclear topics with three items—"I avoid reading or listening to news about nuclear threats"; "I prefer to ignore the idea that a nuclear attack could occur"; and "If a nuclear attack occurs, there is not much I could do to save my own life"—on a 5-point scale (*strongly disagree* to *strongly agree*; Time 1 $\alpha = 0.69$, Time 2 $\alpha = 0.72$). The apathy measure is a linear additive scale of all three items that produces the mean across the three items.

Communicative actions. Participants were asked: "How likely are you to do each of the following in the next six months?" for the following items: "share information or opinions about nuclear threat online"; "initiate a conversation about nuclear threat and/or risk"; and "contact an elected official, candidate, or political group about nuclear threat or preparedness" on a 5-point scale (*not at all likely* to *extremely likely*).

Preparative actions. Participants were asked: "How likely are you to do each of the following in the next six months?" for following items: "create an emergency kit for myself and/or my family"; "identify locations to shelter in near where you spend a lot of time (such as home, work, or school)" on a 5-point scale (*not at all likely* to *extremely likely*).

Information seeking. To assess whether participants would seek additional information on topics related to nuclear risk, click behavior was collected and analyzed. Participants were told: "Now we'd like to offer you additional resources on nuclear threat and preparedness. Below, please find links from several organizations for more information. There are eight, total, organized by topic/theme. Please click on all those you wish to access (each will open in a new window for later use)." The measure is an indicator variable that takes the value of zero if no links are clicked and one if any links are clicked.[3]

Media usage. Participants were asked: "During a typical week, how many days do: 'you watch, listen, or read news on the Internet'; 'watch news on TV;' 'read news in a printed newspaper'; and 'listen to

[3] We also have a measure of click count, but the distribution is right skewed, as the modal respondent did not click on a single link. At Time 1, 23.7% of the sample clicked on one or more links, whereas at Time 2, 20.2% of the sample did so. We rely on the indicator variable because it resolves the distribution concerns and, substantively, the action of information seeking is undertaken whether the individual clicks on one link or more than one link.

news on the radio'?" on a 0–7 days scale. The measure relies on a linear additive scale that produces the mean across all four modes.

Follow the news. Participants were asked: "Some people seem to follow what's going on in the news and public affairs most of the time. Others aren't that interested. How often would you say you follow news and current events?" on a 5-point scale (*hardly at all* to *all of the time*).

Demographics. Participants reported their age, gender identification, racial/ethnic identification, and education level.

In what follows, we conduct a series of multivariate regression models aimed to test the above hypotheses and identify descriptive relationships among individual characteristics, perceptions, and subsequent behavior about nuclear weapons risk. All of the analyses use standardized variables (coded between zero and one) and were conducted using STATA (Version 14).

Results and Discussion

We begin by providing findings about Americans' perceptions of nuclear risk. The results indicate that, on average, Americans think being affected by a nuclear attack in their lifetime is slightly less likely to occur than 50/50 odds. Specifically, the average estimated risk on a 100-point scale at Time 1 was M = 43.7 (SD = 25.7), whereas it was estimated at Time 2 as M = 44.2 (SD = 26.4). A difference of means test revealed that, on average, perceptions of nuclear risk were not significantly different between Time 1 and Time 2 (two-tailed, *ns*). The median response was a 48 (Time 1) and 49 (Time 2; of 100), and the modal response across both time periods was a 50, meaning equally likely as unlikely to occur. Recall, a series of studies from the mid-1950s through the 1980s place perceptions of the risk of nuclear war between one-third chance and about a 50/50 chance (Fiske, 1986). This suggests that, on average, the degree of risk perceived among the U.S. public today is similar to what it was during the Cold War.

Despite stability in aggregate estimates of risk over time, there is little research on the impact of individual characteristics such as media usage and age on these perceptions. Table 2 presents the results of a multivariate linear regression model predicting self-reported perceptions of nuclear risk. The results demonstrate that an individual's perceived risk of being affected by a nuclear attack in their lifetime significantly decreases as age increases and the more they report following the news. Alternatively, perceived nuclear risk significantly increases among women (versus men), among individuals living in cities (versus suburban or rural locations), and as media usage increases. Thus, the impact of reporting high media exposure increases one's perception of nuclear risk whereas the impact of following the news and current events closely decreases one's perceived risk. Why would the effect of following the news pull in the opposite direction of media usage? In short, the effect of increased exposure to TV, radio, and the Internet is different than the effect of closely following current events. Those who report paying close attention to current events show lower predicted estimates of risk than those who report not paying close attention. Whereas those who spend a lot of time with various types of media show higher predicted estimates of risk than those who report low levels of media exposure (see Table 2).

Table 2. Predicting Perceptions of Nuclear Risk Based on Individual Characteristics.

	Time 1	Time 2
Age	−0.271***	−0.253***
	(0.025)	(0.030)
Woman	0.033***	0.053***
	(0.011)	(0.014)
Media usage	0.265***	0.293***
	(0.024)	(0.030)
Follow news	−0.068***	−0.061**
	(0.023)	(0.029)
Education	−0.028	−0.031
	(0.024)	(0.029)
Non-White	−0.002	0.009
	(0.012)	(0.015)
Region_Midwest	0.006	0.012
	(0.017)	(0.020)
Region_South	0.006	0.026
	(0.015)	(0.018)
Region_West	0.001	−0.009
	(0.017)	(0.020)
Urban	0.048***	0.074***
	(0.012)	(0.015)
Constant	0.417***	0.369***
	(0.025)	(0.031)
Observations	1,981	1,425
Adj. *R*-squared	0.138	0.147

Standard errors in parentheses. *p < .10. **p < .05. ***p < .01.

In terms of magnitude, the strongest individual level effects are for age. For example, at Time 1, holding all else constant, an 18-year-old's predicted risk estimate is at 50 (of 100), whereas a 43-year-old's estimate declines to a 44, and an 80-year-old's estimate is a 33 (about a one-third chance). For comparison, individuals living in an urban location put the risk of being affected by a nuclear attack as 5%–7% higher than those living in rural or suburban locations, suggesting that perceptions may be higher among those who believe their home location could be a target. Further, women estimate the risk of nuclear attack as approximately 3%–5% higher than men do, holding all else constant. Notably, women and men have significant differences in media habits in this study, which is consistent with previous findings. Specifically, women report significantly lower media usage than men do (p < .000) and report following the news and current events significantly less often (p < .000).[4] On examination, the significant positive effect of media usage on perceived risk is partially mediated (about 5% of the total effect) by gender (p = .02). Taken

[4] Two-tailed *t* test, Time 1. Time 2 test is substantively and statistically similar.

together, these findings support both Hypotheses 1 and 2. We turn now to examining behavior, focusing on nuclear apathy (H3a and H3b).

Recall that apathy is an additive index of three items, scaled 0–1. At Time 1, apathy was *M* = 0.46 (*SD* = 0.22); whereas at Time 2, apathy was *M* = 0.41 (*SD* = 0.23). A difference of means test across Time 1 and 2 is significant (two-tailed, *p* = .000). In other words, apathy was significantly higher at Time 1. We discuss this difference further after reviewing the full results. To dig deeper into the individual characteristics that predict nuclear apathy, we conducted similar multivariate analyses across both time periods (see Table 3). Model 1 is a simple linear estimation that tests Hypothesis 3a, the expectation that apathy ought to decline with age due to older Americans' increased experience with and exposure to nuclear threat. As is clear from the coefficient on age at both Time 1 and Time 2, as Americans get older, apathy significantly declines. The predicted marginal effect of age on apathy reveals that, holding all else constant, an 18-year-old would be expected to score 0.52 (of 1), putting their degree of apathy above the midpoint and indicating that they agree more than they disagree when averaging across the three items. The median respondent, a 43-year-old, would score 0.46, whereas an 80-year-old's predicted degree of apathy would decrease to 0.37, suggesting they would fall, on average, between *strongly disagreeing* and *disagreeing* with the apathy measures. This is evidence in support of Hypothesis 3a.

Table 3. Predicting Nuclear Apathy Based on Individual Characteristics.

	Time 1		Time 2	
	(1)	(2)	(1)	(2)
Media use	0.119***	0.292***	0.129***	0.241**
	(0.021)	(0.076)	(0.026)	(0.096)
Age (Continuous)	−0.174***	–	−0.158***	–
	(0.021)		(0.027)	
Age (Millennials, 22–37 years)	–	−0.034	–	−0.041
		(0.045)		(0.053)
Age (Gen X, 38–53 years)	–	0.059	–	0.083
		(0.046)		(0.054)
Age (Baby Boomers, 54–72 years)	–	0.033	–	0.061
		(0.046)		(0.055)
Age (Silent Gen, 73–90 years)	–	−0.000	–	0.106
		(0.067)		(0.105)
Media Use × Age (Millennials)	–	−0.029	–	0.091
		(0.082)		(0.102)
Media Use × Age (Gen X)	–	−0.271***	–	−0.280***
		(0.085)		(0.105)
Media Use × Age (Baby Boomers)	–	−0.331***	–	−0.283***
		(0.084)		(0.105)
Media Use × Age (Silent Gen)	–	−0.224*	–	−0.293*
		(0.119)		(0.173)
Woman	−0.022**	−0.019**	−0.025**	−0.026**
	(0.010)	(0.010)	(0.012)	(0.012)

Follow news	−0.195***	−0.180***	−0.144***	−0.145***
	(0.020)	(0.020)	(0.025)	(0.025)
Education	0.098***	0.096***	0.053**	0.055**
	(0.021)	(0.021)	(0.025)	(0.025)
Non-White	−0.048***	−0.045***	−0.065***	−0.058***
	(0.011)	(0.010)	(0.014)	(0.014)
Region_Midwest	−0.016	−0.016	−0.022	−0.021
	(0.015)	(0.014)	(0.018)	(0.018)
Region_South	−0.011	−0.012	−0.001	−0.005
	(0.013)	(0.013)	(0.016)	(0.016)
Region_West	0.008	0.005	−0.019	−0.024
	(0.014)	(0.014)	(0.018)	(0.018)
Urban	0.025**	0.022**	0.057***	0.044***
	(0.010)	(0.010)	(0.013)	(0.013)
Constant	0.573***	0.492***	0.505***	0.434***
	(0.021)	(0.044)	(0.027)	(0.052)
Observations	1,996	1,996	1,448	1,448
Adj. *R*-squared	0.118	0.137	0.088	0.128

Standard errors in parentheses. *$p < .10$. **$p < .05$. ***$p < .01$.

Turning to Hypothesis 3b, we expected media use to significantly increase an individual's degree of nuclear apathy. As indicated by the coefficient on media use across both time periods (Model 1), Hypothesis 3b is also supported. Increasing media use has a significant positive effect on apathy. In other words, as individuals report higher levels of exposure to TV, radio, newspapers, and the Internet, apathy toward nuclear weapons threat increases. Notably, the magnitude of effect for both media use and age are similar across time periods and model specifications. Moreover, several individual characteristics have a consistent significant effect on apathy—specifically, as individuals report following the news more closely, their degree of apathy significantly declines (at a magnitude similar to the effects of both age and media use). Further, the significant effects of woman and non-White (both negatively affecting apathy) and education and urban (both positively impacting apathy) are smaller in magnitude, but the pattern is consistent across time. Together, these factors prove meaningful and their relationship to apathy about nuclear weapons risk warrant greater attention in future research.

Returning to age and media use, it is reasonable to expect these two characteristics to be related. Yet amount of media use and age are not significantly correlated in our sample. Given evidence that both factors play a decisive role in these behaviors, we conducted exploratory analyses based on our theoretical expectation that different generations of Americans use media differently. Individuals between the ages of 18 and 37 years (Generation Z is 21 years and younger, whereas Millennials are between 22–37 years) came of age with a media environment that was vastly different than older Americans. Moreover, for Americans that experienced Civil Defense and the Cold War, exposure to media may be less likely to affect their degree of apathy about nuclear topics because those behaviors may have crystalized over time. Therefore, Model 2 (see Table 3) presents the results of an interactive multivariate model that allows the impact of media use on apathy to vary by age as categorized by

generations. The youngest Americans (Generation Z) are the reference category. Therefore, the coefficient on media use in Model 2 indicates the effect of media use among Generation Z on apathy. To determine the effect for each generation would require adding the constituent terms together. For ease of interpretation and visual clarity, we present the predicted marginal effects in Figure 1.

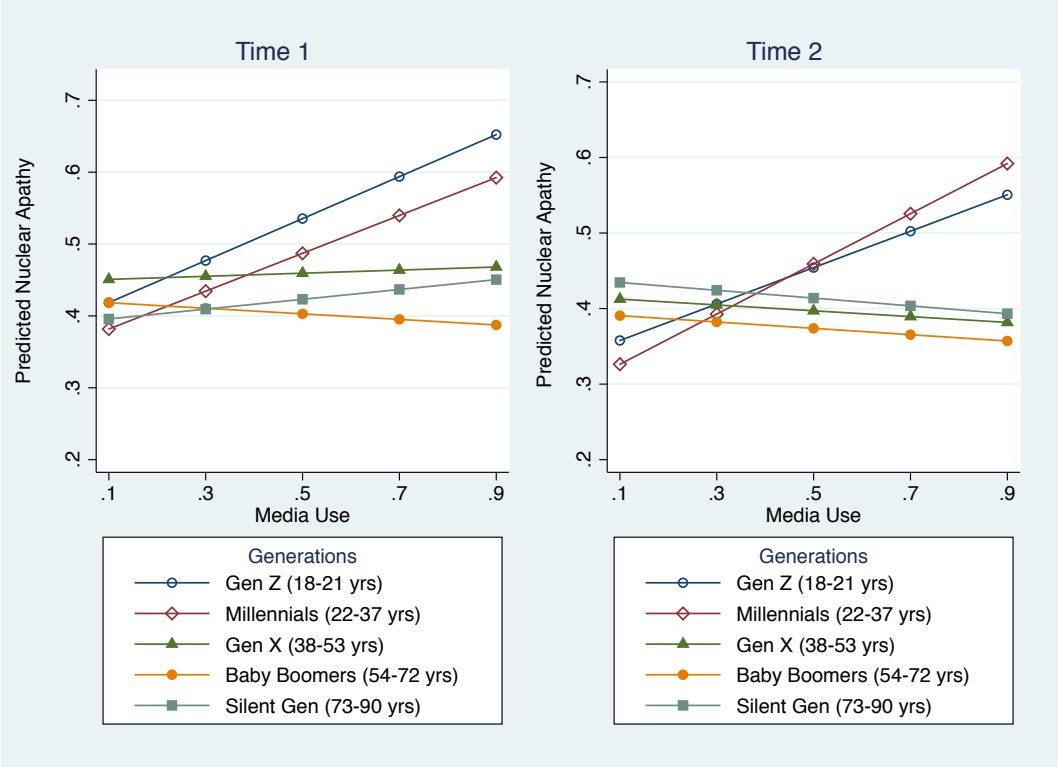

Figure 1. Predicted marginal effect of media usage by age generation on nuclear apathy.

Whether using the table to add the appropriate terms for each age generation or examining the predicted marginal effects plot across time periods, it is clear that increasing media use significantly increases apathy among younger Americans.[5] At low levels of media use, there are no significant differences in apathy among any age groups. It is only as individuals from ages 18–37 years report high levels of media exposure (above the midpoint) that their degree of apathy about nuclear topics is significantly higher than that of older Americans. Therefore, Hypothesis 3b is partially supported because the linear model masks variation across age categories. To be clear, this should not be interpreted to mean that older Americans cannot be apathetic about nuclear topics. Rather, this finding suggests that

[5] Table 3 shows a significant negative effect among older generations in comparison with the reference group. In other words, the slope of the relationship significantly decreases. Postestimation Wald tests confirm that the effect among Millennials is significantly different than the effect among both Gen. X (Time 1, p = .001; Time 2, p = .0001) and Baby Boomers (Time 1, p = .01; Time 2, p = .003).

media usage has no discernible impact on nuclear apathy among older generations of Americans, whereas it increases apathy among younger generations of Americans. Next, we turn to examining the impact of these two key individual characteristics (age and media usage), as well as the two variables reviewed, apathy and perceived risk, on Americans' willingness to take action in response to nuclear topics. Recall that we expect apathy to decrease actions (H4b) and perceived risk of a nuclear attack to increase actions (H4a). We measure action in three ways: self-reported effort thinking about nuclear risk, information seeking as measured by click behavior, and intent to take two types of actions: communicative and preparative.

Overall, most Americans said they do not think about what to do if a nuclear attack occurred. Whether it is a "dirty" bomb, an improvised nuclear device, or a conventional nuclear weapon, 23% of Americans reported at Time 1 that they put "no effort at all" into "thinking about the possibility of a nuclear attack and how to prepare for it." An additional 29% said they put in "a little effort." The average effort reported at Time 1 was $M = 2.54$ ($SD = 1.19$), whereas at Time 2 it was $M = 2.71$ ($SD = 1.25$); the difference of means is significant ($p < .000$, two-tailed), meaning self-reported effort thinking about nuclear risk is significantly higher in Time 2 than in Time 1. This result is similar and substantively consistent with the group difference in apathy reviewed previously. Apathy is significantly higher and effort is significantly lower at Time 1 (versus Time 2). This suggests that, on average, decreases in apathy at Time 2 correspond to increases in self-reported effort. Given that each time period of study includes different respondents, this between-subjects comparison that produces significant group differences indicates that the change in time period is the likely cause. Media coverage before Time 1 (April 25–May 2, 2018) included Russian President Putin's claim to have created "invincible" nuclear weapons that could "reach anywhere in the world" (BBC, 2018, p. 2). Yet if the effect of apathy on effort is direct, we would expect the multivariate results to demonstrate such.

Table 4 shows the results of a multivariate linear regression model estimating the individual level factors that determine one's degree of effort for each time period of the study. The models include the key individual characteristics of age and media usage, but also now include both apathy and perceived risk as variables that might predict action. The results provide clear evidence that self-reported effort significantly decreases as Americans get older and significantly increases both as media usage and estimates of perceived risk increase.

Table 4. Predicting Nuclear Effort Based on Individual Characteristics, Perceptions, and Behaviors.

	Time 1	Time 2
Age	−0.218***	−0.122***
	(0.027)	(0.035)
Media use	0.189***	0.219***
	(0.026)	(0.034)
Estimated risk	0.470***	0.395***
	(0.024)	(0.029)
Nuclear apathy	0.011	0.049
	(0.027)	(0.033)
Women	−0.050***	−0.059***
	(0.012)	(0.015)
Follow news	0.062**	0.039
	(0.025)	(0.032)
Education	−0.021	−0.075**
	(0.025)	(0.032)
Non-White	−0.002	0.063***
	(0.013)	(0.017)
Region_Midwest	−0.005	−0.008
	(0.018)	(0.023)
Region_South	−0.008	0.036*
	(0.016)	(0.020)
Region_West	0.008	0.017
	(0.017)	(0.023)
Urban	0.001	0.013
	(0.013)	(0.017)
Constant	0.154***	0.163***
	(0.031)	(0.039)
Observations	1,978	1,423
Adj. *R*-squared	0.300	0.238

Standard errors in parentheses. *$p < .10$. **$p < .05$. ***$p < .01$.

For ease of interpretation, Figure 2 shows the marginal effects plots for age, media usage, and perceived risk across both time periods. Notably, the magnitude of the effect is greatest for perceived risk, as the rate of change is more than double that of age. This is preliminary evidence in support of Hypothesis 4a. Moreover, the results are strikingly similar across time periods, both in terms of the direction and magnitude of each effect. Contrary to expectations, apathy has little impact on the degree of effort put forward, which is inconsistent with Hypothesis 4b.

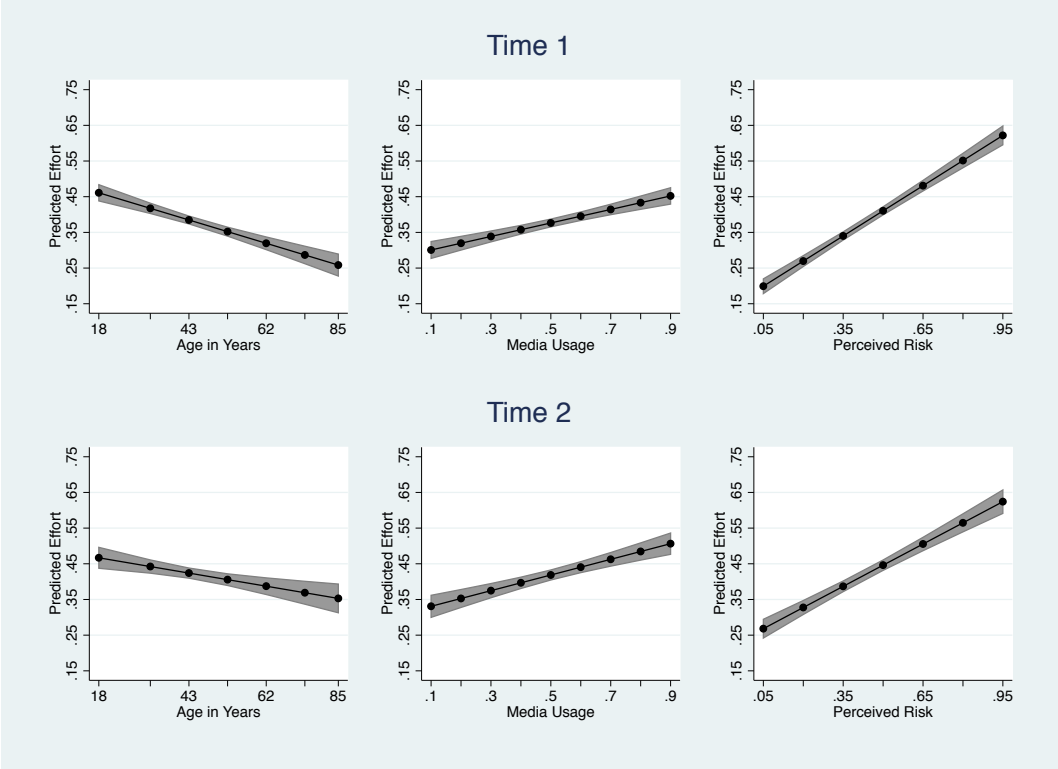

Figure 2. Predicted marginal effects of key variables on self-reported effort, Times 1 & 2.

Given the previous analyses that established the links between age and media usage with perceived risk, tests of mediation are warranted. In other words, to what extent is the impact of age on the degree of effort of thinking about nuclear risk mediated by perceived risk? Across two different tests of mediation, the effect is partially mediated in both time periods. Specifically, 47% at Time 1 and 51% at Time 2 of the impact of age on nuclear effort operates through perceived risk estimates. Turning to media usage, the results are similar, with significant partial mediation. That is, about 35% at Time 1 and 30% at Time 2 of the effect of media usage on nuclear effort is mediated by perceived risk.

How ought we interpret the impact of perceived risk on self-reported effort? A large body of literature suggests that perceptions of risk, regardless of whether the perceived risk is appropriately aligned with the actual risk, are important predictors of behaviors (Arlt et al., 2011; Brewer et al., 2007; Whitmarsh, 2008). Importantly, we neither seek to make any claim about the actual degree of risk to U.S. citizens nor do we seek to claim that individuals ought to perceive the risk of a nuclear weapons attack as higher (or lower). Rather, this research aims to both understand how individuals arrive at their perception of nuclear weapons risk and how these perceptions influence behavior.

Next, we assessed information seeking based on the click behavior of participants as a measure of real-world behavior. Overall, 20%–25% of participants in each time period sought additional information by

clicking on at least one of the provided links. Theoretically, the real-world action of information seeking is undertaken whether the individual clicks on one link or more than one link, and the exact click count variable was right skewed with a few people clicking on multiple links. Table 5 shows the results of two multivariate binomial logistic regression models, one for each time period, predicting information seeking. As indicated by the significant positive coefficient on age, as Americans get older, they are increasingly likely to seek more information. Notably, apathy has a significant negative impact on information seeking. Though the magnitude is smaller than that of age, this indicates that the more apathetic individuals are about nuclear topics, the less they seek related information (consistent with H4b). Lastly, as individuals increasingly follow the news closely, information seeking also significantly increases.

Table 5. Predicting Information Seeking Based on Individual Characteristics, Perceptions, and Behaviors (Logistic Regression).

	Time 1	Time 2
Age	4.557***	3.851***
	(0.312)	(0.387)
Media usage	−0.114	−0.246
	(0.292)	(0.374)
Perceived risk	−0.133	−0.897***
	(0.253)	(0.310)
Apathy	−0.976***	−1.554***
	(0.302)	(0.384)
Woman	0.180	0.578***
	(0.124)	(0.162)
Follow news	0.729**	0.715*
	(0.288)	(0.375)
Education	0.350	0.365
	(0.282)	(0.344)
Non-White	0.090	0.317*
	(0.145)	(0.191)
Region_Midwest	−0.155	0.608***
	(0.185)	(0.228)
Region_South	−0.170	−0.056
	(0.164)	(0.216)
Region_West	−0.220	0.181
	(0.183)	(0.234)
Urban	0.095	−0.169
	(0.139)	(0.184)
Constant	−3.342***	−3.316***
	(0.365)	(0.456)
Observations	1,978	1,423
Pseudo *R*-squared	0.189	0.161

Standard errors in parentheses. *$p < .10$. **$p < .05$. ***$p < .01$.

Thus far, age repeatedly influences actions with respect to nuclear topics, whereas media usage, perceived risk, and apathy have mixed effects that vary across different measures. We turn now to a final measure of action, self-report intention to take communicative actions (see Table 6) or preparative actions (Table 7).

Table 6. Predicting Communicative Action Based on Individual Characteristics, Perceptions, and Behaviors.

	Time 1		Time 2	
	(1)	(2)	(1)	(2)
Age	−0.279***	−0.274***	−0.277***	−0.267***
	(0.025)	(0.025)	(0.028)	(0.028)
Apathy	0.060**	−0.076	0.104***	−0.101
	(0.025)	(0.058)	(0.027)	(0.062)
Media usage	0.329***	0.215***	0.349***	0.198***
	(0.024)	(0.050)	(0.028)	(0.050)
Apathy × Media Usage	–	0.235***	–	0.344***
		(0.090)		(0.093)
Perceived risk	0.428***	0.420***	0.444***	0.433***
	(0.022)	(0.022)	(0.024)	(0.024)
Woman	−0.015	−0.013	0.007	0.009
	(0.011)	(0.011)	(0.012)	(0.012)
Follow news	−0.008	−0.011	0.012	0.009
	(0.023)	(0.023)	(0.026)	(0.026)
Education	−0.036	−0.037	−0.098***	−0.100***
	(0.023)	(0.023)	(0.026)	(0.026)
Non-White	0.030**	0.031***	0.046***	0.048***
	(0.012)	(0.012)	(0.014)	(0.014)
Region_Midwest	0.004	0.005	0.007	0.005
	(0.016)	(0.016)	(0.019)	(0.018)
Region_South	0.031**	0.030**	0.037**	0.035**
	(0.014)	(0.014)	(0.017)	(0.016)
Region_West	0.022	0.022	0.013	0.007
	(0.016)	(0.016)	(0.019)	(0.018)
Urban	0.034***	0.033***	0.031**	0.027**
	(0.011)	(0.011)	(0.014)	(0.014)
Constant	0.051*	0.120***	0.014	0.109***
	(0.029)	(0.039)	(0.032)	(0.041)
Observations	1,974	1,974	1,423	1,423
Adj. *R*-squared	0.402	0.404	0.439	0.444

Standard errors in parentheses. *$p < .10$. **$p < .05$. ***$p < .01$.

Table 7. Predicting Preparative Action Based on Individual Characteristics, Perceptions, and Behaviors.

	Time 1		Time 2	
	(1)	(2)	(1)	(2)
Age	−0.195***	−0.187***	−0.203***	−0.184***
	(0.028)	(0.028)	(0.031)	(0.032)
Apathy	−0.163***	−0.461***	−0.070**	−0.287***
	(0.029)	(0.055)	(0.030)	(0.058)
Perceived risk	0.440***	0.152***	0.462***	0.279***
	(0.025)	(0.052)	(0.027)	(0.050)
Apathy × Perceived Risk	–	0.602***	–	0.414***
		(0.096)		(0.095)
Media usage	0.264***	0.242***	0.292***	0.280***
	(0.028)	(0.028)	(0.031)	(0.031)
Woman	0.022*	0.027**	0.032**	0.038***
	(0.012)	(0.012)	(0.014)	(0.014)
Follow news	−0.006	−0.013	0.024	0.013
	(0.026)	(0.026)	(0.029)	(0.029)
Education	0.017	0.005	−0.068**	−0.070**
	(0.027)	(0.027)	(0.029)	(0.029)
Non-White	0.021	0.027**	0.039**	0.044***
	(0.013)	(0.013)	(0.016)	(0.016)
Region_Midwest	0.006	0.010	0.011	0.008
	(0.018)	(0.018)	(0.020)	(0.020)
Region_South	0.041**	0.039**	0.048***	0.046**
	(0.016)	(0.016)	(0.018)	(0.018)
Region_West	0.044**	0.043**	0.038*	0.035*
	(0.018)	(0.018)	(0.020)	(0.020)
Urban	0.031**	0.028**	0.037**	0.034**
	(0.013)	(0.013)	(0.015)	(0.015)
Constant	0.228***	0.377***	0.148***	0.247***
	(0.033)	(0.040)	(0.036)	(0.042)
Observations	1,975	1,975	1,423	1,423
Adj. *R*-squared	0.275	0.289	0.343	0.351

Standard errors in parentheses. *$p < .10$. **$p < .05$. ***$p < .01$.

Model 1 is a simple linear model across both time periods. The results suggest that increases in age significantly decrease individuals' intent to take both communicative and preparative actions. Perceived risk significantly increases individuals' intent to take both types of actions, consistent with Hypothesis 4a. However, the effect of apathy across action types (H4b) is mixed, as increased apathy about nuclear topics leads to increases in communicative actions, but decreases in preparative actions.

Given the previously demonstrated dependent effects of apathy on individual characteristics (age and media usage), we explored the possibility that the impact of apathy on actions is dependent on narrowly relevant preexisting beliefs. Research on cognition has found that individuals will rely on the most narrowly relevant or diagnostic information available when constructing a belief or opinion (Crawford, Jussim, Madon, Cain, & Sean, 2011; Karl & Ryan, 2016). In this study, actions may vary in how costly an individual perceives them to be based on their existing beliefs. For example, communicative actions should be less costly to someone who engages with the media regularly compared with someone who rarely does so. Similarly, preparative actions should be costly to everyone, yet individuals who perceive a higher likelihood of nuclear attack in their lifetime ought to be more willing to undertake preparative actions despite the cost. In technical terms, these expectations mean that the relationship between apathy and communicative action ought to be dependent on media usage, whereas the relationship between apathy and preparative action ought to be dependent on perceived risk. Despite establishing these theoretical expectations, Model 2 in both Tables 6 and 7 should be considered exploratory analyses to identify theoretically motivated relationships that can be tested more thoroughly in future research.

The marginal effects for communicative action across Time 1 and Time 2 are plotted in Figure 3.

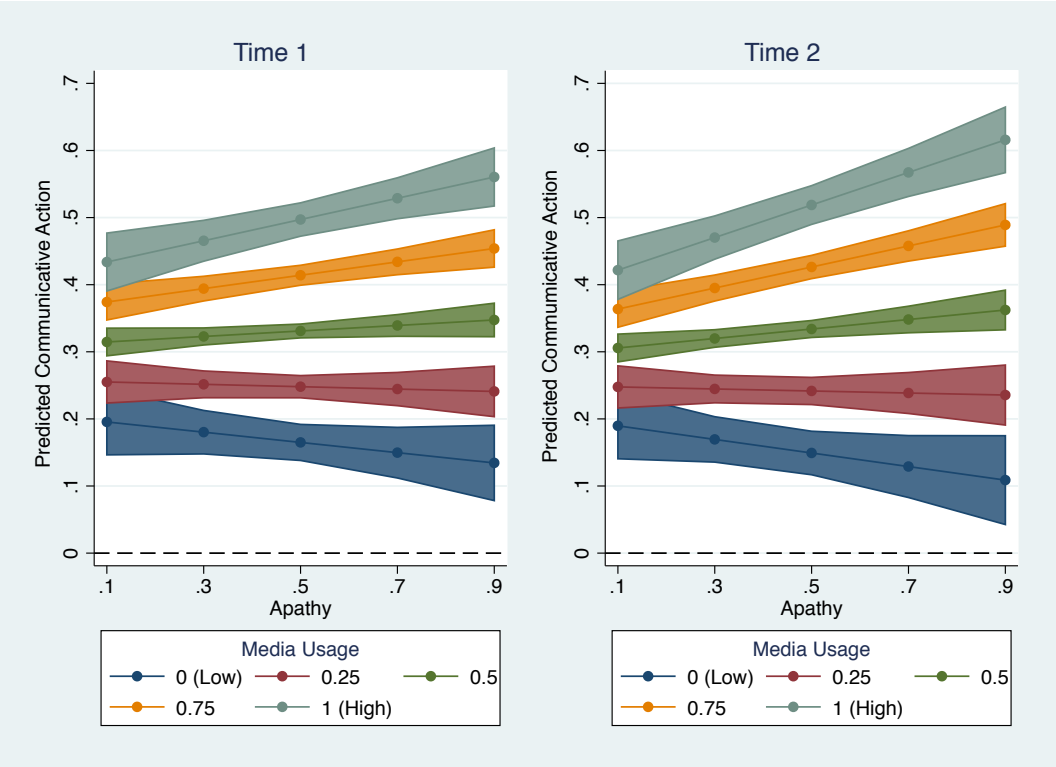

Figure 3. Predicted marginal effect of apathy by media usage on communicative action.

Taken together, this means Hypothesis 4b is only partially supported. Turning to preparative action, the costlier type, the pattern of results is similar, albeit with a slightly different interpretation. The marginal effects for preparative action across Time 1 and Time 2 are plotted in Figure 4. Among individuals who think there is a very low chance of a nuclear attack, apathy strongly decreases intent to take concrete preparative steps. However, as perceptions of risk increase, the relationship between apathy and willingness to take preparative actions weakens, and individuals increase their intent to take these actions. At the highest level of perceived risk, apathy has virtually no impact (the slope of the line cannot be distinguished from zero) on individuals' intent to take concrete steps to prepare, consistent with Hypothesis 4a.

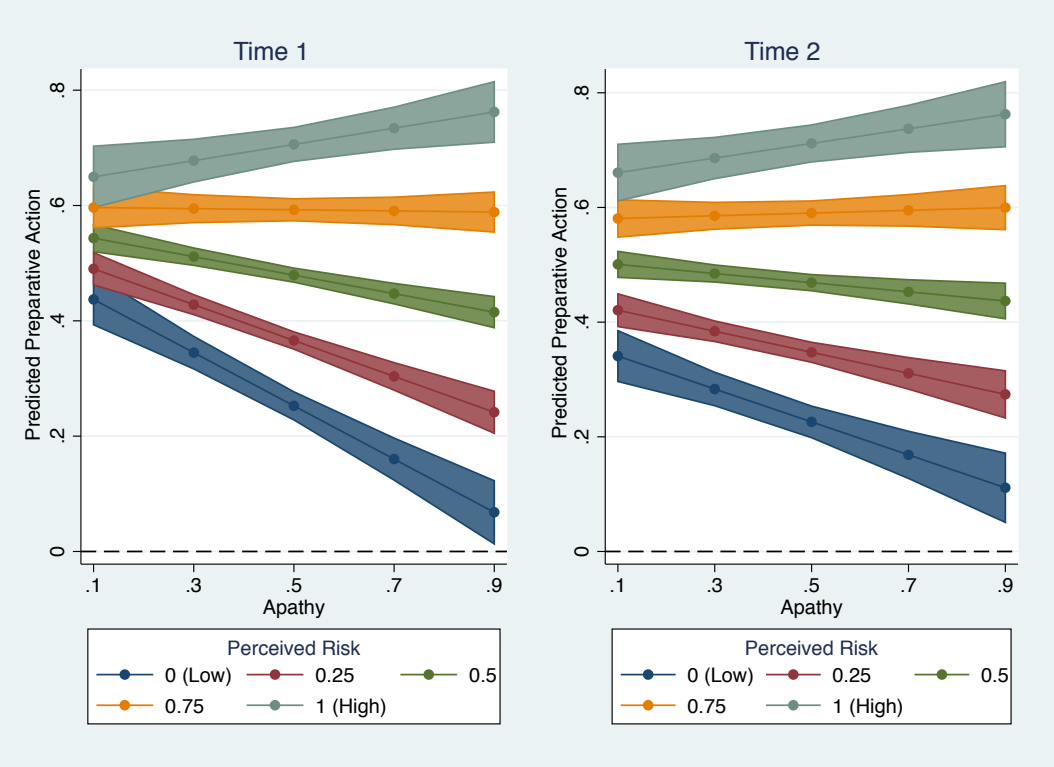

Figure 4. Predicted marginal effect of apathy by perceived risk on preparation action.

Conclusions

The main focus of the current research was to gain a better understanding of current perceptions of nuclear weapons risk among U.S. adults, and a better understanding of the relationship between perceptions of nuclear weapons risks and subsequent behavior. Since the end of the Cold War, few studies have examined Americans' perceived risk of a nuclear attack. We conducted two nationally diverse surveys of more than 1,500 U.S. citizens to address this gap in the literature. In general, the results suggest that Americans, on average, continue to perceive the risk of a nuclear attack to be only slightly less likely than

50/50 odds. As anticipated, we find evidence that age and media usage were important individual difference characteristics that impacted perceptions of nuclear risk, apathy, and subsequent action.

Older Americans perceive the risk of a nuclear attack in their lifetime as lower than younger Americans do, and these estimates are also less influenced by media exposure. Media usage significantly increases nuclear apathy among younger Americans, particularly those who did not come of age during the Cold War period. As discussed earlier, this age group has a lack of familiarity and experience with nuclear risk. Theoretically, this combination could stimulate fatalism about nuclear issues and survivability among younger Americans. To reduce the cognitive dissonance of knowing little about nuclear issues, but being exposed to media about these and related issues, younger Americans may embrace apathy to justify their lack of knowledge or efficacy of how to respond.

Furthermore, this research clearly and consistently demonstrates that increasing perceptions of nuclear risk significantly increases actions on nuclear topics. Stated differently, Americans with higher estimates of risk are more likely to exert effort in thinking about how to prepare and to express a willingness to take communicative and preparative actions. Lastly, we find suggestive evidence that the impact of apathy on actions may be dependent on an individuals' existing perceptions, and in particular on those perceptions that are most relevant to the action at hand.

Limitations

The results of the current investigation should be considered in light of limitations of the study. Although our results arise from a reliable data-gathering source and include two nationally diverse samples with variation across age, race/ethnicity, region, and other characteristics (see Table 1), our sample is not representative. In particular, participants in this study opt-in to participating in online surveys, and thus we cannot generalize the results to individuals without online access. In addition, our study examined perceptions and subsequent behavior among U.S. citizens. Given that the use of a nuclear weapon would likely involve citizens from countries around the world or a conflict between two or more countries/regions, future research should investigate perceived nuclear risk among individuals in different countries and cultures.

With respect to measures, we assessed willingness to take action in response to nuclear issues using both behavioral intentions and behavioral outcomes. Our measure of behavioral outcomes, click behavior, resulted in low participation. Although meaningful information can still be gleaned from this data, future research should investigate behavioral outcomes that result in greater participation. Additionally, the wording of some measures should be explored by future research. For example, our measure "effort thinking about nuclear risk" should be separated into two questions: "How much effort would you say you have put into thinking about the possibility of a nuclear attack," and "How much effort would you say you have put into preparing for a possible nuclear attack?" Likewise, based on the similar wording used in past studies (Fiske, 1986; Fiske et al., 1983), we asked participants, "How likely do you believe it is that you will be affected by a nuclear attack in your lifetime?" As indicated by analyses of urban/suburban versus rural participants, rural participants perceive the risk of nuclear attack as lower. It is possible that this discrepancy is driven by a belief that a nuclear attack is possible, but that individuals living in rural areas are less likely

to personally impacted. Further clarification should be sought by asking participants about their perceptions of risk and their perceptions of being impacted if a nuclear attack were to occur.

Lastly, this research leverages quantitative methods to analyze a series of comparisons. As the number of estimated models multiplies, the likelihood of false positive results also increases. We have indicated where this research developed clear theoretical expectations and tested these hypotheses explicitly, whereas exploratory analyses should be treated as preliminary and future research should examine the identified mechanisms explicitly.

Future Directions and Implications

This research represents a first step toward greater understanding of Americans' current perceptions of nuclear weapons threat. Yet much work remains. Our research found that most Americans reported having had little to no exposure to nuclear disaster preparedness messaging about how to respond in the case of a nuclear emergency. Specifically, a majority of Americans in both surveys (64% at Time 1 and 55% at Time 2) reported they had never previously heard or seen any recommendations about what to do in the event of a nuclear attack. This is particularly striking because the false Hawaiian missile alert occurred only a few months before (January 2018) and received widespread media coverage in the United States and worldwide. In the aftermath of the Hawaiian false missile alert, a better understanding of individuals' knowledge of how to respond in the event of a nuclear emergency is paramount (Karl & Lytle, 2019). If most Americans have little to no knowledge of how to respond, the number of preventable causalities may be much higher than expected. How to best educate Americans on nuclear disaster preparedness is essential and should be the focus of future research.

Regarding implications, specifically educational campaigns geared toward increasing Americans' knowledge of nuclear weapons risk and how to respond in a nuclear emergency, recall that individuals who reported higher estimates of risk were more likely to think about how to prepare and to express a willingness to take communicative and preparative actions. Educational campaigns may increase Americans' willingness to think about nuclear issues and take action. Such campaigns should also provide information of how to respond in the event of a nuclear attack and facilitate self-efficacy that recommended actions can be taken to increase one's chance of survival. The importance of accurate and widespread educational campaigns and their impact on perceptions of nuclear risk should be the focus of future research.

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