It Depends:

Partisan Evaluation of Conditional Probability Importance

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NSF Grants 1757315 and 1730611 supported this research.

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Abstract

Policies to suppress rare events such as terrorism often restrict co-occurring categories such as Muslim immigration. Evaluating restrictive policies requires clear thinking about conditional probabilities. Terrorism is extremely rare, for example. Even if most terrorist immigrants are Muslim, a high "hit rate," the inverse conditional probability of Muslim immigrants being terrorists is extremely low. Yet the inverse conditional probability is more relevant to evaluating restrictive policies such as the threat of terrorism if Muslim immigration were restricted. We suggest that people engage in partisan evaluation of conditional probabilities, judging hit rates as more important when they support politically prescribed restrictive policies. In two studies, supporters of expelling asylum seekers from Tel Aviv, Israel, of banning Muslim immigration and travel to the United States, and of banning assault weapons judged "hit rate" probabilities (e.g., that terrorists are Muslims) as more important than did policy opponents, who evaluated the inverse conditional probabilities (e.g., that Muslims are terrorists) as more important. These partisan differences spanned restrictive policies favored by Rightists and Republicans (expelling asylum seekers and banning Muslim travel) and by Democrats (banning assault weapons). Inviting partisans to adopt an unbiased expert's perspective partially reduced these partisan differences. In Study 2 (but not Study 1), partisan differences were larger among more numerate partisans, suggesting that numeracy supported motivated reasoning. These findings have implications for polarization, political judgment, and policy evaluation. Even when partisans agree about what the statistical facts are, they markedly disagree about the relevance of those statistical facts.

Keywords: conditional probability; motivated reasoning; political cognition; probability judgment

1. Introduction

In 2017 the Trump administration put forth Executive Order 13780 entitled, "Protecting the Nation from Foreign Terrorist Entry into the United States." The order restricted travel to the United States (US) from majority-Muslim countries and blocked refugees from Syria. The so-called "Muslim travel ban" echoed earlier arguments from conservative commentator, Ann Coulter (Coulter, 2001). Following the terrorist attacks of 9/11, Coulter advocated the expulsion of non-citizen Muslims from the US, appealing to the logic of conditional probability: "As the entire country has been repeatedly lectured, most Muslims are amazingly peaceful… This is a preposterous irrelevancy… Not all Muslims may be terrorists, but all terrorists are Muslims."[1]

We suggest that Coulter's inappropriate use of conditional logic to justify restrictive immigration policies is an instance of widespread partisan reasoning about conditional probability. Partisans who favor policies that restrict broad categories (e.g., Muslim immigrants) to reduce rare events (e.g., terrorism) evaluate dubious "hit rate" probabilities (the likelihood that immigrant terrorists are Muslim) as more important than do policy opponents. Opponents favor the more normatively appropriate inverse probability (the likelihood that Muslim immigrants are terrorists). These predictions are derived from research indicating that people often confuse conditional hit rate probabilities and their inverse and from research indicating that people engage in motivated reasoning to defend stances prescribed by their sociopolitical groups.

We report the results of two studies that test these hypotheses. One study examines Israeli participants' evaluation of a policy to reduce crime by expelling Sudanese and Eritrean refugees. Another study examines US participants' evaluation of two policies: restricting Muslim immigration to reduce terrorism and banning assault weapons to reduce mass shootings. We find

[1] This claim ignores the rather large category of "domestic terrorism." This might reflect that people in the US are more likely to label acts of violence as "terrorism" when committed by foreign Muslims than by domestic non-Muslims (Kearns, Betus, & Lemieux, 2018).

that people who support restrictive policies evaluate hit rate probabilities as more important than do policy opponents, who favor inverse conditional probabilities. These partisan differences are partially reduced by adopting the perspective of an unbiased expert. We also find evidence in one study that numeracy is associated with increased partisan differences, suggesting that numeracy bolsters politically motivated reasoning.

1.1 Conditional Probabilities and Inverse Fallacies

People have difficulty reasoning about conditional probability (Bar-Hillel, 1980; Barbey & Sloman, 2007; Kahneman & Tversky, 1972; Lyon & Slovic, 1976). Whereas most research examines the estimation of conditional probabilities—often following the provision of information regarding hit rates and base rates—our hypotheses concern the evaluation of explicitly stated conditional probabilities. Understanding the importance of conditional probabilities is relevant to the rational consideration of policies that restrict broad categories to reduce disastrous rare events. The Muslim travel ban described earlier, for example, sought to reduce terrorism by restricting immigration and travel to the US by individuals from majority Muslim countries. Even though there might be a high hit rate of the restricted category (Muslims) conditional on rare events (immigrant terrorists), the hit rate is considerably less informative than its inverse when evaluating how much the policy would reduce terrorist risks.

Consider the distribution of events in Figure 1. Suppose these events are less politically charged: the category is whether an adult US male is Black; the rare event is whether an adult US male plays in the National Basketball Association (NBA). The hit rate is high. Among NBA players, a relatively high percentage are Black: p(Category | Rare) = .75.[2] But if one wants to know whether an individual plays in the NBA, the more important probability is the vastly smaller inverse conditional: p(Rare | Category) = .000023. Because the probability of playing in

[2] These statistics are close to actual numbers for the NBA in 2018.

the NBA is exceptionally low, p(Rare) = .0000042, there is a difference of several orders of magnitude between the hit rate (.75) and its inverse (.000023). This difference would make a strategy of recruiting NBA players by first identifying Black males seem highly dubious as the ratio of black males to black NPA players is 42,666:1!

Similar logic applies to policies that restrict broad categories to reduce rare events. In evaluating what the risk of terrorism would be if Muslim immigration were severely restricted, the relevant probability is not the hit rate (the probability that terrorist immigrants are Muslim) but the inverse (the probability that Muslim immigrants are terrorists).

People often confuse hit rate probabilities and their inverse, exhibiting an *inverse fallacy* (Chapman & Chapman, 1969; Dawes, 1993; Gigerenzer & Hoffrage, 1995; Hamm, 1993; Koehler, 1996; Macchi, 1995; Mandel, 2014; Villejoubert & Mandel, 2002; Wolfe, 1995). People neglect base rates and Bayesian logic when estimating conditional probabilities (Bar-Hillel, 1980; Barbey & Sloman, 2007; Kahneman & Tversky, 1972; Lyon & Slovic, 1976). For example, people frequently estimate that the likelihood of a disease conditional on a positive test is the same as the likelihood of a positive test conditional on having a disease (Casscells, Schoenberger, & Graboys, 1978; Eddy, 1982; Hammerton, 1973; Liu, 1975).

The inverse fallacy is multiply determined. Because of similar wording, people may not realize that the probability of evidence conditional on a hypothesis is different from the probability of a hypothesis conditional on evidence (Gigerenzer & Hoffrage, 1995; Koehler, 1996). Hit rate probabilities are highly accessible and representative of rare risks, which may lead to their overweighting (Johnson & Tubau, 2015; Kahneman & Frederick, 2002; Kahneman & Tversky, 1972, 1973; Mandel, 2014). Because people seek to explain why rare events occur (rather than do not occur), people naturally sample instances conditional on the rare event, increasing their availability (Bes, Sloman, Lucas, & Raufaste, 2012; Fiedler, Brinkmann, Betsch,

& Wild, 2000; Gavanski & Hui, 1992). The co-occurrence of rare events and their associated categories is more easily observed and widely covered by the media compared with common events and the non-occurrence of rare events (Bohle, 1986; Combs & Slovic, 1979; Hamilton & Gifford, 1976; Miller & Albert, 2015).

Research on conditional probability judgment has held hope that improving the quality of judgment will improve decision quality (Mandel, 2014). Yet we suggest that in politicized contexts, people exhibit biased evaluation of probability importance, even when people are explicitly provided with accurate information about base rates, hit rates, and inverse conditional probabilities, thereby eliminating any bias in probability estimation. Even when they agree about what the probabilities are, partisans disagree about the importance of those probabilities.

1.2 Intuitive Politicians, Motivated Reasoning, and Conditional Probability Evaluation

We hypothesize that partisans exhibit polarized evaluation of the importance of conditional probabilities. Partisans who support restrictive policies (such as restricting Muslim immigration and travel) evaluate normatively dubious hit rate probabilities (that immigrant terrorists are Muslim) as more important than do policy opponents. In contrast, partisans who oppose restrictive policies evaluate the more normatively defensible inverse conditional probabilities (that Muslim immigrants are terrorists) as more important than do supporters.

In partisan contexts, people reason as intuitive politicians rather than intuitive scientists or statisticians (Bell & Tetlock, 1989; Tetlock, 1991, 2002). Partisans are highly cognizant of their various political constituencies, including friends, family, neighbors, and colleagues. The anticipation of public exchange shapes private thoughts: “A central function of private thought is preparation for public performances… Thought frequently takes the form of internalized dialogues in which people gauge the justifiability of options by imagining conversations in

which accounts are exchanged, debated, revised, and evaluated" (Tetlock, 2002, p. 456). The evaluation of probabilities is an act of political persuasion, not of detached rational analysis.

Being intuitive politicians, people evaluate claims as motivated members of socio-political tribes that have prescribed stances on partisan topics (Ditto et al., 2018; Haidt, 2012; Jost & Amodio, 2012; Jost, Glaser, Kruglanski, & Sulloway, 2003; Kahan & Braman, 2006; Kahan, Jenkins-Smith, & Braman, 2011; Kahan, Peters, Dawson, & Slovic, 2017; Knowles & Ditto, 2012; Tajfel, 1959; Van Bavel & Pereira, 2018). A constellation of psychological processes shape partisans' judgments to align with their partisan identities. Confirmation bias leads people to select and evaluate information in ways that fit with expectation (Klayman & Ha, 1987; Newell & Shanks, 2014; Simon & Holyoak, 2002; Simon, Stenstrom, & Read, 2015; Snyder & Swann, 1978). Motivated skepticism shapes both the amount and type of information processed (Baumeister & Newman, 1994; Ditto & Lopez, 1992; Ditto, Scepansky, Munro, Apanovitch, & Lockhart, 1998; Knowles & Ditto, 2012; Kunda, 1990; Taber & Lodge, 2006). Through construal processes, partisans differentially perceive, disambiguate, and recall objectively equivalent situations (Hastorf & Cantril, 1954; Lepper, Ross, & Lau, 1986; Lord, Ross, & Lepper, 1979; Vallone, Ross, & Lepper, 1985). All of these processes lead intuitive politicians to seek, criticize, and construe information in ways that comport with the sociopolitical groups with which they identity.

Motivated reasoning also influences evaluations even when information is accurate and clearly stated. Participants in one study considered motivationally relevant evidence presented as rules in a Wason selection task such as "people with high emotional lability experience early death" (Dawson, Gilovich, & Regan, 2002). Because people do not readily appreciate the underlying logic of testing rules by seeking disconfirming information (Klayman & Ha, 1987; Snyder & Swann, 1978; Wason, 1966, 1968) their motivational stances lead them to apply

different evidentiary standards. When testing non-threatening rules, people seemed to ask themselves “Can I?” confirm the rule, whereas when evaluating threatening claims people seemed to ask, “Must I?” accept the rule. Because the Wason task is solved by seeking disconfirming information, people who tested threatening hypotheses performed better than did those who tested non-threatening hypotheses.

We suggest that motived reasoning similarly influences the evaluation of conditional probabilities even when all of the information is explicitly stated. As discussed earlier, people do not readily appreciate the vast difference between hit rate probabilities and their inverse in the context of rare events. Supporters of restrictive policies should therefore evaluate hit rates as more important than opponents of restrictive policies, who evaluate inverse conditional probabilities as relatively more important.

It is possible, of course, that supporters and opponents have different policy stances for reasons other than differential probability evaluation. Rational policy evaluation should integrate both probability (expectation) and utility (value). Even if partisans agree what the probabilities are, supporters and opponents might attach dramatically different utilities to outcomes. For example, if opponents and proponents of banning Muslim immigration both place extreme disutility on terrorist attacks, opponents might place higher disutility on the humanitarian costs of banning Muslim immigrants and higher utility on the humanitarian benefits of admitting immigrants to the US. Supporters and opponents might agree that the most relevant probability is the likelihood of Muslim immigrants being terrorists (rather than the hit rate of immigrant terrorists being Muslim) yet have different values. If the key differences between supporters and opponents lie primarily in the utilities attached to relevant outcomes, they should agree about the importance of conditional probabilities. Our hypothesis is that, beyond any differences in

utilities, partisans differ in their evaluation of conditional probabilities in ways that support their policy stance.

1.3 Expert Perspective Taking Might Reduce Partisan Probability Evaluation

Motivated reasoning is notoriously difficult to debias (Fischhoff, 1982; Larrick, 2004). People are blind to their own motivated reasoning, even though they readily detect and expect partisan motivated reasoning in other people (Pronin, Gilovich, & Ross, 2004; Pronin, Lin, & Ross, 2002; Pronin, Puccio, & Ross, 2002; Westfall, Van Boven, Chambers, & Judd, 2015). This might partially explain why people expect neutral observers to side with them in legal disputes (Babcock & Loewenstein, 1997; Babcock, Loewenstein, Issacharoff, & Camerer, 1995).

Yet there is reason to suspect that inviting people to adopt the perspective of an unbiased expert might reduce partisan differences when evaluating conditional probabilities. If thinking like intuitive politicians exacerbates partisan differences, encouraging people to set aside their political stance in favor of more objective analysis might reduce partisan differences. Indeed, several studies have found that asking people to adopt an expert's perspective prompts them to strive for neutrality and can reduce biased information processing (Beatty & Thompson, 2012; Bialek & Sawicki, 2014; McCrudden, Barnes, McTigue, Welch, & MacDonald, 2016). We therefore expected that adopting an expert's perspective might reduce partisan bias in evaluation of conditional probabilities.

1.4 Numeracy Might Exacerbate Partisan Probability Evaluations

Numeracy is the tendency to comprehend and use quantitative information (Lipkus, Samsa, & Rimer, 2001; Peters et al., 2006). Numeracy might be expected to reduce partisan probability evaluation because numeracy reflects greater risk comprehension (Peters, Dieckmann, Dixon, Hibbard, & Mertz, 2007; Peters et al., 2006; Reyna, Nelson, Han, & Dieckmann, 2009), more precise probability estimates (de Bruin, Fischhoff, Millstein, &

Halpern-Felsher, 2000), and reduced susceptibility to framing effects (Peters et al., 2006). However, recent evidence suggests that numeracy is associated with exacerbated partisan differences (Kahan et al., 2012). In one study, highly numerate people exhibited larger partisan evaluations of (illusory) confirmatory evidence about the politicized topic of handguns compared with less numerate people, even though highly numerate people were less swayed by confirmatory evidence when considering the non-politicized topic of skin creams (Kahan et al., 2017). More generally, greater levels of education, which is intertwined with numeracy, are associated with greater levels of political polarization on politicized issues such as climate policy (Ehret, Sparks, & Sherman, 2017; Ehret, Van Boven, & Sherman, 2018). Given the tentative, somewhat mixed evidence about numeracy and motivated reasoning, explored whether numeracy would moderate partisan differences in conditional probability evaluation.

1.5 Overview of the Present Studies

We examined our hypotheses in two studies. Participants considered policies designed to reduce rare events by restricting broad categories associated with those events: expulsion of Eritrean and Sudanese asylum seekers to reduce crime in South Tel Aviv, Israel (Study 1); a Muslim travel ban to reduce terrorist attacks in the US (Study 2); and an assault weapons ban to reduce mass shootings in the US (Study 2). Both in our studies and in polling results, Republicans and Rightists favored expulsion of asylum seekers and the Muslim travel ban more than did Democrats and Leftists. Democrats favored an assault weapons ban more than did Republicans. Additionally, participants in Study 2 considered *both* a Muslim travel ban and an assault weapons ban, affording a within-person test of partisan differences. Participants read about the proposed policy and four relevant and realistic statistics: the hit rate, p(category | rare event); the inverse conditional, p(rare event | category); and the base rates, p(rare event) and p(category). Participants selected which probability was the most personally important when

considering their personal support for or opposition to policy. We predicted that supporters would be more likely to select the hit rate whereas opponents would be more likely to select the inverse conditional. We expected these partisan differences to be partially, if not completely, reduced when participants indicated which probability an unbiased policy analysis would select as most important. Finally, we examined whether individual differences in numeracy would moderate these partisan differences.

The Supplemental Online Material (SOM) includes all materials, data, and analysis scripts: https://osf.io/w8tzr/ ([dataset] Van Boven, Ramos, Montal-Rosenberg, Kogut, Sherman, & Slovic, 2019). The SOM also includes the methods and results of four additional studies using very similar contexts but with a somewhat different dependent measure, discussed later.

2.0 Study 1: Banning Eritrean and Sudanese Asylum Seekers

Participants in Israel considered a policy to expel Eritrean and Sudanese asylum seekers from South Tel Aviv to reduce crime. Conservative Rightists were more supportive of expelling refugees than were liberal Leftists and Centrists (Canetti, Snider, Pedersen, & Hall, 2016). Using statistics from the Aid Organization for Refugee and Asylum Seekers (http://assaf.org.il/en/node/2), we provided participants with information about the relative frequency of criminals who are asylum seekers (hit rate), the inverse frequency of asylum seekers who are criminals, and the base rate frequencies of crimes and asylum seekers. We asked participants to select which probability was most important for them personally to consider when evaluating the proposed expulsion policy, and which probability an expert policy analyst would select as most important.

2.1 Method

Undergraduate university students (N = 307; 131 males, 176 females) from Ben-Gurion University, Tel-Aviv University, and the Hebrew University in Israel participated online in

exchange for entry into a lottery that offered 20 monetary incentives of 40 ILS ($11.50). The study was conducted between 25–27 July 2018.

Participants read a description of a proposed policy to expel Eritrean and Sudanese asylum seekers from South Tel Aviv, Israel:

> According to the latest Population Registry estimation, there are approximately 32,500 Eritrean and Sudanese asylum seekers in Israel who have crossed the border from Egypt. Government persecution, civil war, genocide, and other atrocities forced them to leave their homes and countries and seek protection in Israel. Most asylum seekers live in South Tel Aviv. More than half a year ago, the government of Israel built an outline for the expulsion of Eritrean and Sudanese asylum seekers, according to which asylum seekers from Sudan or Eritrea whose asylum application was not approved or who did not have time to apply until the beginning of January 2018 will be deported to Third World countries such as Rwanda. The outline of this expulsion was canceled, and an attempt was made to reach an agreement with the United Nations High Commissioner for Refugees, according to which some of the asylum seekers would be transferred to Western countries. This attempt also failed. Therefore, about 32,500 asylum seekers from Eritrea and Sudan are in an uncertain situation, and if there won't be a solution according to which they will be transferred to Western countries, their expulsion to Third World countries may be considered again. Supporters of the original expulsion plan claim that the multitude of infiltrators has various negative consequences, including reduced sense of personal security among citizens and an increase in crime. Opponents of the original expulsion plan claim that this plan is racist and that their return to Africa poses a danger to their lives.

Participants were asked to read relevant statistics regarding crime and refugees in South Tel Aviv. We provided statistics in frequency format for ease of interpretation (Brase, 2008; Gigerenzer, 1996; Hoffrage & Gigerenzer, 1998; Hoffrage, Gigerenzer, Krauss, & Martignon, 2002). Participants were informed that these estimates were based on reports published by the Knesset's Research and Information Center regarding the crime of asylum seekers as well as on the website of the Aid Organization for Refugees and Asylum Seekers in Israel:

p(C): In the last few years, 385 out of 38,461 residents living in south Tel Aviv have committed a crime.

p(A): In the last few years, 20,000 out of the 38,461 residents living in southern Tel Aviv have been asylum seekers from Eritrea and Sudan.

p(A|C): Out of the 385 Tel Aviv residents who committed a crime, 208 were asylum seekers from Eritrea and Sudan.

p(C|A): Out of the 20,000 asylum seekers from Eritrea and Sudan who live in south Tel Aviv, 200 committed a crime.

Participants indicated whether they supported or opposed the proposed expulsion policy before reading the statistics, and then again after reading the statistics.

Participants were randomly assigned to one of the three between-subjects perspective conditions: Own Perspective, Opposite Perspective, or Expert Perspective. In the Own Perspective condition, participants were asked:

> Which one of these probabilities is most important to personally consider when evaluating the proposed expulsion policy? That is, when you are personally deciding whether to support or oppose this policy, which of these probabilities do you think is the most important to consider?

In the Opposite Perspective condition, participants were asked to take the perspective of someone with the opposite stance as themselves and to indicate which probability that person would select as most important to personally consider.

In the Expert Perspective condition, participants were asked to select a probability having taken the perspective of a policy analyst:

> Which one of these probabilities would an expert policy analyst think is most important to consider when evaluating the proposed expulsion policy? That is, when personally deciding whether to support or oppose this policy, which of these probabilities would an expert policy analyst think is the most important to consider?

Participants rated the accuracy of the frequency information (1 = *very inaccurate*, 7 = *very accurate*). They completed a numeracy scale with 15 items scored as correct or incorrect (Peters et al., 2007). They also completed a 10-item version of the Rational Experiential Inventory (REI, Epstein, Pacini, Denes-Raj, & Heier, 1996), which is not further discussed. Participants answered demographic questions before debriefing.

2.2 Results

Conservative Rightists were more likely to support the expulsion policy (n = 97, 81.44%, 18 opponents, 79 supporters) than were liberal Leftists (n = 73, 17.81%, 60 opponents, 13 supporters), Centrists (n = 119, 47.06%, 63 opponents, 56 supporters), and those with no political preference (n = 18, 27.78%, 13 opponents, 5 supporters), χ^2 (3, N = 307) = 78.30, p < .001.

There was no difference between those who initially supported and opposed expulsion in the likelihood of changing their stance after seeing the statistics (6.58% supporters; 7.10% opponents), χ^2 (1, N = 307) = .03, p = .857. We use the post-statistic stances to categorize participants as Supporters or Opponents in our analyses because they reflect participants' most

updated stances after seeing the statistics. Participants judged the statistics as moderately accurate, with Supporters judging them as somewhat less accurate than Opponents ($M_{supporter}$ = 4.20, $SD_{suppoter}$ = 1.36; $M_{opponent}$ = 4.55, $SD_{opponent}$ = 1.02), $t(281) = 2.49$, $p = .013$. Judged accuracy did not moderate the partisan differences described below in selection of the hit rate ($p = .498$) or the inverse probability ($p = .322$).

2.2.1 Partisan Evaluation of Conditional Probabilities

As predicted, in the Own Perspective condition, Supporters of the expulsion policy were more likely (56.25%) than Opponents (18.87%) to select the hit rate, χ^2 (1, N = 101) = 15.16, $p < .001$ (top panel of Figure 2). In contrast, Opponents (49.06%) were more likely than Supporters (10.42%) to select the inverse conditional frequency, χ^2 (1, N = 101) = 17.68, $p < .001$.

Participants correctly anticipated that those with the opposite perspective would select the opposite conditional frequencies as most important. In the Opposite Perspective condition, Opponents, who considered the perspective of Supporters, were more likely to select the hit rate (72.55%) than were Supporters, who considered the perspective of Opponents (13.73%), χ^2 (1, N = 102) = 35.97, $p < .001$ (middle panel of Figure 2). Similarly, when considering the opposite perspective, Opponents were less likely (15.69%) to select the inverse frequency than were Supporters (62.75%), χ^2 (1, N = 102) = 23.69, $p < .001$.

2.2.2 Does Expert Perspective Taking Reduce Partisan Differences?

Adopting the perspective of an unbiased expert partially reduced partisan differences. This reduction was reflected by an interaction between Stance (–1 = Opponent; +1 = Supporter) and Perspective (–1 = Own Perspective; +1 = Expert Perspective) in a logistic regression estimating participants' selection of the hit rate frequency, *OR* = .76, *Wald's Z* = 3.26, $p = .071$ (compare the top and bottom panels of Figure 2). In the Expert Perspective condition, the difference between the fractions of Supporters (46.30%) and Opponents (32.00%) who selected

the hit rate frequency was smaller, *OR* = 1.35, *Wald's Z* = 2.20, *p* = .138, than in the Own Perspective condition, *OR* = 2.35, *Wald's Z* = 3.75, *p* < .001. There was a similar interaction when estimating participants' selection of the inverse conditional frequency, *OR* = 1.39, *Wald's Z* = 3.52, *p* =.061. In the Expert Perspective condition, the difference between the fractions of Supporters (20.37%) and Opponents (36.00%) who selected the inverse conditional frequency was smaller, *OR* = .67, *Wald's Z* = 3.09, *p* = .076, than in the Own Perspective condition, *OR* = .35, *Wald's Z* = -3.87, *p* < .001.

2.2.3 Does Numeracy Moderate Partisan Differences?

There was no evidence that numeracy moderated partisan differences in probability evaluation. In the Own Perspective condition, individual differences in numeracy (*M* = 12.18, *SD* = 2.06) were not associated with partisan differences. In a logistic regression estimating participants' selection of the hit rate, there was neither a main effect of Numeracy (mean centered), *OR* = 1.02, *Wald's Z* = .176, *p* = .861, nor a Stance × Numeracy interaction, *OR* = .87, *Wald's Z* = -1.07, *p* = .283. Similarly, in a logistic regression estimating the selection of the inverse conditional frequency there was neither a main effect of Numeracy, *OR* = .92, *Wald's Z* = -.60, *p* = .550, nor a Stance × Numeracy interaction, *OR* = 1.18, *Wald's Z* = 1.42, *p* = .253.

2.3 Discussion

Considering a potential policy by the Israeli government to expel refugees from South Tel Aviv, supporters evaluated the hit rate of being a refugee conditional on having committed a crime as more important than did opponents, who favored the inverse conditional frequency. These differences were partially reduced when partisans adopted the perspective of an expert policy analyst. These results do not provide evidence that numeracy moderates partisan differences (Kahan et al., 2017; Kahan et al., 2012). As we will see, however, numeracy is associated with increased partisanship in Study 2 (and in four studies reported in SOM). Study 1

participants apparently had unusually high and homogenous numeracy scores, suggesting that the lack of moderation might be attributed to restricted range in numeracy.

3.0 Study 2: Banning Muslim Travel and Assault Weapons

We next examined partisan differences in conditional probability evaluation in two politicized policy contexts in the US: The Trump administration's Muslim Travel Ban and a ban on the sale of assault weapons. Both policies involve restrictions on a broad category, banning Muslims from travelling to the US and banning the sale of assault weapons, to reduce rare events of terrorism and of mass shootings. We presented participants with hit rates, inverse conditional probabilities, and base rates. We asked participants to select which probability was most important to consider when deciding whether to support or oppose the policy.

We reasoned that Republicans and Democrats would differ in their support of the two policies, with Republicans more likely to support Muslim travel ban and Democrats more likely to support an assault weapons ban (Jackson & Newall, 2018; QuinnipiacUniversityPollingInstitute, 2018). The predicted partisan differences in these two contexts would thus demonstrate that favorably evaluating hit rates when supporting restrictive policies spans different political identities and ideologies. This bipartisan bias in probability evaluation is important because whereas some research suggests that both liberal and conservative partisans engage in motivated reasoning (e.g., Ditto et al., 2018; Washburn & Skitka, 2018), other research suggests that conservatives engage in more motivated reasoning than do liberals (Jost & Amodio, 2012; Jost et al., 2003; Mooney, 2012). The results of this study thus contribute important evidence to an ongoing discussion ideological asymmetry versus symmetry in motivated reasoning.

All participants evaluated probabilities in both policy contexts and from three perspectives within each context: their own perspective, the opposite perspective, and an

unbiased expert's perspective. Previous research had found that within-person joint evaluation contexts make it easier to evaluate differences between information that people might otherwise difficult to evaluate (Hsee, 1996; Hsee, Loewenstein, Blount, & Bazerman, 1999; Hsee & Zhang, 2010; Irwin, Slovic, Lichtenstein, & McClelland, 1993; Kahneman & Ritov, 1994), and easier to avoid inconsistent responses (Caruso, Gilbert, & Wilson, 2008). We nevertheless expected to replicate our previous findings: that supporters of the bans would prefer the hit rate probability more than opponents, who would prefer the inverse conditional. We also expected that adopting the perspective of an unbiased expert would partially reduce partisan differences in probability evaluation. Finally, we examined whether numeracy would moderate these partisan differences.

3.1 Method

Participants were US adults recruited from Mechanical Turk between 19–22 July 2018 (N = 576; female = 226, male = 348, M_{age} = 34.46) in exchange for $2.00. We excluded additional respondents who did not complete all measures used in the analysis (n = 67) or who had duplicate IP addresses (n = 51).

Participants read and completed measures about two different randomly ordered policy contexts. One concerned the Trump administration's travel ban:

> On June 26th, 2018, the Supreme Court upheld the Trump administration's travel ban. The latest version of this policy has placed heavy restrictions on travel and immigration from seven countries, five of which are majority-Muslim countries (Syria, Iran, Libya, Somalia and Yemen). The policy is meant to prevent the entrance of potential terrorists into the US; however, various other courts and organizations have questioned the legality of the ban, claiming that it is discriminatory on the basis of religion.

Participants were then shown the following statistics, which they read, truthfully, were based on current and historical data provided by the Pew Research Center and the Cato Institute (Connor, 2016; Nowrasteh, 2016):

p(M): The probability that an immigrant is from a Muslim country is 17%.

p(T): The probability that an immigrant is a terrorist is 0.00001%.

p(T|M): The probability that an immigrant from a Muslim country is a terrorist is 0.00004%.

p(M|T): The probability that a terrorist immigrant is from a Muslim country is 72%.

The other context was an assault weapons ban to minimize mass shootings. The statistics were presented as frequencies:

> On February 14, 2018 a lone gunman opened fire inside a high school in Parkland, FL, killing 17 students. This incident has sparked calls from a number of organizations and government officials for stricter gun control laws targeting "assault weapons," a category of firearms that has been associated with mass shootings. Recently proposed legislation has broadly used the term "assault weapon" to refer to a number of semiautomatic rifles, and other semiautomatic weapons equipped with attachments (such as a scope, pistol grip, or grenade launcher) or high-capacity magazines. A comprehensive law banning a number of "assault weapons" was introduced by Senator Dianne Feinstein in 2013, after the Sandy Hook Massacre; however, the bill did not make it past the senate floor.

Participants were then shown the following statistics (Miniter, 2018; MotherJones, 2018; PewResearchCenter, 2013):

p(S): In the last few years, 6 out of 100 million American adults committed a mass shooting.

p(A): In last few years, 12 million out of 100 million American adults owned an assault weapon.

p(A|S): Out of 6 American adults who committed a mass shooting, 4 owned an assault weapon.

P(S|A): Out of 12 million American adults who owned an assault weapon, 4 committed a mass shooting.

Within each context, participants indicated whether they supported or opposed the policy before they read the statistics, and then again after reading the statistics.

Within each policy context, participants considered three perspectives: Own Perspective, Opposite Perspective, and Expert Perspective. In the Own Perspective scenario, participants read:

> Which one of these probabilities is most important to personally consider when evaluating the… policy? That is, when you are personally deciding whether to support or oppose this policy, which of these probabilities do you think is the most important to consider?

In the Opposite Perspective condition, participants were asked to imagine the perspective of someone with the opposite stance as themselves, and to select which probability that person would think is most important to consider. In the Expert Perspective condition, participants were asked to take the perspective of an "expert policy analyst; that is, an unbiased, non-partisan evaluator, with an exceptional understanding of the degree to which different factors should be taken into consideration when assessing immigration policy." Participants selected which "probability would an expert policy analyst find most important to consider when evaluating the… policy?" Participants answered questions from each perspective in random order, with the stipulation that the Own Perspective scenario was never last.

After considering both policies, participants judged how accurate the set of probabilities was for each scenario (1 = *very inaccurate*, 7 = *very accurate*). Then participants identified themselves as Democrats (n = 329), Republicans (n = 193), or Independents (n = 54), following a branched series of questions used in the American National Election Studies (Ehret et al., 2018; Van Boven, Ehret, & Sherman, 2018; Westfall et al., 2015). Participants also completed a 15-item numeracy scale (Peters et al., 2007) and the 10-item REI (Epstein et al., 1996), which is not further discussed. Participants answered several demographic questions before being debriefed.

3.2 Results

Most participants (62.32%, 359 of 576) supported one ban and opposed the other (Table 1). Few participants opposed both bans (15.97%, 92 of 576) or supported both bans (21.70%, 125 of 576). Republicans (79.79%, 154 of 193) supported the Muslim travel ban more than did Democrats (19.45%, 64 of 329) and Independents (35.85%, 19 of 53). Democrats (77.51%, 255 of 329) and Independents (59.35%, 92 of 155) supported the Assault weapons ban more than did Republicans (47.17%, 25 of 53).

Few participants changed their stance toward the travel ban after seeing the statistics. Those who initially supported the policy were somewhat more likely to change their stance than those who initially opposed the policy (10.93% supporters; 5.47% opponents), χ^2 (1, N = 576) = 5.10, p = .024. Few participants changed their stance toward the assault weapons ban after seeing the statistics, Supporters and opponents did not differ in the likelihood of changing their stance (13.45% supporters; 10.67% opponents), χ^2 (1, N = 576) = 1.25, p = .264. As in Study 1, we used the second measure to categorize Supporters and Opponents in our analyses.

Both Supporters and Opponents of the travel ban judged the statistics as highly accurate ($M_{supporter}$ = 5.03, $SD_{supporter}$ = 1.22; $M_{opponent}$ = 5.20, $SD_{opponent}$ = 1.30), t(574) = 1.39, p = .165. Supporters and Opponents of the assault weapons ban also judged the statistics as highly

accurate ($M_{supporter}$ = 4.92, $SD_{supporter}$ = 1.40; $M_{opponent}$ = 5.09, $SD_{opponent}$ = 1.26), $t(574) = 1.61$, p = .108. For both the Muslim travel ban and assault weapons ban, accuracy assessments did not moderate differences between supporters and opponents in evaluation of the hit rate (ps = .783 and .459, respectively) or inverse conditional (ps = .980 and .946, respectively).

3.2.1 Partisan Evaluation of Conditional Probabilities

As predicted, when adopting their Own Perspective, Supporters of the Muslim travel ban were more likely (62.18%) than Opponents (7.99%) to select the hit rate as the most important probability, $\chi^2 (1, N = 576) = 191.39$, $p < .001$ (top row of Figure 3). Opponents, in contrast, were more likely (56.21%) than Supporters (5.88%) to select the inverse conditional probability as the most important, $\chi^2 (1, N = 576) = 154.28$, $p < .001$.[3]

Similarly, in the context of the assault weapons ban, when adopting their Own Perspective, Supporters were more likely (55.80%) than Opponents (14.15%) to select the hit rate as the most important probability, $\chi^2 (1, N = 576) = 93.00$, $p < .001$ (top row of Figure 4). In contrast, Opponents were more likely (53.17%) than were Supporters (8.89%) to select the inverse conditional probability as the most important, $\chi^2 (1, N = 576) = 136.98$, $p < .001$. These results conceptually replicate partisan differences in evaluation of conditional probabilities for two different policies.

Participants correctly expected that those with the opposing stance would have opposing probability evaluations (the middle rows of Figures 3 and 4). Considering the travel ban, Opponents, who estimated Supporters, were more likely (82.54%) than Supporters (21.85%), who estimated Opponents, to select the hit rate, $\chi^2 (1, N = 576) = 208.02$, $p < .001$. Opponents were less likely (5.92%) than Supporters (30.25%) to select the inverse conditional probability, $\chi^2 (1, N = 576) = 59.82$, $p < .001$. Considering the assault weapons ban, Opponents were more

[3] These differences were not moderated by the order in which participants evaluated the three perspectives.

likely (67.80%) than Supporters (10.51%) to select the hit rate, χ^2 (1, N = 576) = 200.30, p < .001. Opponents were less likely (9.27%) than Supporters were (49.60%) to select the inverse conditional frequency, χ^2 (1, N = 576) = 92.32, p < .001.

3.2.2 Does Expert Perspective Taking Reduce Partisan Differences?

Taking the perspective of an unbiased expert partially reduced partisan differences in probability evaluation (see the lower rows of Figures 3 and 4). We conducted a mixed-effects model with random intercepts for participant, estimating selection of the hit rate from Stance (Opponent = –1, Supporter = +1), Perspective (–1 = Own Perspective, +1 = Expert Perspective), and their interaction, which was significant, *OR* = .58, *Wald's Z =-5.59*, p < .001.[4] The effect of Stance was larger in the Own Perspective condition, *OR* = 7.20, *Wald's Z* = 9.57, p < .001, than in the Expert Perspective condition (37.82% supporters and 13.91% opponents selected the hit rate), *OR* = 2.45, *Wald's Z = 5.95*, p < .001. The interaction was also significant in a similar model examining selection of the inverse conditional probability, *OR* = 1.52, *Wald's Z* = 3.86, p < .001. The effect of Stance was larger in the Own Perspective condition, *OR* = .10, *Wald's Z* = -8.70, p < .001, than in the Expert Perspective condition (19.33% supporters and 57.69% opponents selected the inverse conditional probability), *OR* = .23, *Wald's Z* = -7.45, p < .001.

An analogous pattern of results emerged for the assault weapons ban. The interaction between Stance and Perspective was significant in a model estimating selection of the hit rate, *OR* = .71, *Wald's Z* = -4.13, p < .001. The effect Stance was larger in the Own Perspective condition, *OR* = 3.10, *Wald's Z* = 8.40, p < .001, than in the Expert Perspective condition (35.04% supporters and 18.54% opponents selected the hit rate), *OR* = 1.65, *Wald's Z* = 4.10, p < .001. The interaction was also significant in a model estimating selection of the inverse conditional frequency, *OR* = 1.61, *Wald's Z* = 5.45, p < .001. The effect of stance was larger in

[4] Mixed-effects models were estimated using the lmerTest package in R. P-values were calculated using Satterthwaite's approximation for degrees of freedom.

the Own Perspective condition, *OR* = .20, *Wald's Z* = -9.06, $p < .001$, than in the Expert Perspective condition (25.34% supporters and 45.85% opponents selected the inverse conditional frequency), *OR* = .53, *Wald's Z* = -4.77, $p < .001$.

3.2.3 Does Numeracy Moderate Partisan Differences in Probability Evaluation?

Numeracy was associated with larger partisan differences in both policy contexts. In the context of the travel ban, we estimated selection of the hit rate probability from Numeracy (mean centered; *M* = 9.70*, SD* = 3.83), Stance, and their interaction. The Numeracy × Stance interaction was significant, *OR* = 1.32, *Wald's Z* = 8.13, $p < .001$ (compare the left, center, and right graphs on the top row of Figure 3).[5] Numeracy was positively associated with selecting the hit rate among Supporters, *OR* = 1.32, *Wald's Z* = 7.01, $p < .001$, but was negatively associated with selecting the hit rate among Opponents, *OR* = .76, *Wald's Z* = -5.00, $p < .001$. There was also a significant Numeracy × Stance interaction when estimating the selection of the inverse probability, p(T|M), *OR* = .91, *Wald's Z* = -2.39, $p = .018$. Numeracy was positively associated with selecting the inverse conditional probability among Opponents, *OR* = 1.28, *Wald's Z* = 5.37, $p < .001$, but was not associated with selection of the inverse conditional probability among Supporters, *OR* = 1.06, *Wald's Z* = .84, $p = .403$.

A similar pattern emerged in analyses of the assault weapons ban (compare the left, center, and right graphs on the top row of Figure 4). When estimating selection of the hit rate, there was a Numeracy × Stance interaction, *OR* = 1.25, *Wald's Z* = 7.51, $p < .001$. Numeracy was positively associated with selecting the hit rate among Supporters, *OR* = 1.27, *Wald's Z* = 7.31, $p < .001$, but was negatively associated with selection of the hit rate among Opponents, *OR* = .82, *Wald's Z* = -4.13, $p < .001$. There was also a significant Numeracy × Stance interaction

[5] Considering the travel ban, Supporters were less numerate (*M* = 7.99, *SD* = 4.30) than Opponents (*M* = 10.90, *SD* = 2.91), $t(574) = 9.69$, $p < .001$. Supporters of the assault weapons ban were non-significantly less numerate (*M* = 9.60, *SD* = 3.82) than Opponents (*M* = 9.88, *SD* = 3.84), $t(574) = .85$, $p = .393$.

when estimating participants' selection of the inverse conditional frequency, *OR* = .91, Wald's Z = -2.56, *p* = .010. Numeracy was positively associated with the selection of the inverse frequency among Opponents, *OR* = 1.26, *Wald's Z* = 5.08, *p* < .001, but it was not associated with the selection of the inverse conditional frequency among Supporters, *OR* = 1.06, *Wald's Z* = 1.06, *p* = .291.

We next explored whether numeracy was associated with partisan differences when participants adopted an expert's perspective. For the Muslim travel ban, a mixed-effects binomial logistic regression revealed a significant Numeracy × Stance × Perspective (–1 = Own Perspective, +1 = Expert Perspective) interaction on selection of the hit rate, *OR* = .89, *Wald's Z* = -4.46, *p* < .001. The Numeracy × Stance interaction was weaker, but still significant, in the Expert Perspective condition, *OR* = 1.12, *Wald's Z* = 3.03, *p* = .003. A similar model estimating selection of the inverse conditional probability revealed a marginally significant Numeracy × Stance × Perspective interaction, *OR* = 1.06, *Wald's Z* = 1.89, *p* =.06. In the Expert Perspective condition, Numeracy did not moderate Stance, *OR* = .95, *Wald's Z* = -1.22, *p* = .222. Instead, there was a main effect such that more numerate participants were more likely to select the inverse conditional probability, *OR* = 1.31, *Wald's Z* = 5.73, *p* < .001.

An analogous pattern emerged for the assault weapons ban. There was a significant Numeracy × Stance × Perspective interaction on selection of the hit rate, *OR* = .91, *Wald's Z* = -4.13, *p* < .001. The Numeracy × Stance interaction was weaker, but still significant, when participants adopted an expert's perspective, *OR* = 1.08, *Wald's Z* = 2.47, *p* = .014. A model estimating selection of the inverse conditional probability revealed a significant Numeracy × Stance × Perspective interaction, *OR* = 1.05, *Wald's Z* = 2.06, *p* = .040. In the Expert Perspective condition, there was no Numeracy × Stance interaction, *OR* = .98, *Wald's Z* = -.46, *p* = .650.

Instead, there was a main effect such that more numerate participants were more likely to select the inverse conditional frequency, $OR = 1.96$, *Wald's* $Z = 5.97$, $p < .001$.

An exploratory analysis thus indicated that numeracy was less strongly associated with partisan differences when participants adopted the perspective of an unbiased experts than when they evaluated probabilities from their own perspective. Instead, when thinking like an expert, numeracy was positively associated with selection of the normatively more informative inverse conditional probability.

3.3 Discussion

Supporters of a ban on Muslim travel and immigration and supporters of an assault weapons ban evaluated the hit rate probability as more important than did opponents of the bans. Policy opponents, in contrast, were more likely to evaluate the genuinely more informative inverse conditional probability as important. These partisan differences occurred across contexts where most Republicans supported the travel ban and oppose an assault weapons ban, and most Democrats opposed the travel ban and support an assault weapons ban. These partisan differences were reduced when participants adopted the perspective of an unbiased expert, replicating the findings from Study 1. Partisans were consequently more consistent across the two contexts in the expert perspective condition. From their own perspective, a plurality of participants selected the hit rate for one policy context while selecting either its inverse or the base rate of rare events for the other context (43.92%, 253 out of 576). This pattern of inconsistent probability selection dropped substantially when participants adopted the perspective of an unbiased expert (28.65%, 165 out of 576), McNemar $p < .001$.[6] Adopting an expert's perspective thus reduced partisanship and increased consistency.

[6] Looking only at participants who supported one policy and opposed the other, the majority selected the hit rate probability for one policy context while selecting either its inverse or the base rate of rare events for the other context (62.12%, 223 out of 359). Among these participants, the pattern of inconsistent probability selection

Finally, numeracy was associated with increased partisan differences in evaluation of conditional probabilities, consistent with research that numeracy bolsters partisan reasoning (Kahan et al., 2017; Kahan et al., 2012). We did not find that numeracy was associated with partisanship in Study 1. We suspect this difference between studies is attributable to restricted range in numeracy. Numeracy scores were lower and significantly more variable in Study 2, which was an online sample in the US ($M = 9.70$, $SD = 9.83$), than they were in Study 1, which was an online sample of Israeli university students ($M = 12.18$, $SD = 2.06$), Brown-Forsythe Test $p < .001$.

4.0 General Discussion

Policies to reduce negative rare events often restrict broad categories associated with those events, as when immigrants and refugees are restricted to reduce crime. Across three different contexts, we found people who disagree about these policies—typically keeping with the prescribed stances of their sociopolitical groups—also disagree about the importance of probabilistic facts. Supporters evaluated hit rate probabilities of the category (asylum seekers, Muslim immigrants, and assault weapon ownership) conditional on the rare event (crimes, terrorism, and mass shootings) as more important than did opponents. In contrast, policy opponents evaluated the inverse conditional probabilities of rare events conditional on categories as more important. Of course, to the extent that policy evaluation is concerned with reducing the likelihood of already rare events, the hit rate is less informative than the inverse conditional.

The present findings contribute to previous work by integrating, for the first time, research on the confusion of conditional probabilities (Dawes, 1993; Mandel, 2014; Villejoubert & Mandel, 2002) with research on motivated political reasoning (for reviews, see Ditto et al., 2018; Haidt, 2012; Jost & Amodio, 2012; Kahan & Braman, 2006; Kahan et al., 2011; Kahan et

dropped substantially when participants adopted the perspective of an unbiased expert (35.10%, 126 out of 359), McNemar $p < .001$.

al., 2017; Van Bavel & Pereira, 2018). Much research assumes that partisan differences might be reduced if people agreed on what the facts are. It is often hoped that by providing people with accurate information, they will come to agreement on politicized policies. Yet participants exhibited strong partisan differences in evaluating conditional probabilities even when they were provided with the same information. In one of our two studies, furthermore, partisans who were more numerate exhibited larger partisan differences in probability evaluation. Numeracy certainty does not prevent, and appears to be associated with, motivated political reasoning.

4.1 Future Research

We examined how people who hold different stances on restrictive policies evaluate probabilities differently. This correlational approach cannot definitively conclude that different policy stances cause different probability evaluations. The reverse might also be true: People who deem hit rates as compelling might consequently support restrictive policies. We are skeptical about this reverse causality, however. Participants in Study 2 tended to support one policy and oppose the other—differences that are not easily explained by a context-independent, general preference for hit rates. Still, an important task for future research will be to experimentally manipulate partisan stances, measuring resulting evaluation of conditional probabilities.

Another question for future research stems from an intriguing inconsistency. We suspect that people familiar with professional basketball recognize that although most NBA players in the US are Black (hit rate), a vanishingly small fraction of Black males in the US play in the NBA (inverse conditional). And we suspect that such people would scoff at an NBA recruiting strategy that began with the identification of Black males. If people can think clearly about conditional probabilities in the context of professional basketball, what prevents people from thinking clearly about conditional probabilities when it comes to polarized restrictive policies?

The answer, we believe, is that in partisan contexts, people think like intuitive politicians, treating the evaluation of conditional probabilities as persuasive acts rather than acts of rational analysis (Bell & Tetlock, 1989; Tetlock, 1991, 2002).

The results of four studies summarized in SOM are consistent with this view. These studies were highly similar to Studies 1 and 2, except the key dependent measure was explicitly persuasive. Partisans selected which probability they would include in a persuasive letter to their Prime Minister (in the context of excluding Eritrean refugees) or Senator (in the contexts of assault weapons ban and Muslim travel ban). The patterns were nearly identical to Studies 1 and 2. We conducted an analysis that integrated data from all six studies. Supporters of restrictive policies, compared with opponents, were more likely to select hit rate probabilities, $OR = 5.82$, *Wald s* $Z = 12.16$, $p < .001$, and less likely to select inverse conditional probabilities, $OR = 0.17$, *Wald s* $Z = -10.42$, $p < .001$. The simple effects among participants who selected explicitly persuasive probabilities were only slightly larger than among participants who selected personally important probabilities (hit rates $OR = 3.63$, *Wald's* $Z = 10.07$, $p < .001$; inverse conditionals $OR = 0.26$, *Wald's* $Z = -11.05$, $p < .001$). The results suggest that people respond in a similar way whether they evaluate personally important or explicitly persuasive probabilities.

Future research might also more closely examine the processes underlying partisan probability evaluation. Are partisan differences shaped by defensive reactions to identity threats (Iyengar, Sood, & Lelkes, 2012)? If so, experimental manipulations that alleviate identity threats might reduce partisan disagreement, increasing openness to otherwise threatening statistics (Binning, Sherman, Cohen, & Heitland, 2010; Sherman & Cohen, 2006). Are partisan differences shaped by differential attention to probabilities that comport with people's partisan stances? If so, then partisan differences might be diminished by asking partisans not only to explain their own stance, but also to explain the relevance (or irrelevance) of all probabilities,

which could reduce focus on hit rates (Fernbach, Rogers, Fox, & Sloman, 2013; Rozenblit & Keil, 2002). Does the politicization of rare events exacerbate partisan reasoning (Kahan et al., 2017)? If so, then training people to think clearly about hit rates, rare events, and inverse conditional probabilities in more familiar and neutral contexts, such as in the example of Black males playing in the NBA, might be used as a scaffold to train people to think clearly about politicized conditional probabilities.

4.2 Implications

One broader implication of these findings is the additional evidence that numeracy can increase rather than decrease partisan differences (Kahan et al., 2017; Kahan et al., 2012). Individuals who were higher in numeracy exhibited greater disagreement about which probabilities were compelling in the contexts of a Muslim travel ban and an assault weapons ban. We obtained similar effects of increased partisan differences—with policy supporters preferring hit rates and opponents preferring inverse conditionals—among more numerate individuals in the SOM studies where we measured numeracy. Importantly, highly numerate policy opponents more frequently selected as most important the probability of rare events conditional on category membership not simply the even lower base rate probability of rare events. This suggests that more numerate opponents were thinking carefully about conditional probabilities, not simply selecting the lowest probability.

Our findings also hint at strategies to reduce partisan differences. Participants who adopted an unbiased expert's perspective exhibited less partisan disagreement in evaluating conditional probabilities than when evaluating probabilities from their own perspective (Beatty & Thompson, 2012; Bialek & Sawicki, 2014; McCrudden et al., 2016). When adopting an expert's perspective, furthermore, numeracy was associated with increased likelihood of selecting the inverse conditional probability. This suggests that numeracy operates differently

when people reason to support their partisan stance than when they reason to support an unbiased stance. If borne out in future research, this pattern suggests that the combination of taking an expert's perspective and higher numeracy improves probabilistic reasoning.

4.3 Conclusion

It is worth reiterating that the present findings do not directly imply that supporting restrictive policies is incorrect or irrational. Rationality of policy support hinges critically on utilities. Supporters and opponents might attach different utilities to the outcomes associated with restrictive policies. Assuming that both supporters and opponents place extreme disutility on terrorist attacks and mass shootings, supporters of expelling refugees and banning Muslim immigration might place relatively little utility on the welfare of refugees and immigrants. And supporters of banning assault weapons might place very little utility on the right to own assault weapons. Such utilities could justify supporting restrictive policies even if people understand the difference between hit rates, base rates, and inverse conditional probabilities.

What our studies demonstrate is that beyond any differences in utilities, partisans do not agree about the importance of conditional probabilities. Rather, supporters of restrictive policies think that hit rates are more informative than opponents of such policies—much as Ann Coulter did when suggesting that "Not all Muslims may be terrorists, but all terrorists are Muslims." We believe it is incumbent upon citizens to think clearly about conditional probabilities and base rates when evaluating policies—much as they prove themselves capable of when adopting the perspective of an unbiased expert. Politically motivated evaluation of conditional probabilities is a psychological trap that can lead to decisions that are ineffective if not harmful.

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Table 1

Distribution of Democratic, Republican, and Independent participants who supported and opposed the Muslim Travel Ban and the Assault Weapons Ban in Study 2.

	Assault Weapons Ban		
Muslim Travel Ban	Supporters	Opponents	
Supporters	46 Democrats, 71 Republicans, 8 Independents	18 Democrats, 83 Republicans, 12 Independents	64 Democrats, 154 Republicans, 20 Independents
Opponents	209 Democrats, 19 Republicans, 18 Independents	56 Democrats, 20 Republicans, 16 Independents	265 Democrats, 39 Republicans, 34 Independents
	255 Democrats, 90 Republicans, 26 Independents	74 Democrats, 103 Republicans, 28 Independents	

	Rare Event	¬ Rare Event	
Category	375	15,999,625	16,000,000
¬ Category	125	103,999,875	104,000,000
	500	119,999,500	120,000,000

base rate: p(Rare)	0.0000042
base rate: p(Category)	0.13
hit rate: p(Category | Rare)	0.75
inverse conditional: p(Rare | Category)	0.000023

Figure 1. Hypothetical distribution of rare events and category membership. The table represents extremely rare events such as terrorist attacks, mass shootings, and other serious crimes that are often associated with category membership such as Muslim immigrants, assault weapons, and refugees. Because the base rate of the rare event is extremely low, the likelihood of a rare event conditional on category membership is also extremely low, even though the hit rate probability of category membership conditional on the rare event is high.

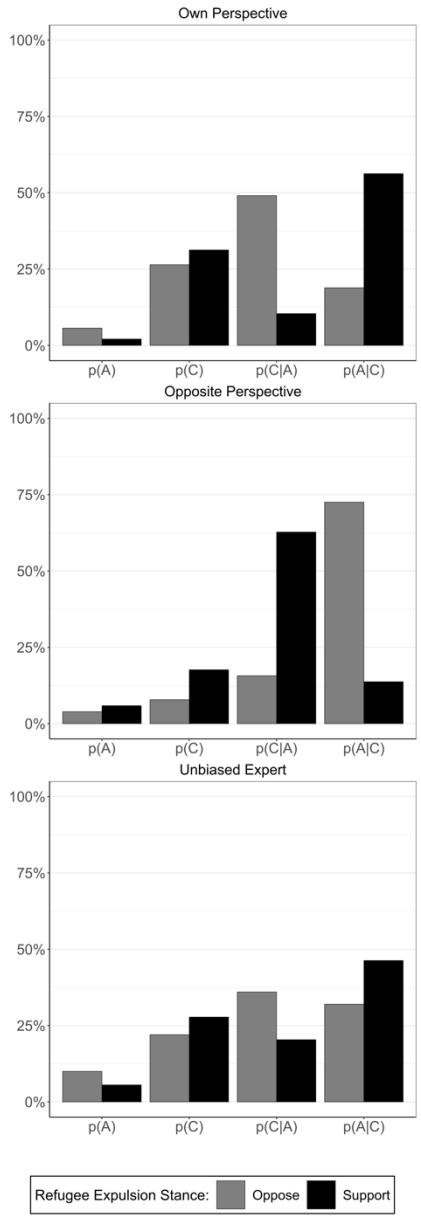

Figure 2. Selection of frequencies that were most personally important for Supporters and Opponents of the expulsion of Eritrean and Sudanese asylum seekers, separately when selecting from their Own Perspective (top row), the Opposite Perspective (middle row), and from an Expert Perspective (bottom row). p(A|C) = probability of that a resident of southern Tel Aviv is an Eritrean or Sudanese asylum seeker conditional on having committed a crime; p(C|A) = probability of having committed a crime conditional on being an Eritrean or Sudanese asylum seeker; p(A) = probability that a resident of southern Tel Aviv is an Eritrean or Sudanese asylum seeker; and p(C) = probability that a resident of southern Tel-Aviv has committed a crime.

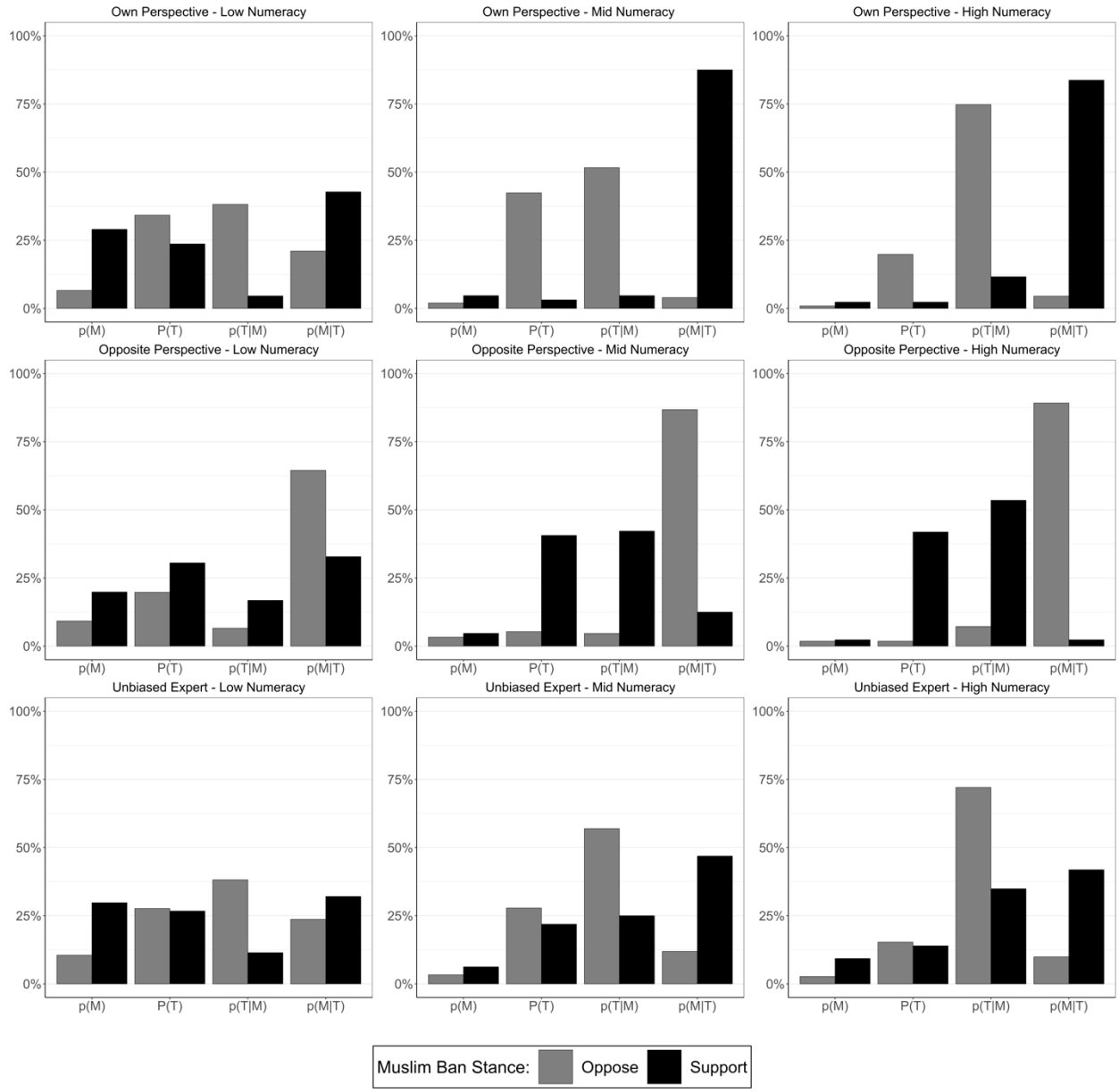

Figure 3. Selection of probabilities that were most important for Supporters and Opponents of the Muslim travel ban, separately when selecting from their Own Perspective (top row), the Opposite Perspective (middle row), and from an Expert Perspective (bottom row). Preferences are presented separately for those with low numeracy (bottom third, left column), medium numeracy (middle third, center column), and high numeracy (top third, right column). p(M|T) = probability of being a Muslim immigrant conditional on being a terrorist; p(T|M) = probability of being terrorist conditional on being a Muslim immigrant; p(M) = probability of being a Muslim immigrant; and p(T) = probability of being a terrorist immigrant.

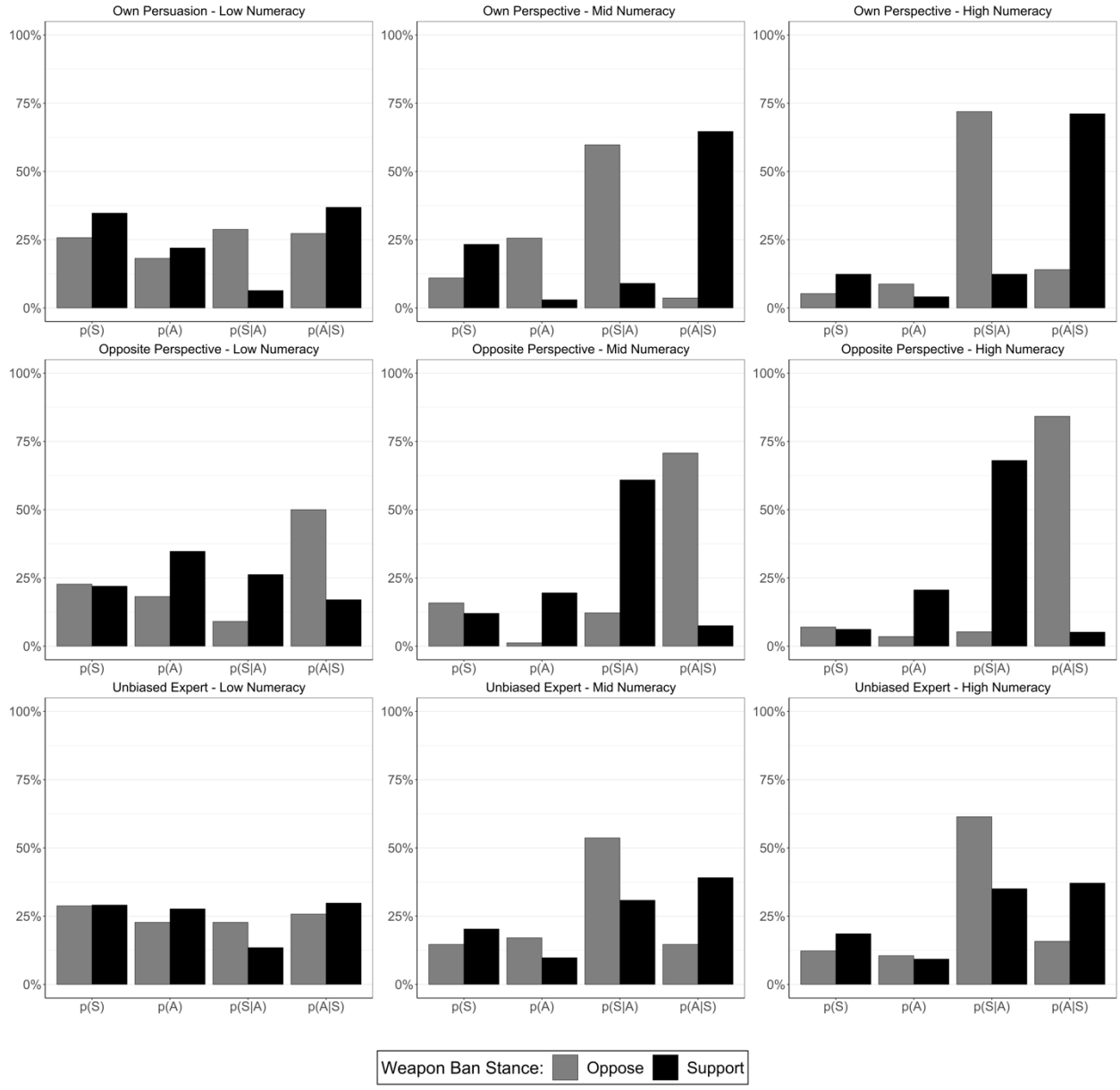

Figure 4. Selection of which frequencies were most important for Supporters and Opponents of an assault weapons ban separately when selecting from their Own Perspective (top row), the Opposite Perspective (middle row), and from an Expert Perspective (bottom row). Preferences are presented separately for those with low numeracy (bottom third, left column), medium numeracy (middle third, center column), and high numeracy (top third, right column). p(S|A) = probability of being an adult in the US who owns an assault weapon conditional on having committed a mass shooting; p(A|S) = probability of having committed a mass shooting conditional on being an adult in the US who owns an assault weapon; p(A) = probability that an adult in the US owns an assault weapon; and p(S) = probability that an adult in the US has committed a mass shooting.