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Industry-Dominated Science Advisory Boards Are Perceived To Be Legitimate . . . But Only When They Recommend More Stringent Risk Management Policies

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ABSTRACT: In 2017, the US Environmental Protection Agency (EPA) was criticized for two controversial directives that restricted the eligibility of academic scientists to serve on the agency's key science advisory boards (SABs). The EPA portrayed these directives as necessary to ensure the integrity of the SAB. Critics portrayed them as a tactic by the agency to advance a more industry-friendly deregulatory agenda. With this backdrop, this research examined board composition and its effect on the perceived legitimacy of risk management recommendations by the SAB. In an experiment, we presented participants with hypothetical EPA SABs composed of different proportions of academic and industry scientists. We then asked participants to rate their satisfaction with, and the legitimacy of, these boards in light of their decisions in scenarios based on actual EPA SAB deliberations. Participants perceived higher levels of satisfaction and legitimacy when SABs made more stringent risk management recommendations. While SABs dominated by industry scientists were perceived to be more strongly motivated to protect business interests, we found no effect of board composition on perceptions of satisfaction and legitimacy. These results are consistent with prior research on decision quality that suggests people use normative outcomes as a heuristic for assessing the quality of deliberations. Moreover, these results suggest that members of the public are supportive of federal SABs regardless of their composition, but only if they take actions that are consistent with normative expectations.

KEY WORDS: Decision making; EPA; legitimacy; procedural justice; risk management

1. INTRODUCTION

Federal advisory boards offer guidance to policymakers about preexisting or proposed policies. Of the 1,004 advisory boards assembled under Federal Advisory Committee Act (FACA) in 2018, 220 were designated as "scientific and technical" (General Services Administration, 2019). Scientists who serve on these federal science advisory boards (SABs) are considered to be experts in their field, and they are

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subject to external review and comment during their selection as a way of confirming their standing. Membership on federal SABs is often drawn from the community of scientists working in academia. However, scientists from industry (and industry trade associations), private consulting, tribal and state agencies, and the nonprofit sector may also be invited to serve. Service on an SAB represents one of the few formal channels through which nongovernmental scientists may formally participate in the policy-making process (Stuessy, 2016).

Far from a proverbial feather in the cap of nongovernmental scientists, service on a federal SAB serves an important, practical purpose. These scientists help government agencies to identify relevant studies in the early stages of problem identification and policy formulation, they offer guidance on best practices—in research design, data collection, and analysis—across a wide spectrum of scientific disciplines, and they help to set expectations about the ethical and scientific norms (e.g., regarding replication and data transparency) that underlie the conduct and use of science for policymaking. In effect, a federal SAB serves a critical peer review role for the science underlying policy (Wagner, Fisher, & Pascual, 2018).

A high-profile example of a federal SAB is the Chartered Science Advisory Board assembled by the United States Environmental Protection Agency (EPA). The EPA SAB was created in 1978 and works under a congressional mandate codified under section 8(b) of the Environmental Research, Development, and Demonstration Authorization Act (ERDDAA). Its objective is to provide independent advice and peer review to the EPA Administrator on scientific and technical matters that are relevant to agency rulemaking. While the SAB reports to the EPA Administrator, congressional committees may also ask for guidance from the SAB on scientific and technical matters (95th Congress of the United States of America, 1978).

Under the Trump administration, the EPA SAB has come under public and political scrutiny because of a directive[1] issued by former EPA Administer, Scott Pruitt, and upheld by the agency's current Administrator, Andrew Wheeler. This directive (henceforth referred to as the "Pruitt directive") introduced more restrictive rules governing the eligibility of academic scientists to serve on the EPA SAB[2] by barring those who received research grant support from the EPA from serving on the SAB. These rules did not restrict the service on SABs of scientists from EPA-regulated industry, or from state agencies that receive EPA funds. A second directive, building directly on the first, prematurely terminated the appointments of several EPA SAB members.

The Pruitt directive was framed by the EPA as necessary for ensuring the independence, diversity, and integrity of EPA science committees. However, critics portrayed the directive as a tactic by the agency to advance a deregulatory policy agenda—and to suppress mainstream science—by increasing the influence of scientists employed by industries (and their trade associations) that are regulated by the EPA, and state agencies known for a right-of-center political stance on environmental and public health risks (Cornwall, 2017; Union of Concerned Scientists, 2018).[3]

That in today's political climate a conservative leaning EPA leadership and a largely liberal leaning block of academic scientists (Nisbet, 2011) and their supporters disagree about the intent behind the Pruitt directive is not surprising. However, an open question remains as to whether members of the American public (to whom the agencies like EPA ultimately answer) would nevertheless be satisfied with the work being done by SABs—importantly, view the work as legitimate—given these changes.

Public polling data offer conflicting answers to these questions. Even though public trust in the scientific community has remained both high and stable since the 1970s (Pew Research Center, 2019), recent research has demonstrated that industry scientists are viewed with greater skepticism by members of the public than are academic scientists (Besley et al., 2017). This result points to the possibility of dampened public support for the EPA's current stance on the composition of its SAB.

[1] Administrator Pruitt's directive, dated 31 October 2017, was entitled Strengthening and Improving Membership on EPA Federal Advisory Committees.

[2] This same directive affected the eligibility of academic scientists to serve on the EPA's Clean Air Scientific Advisory Committee (CASAC) and the EPA's Board of Scientific Councillors (which is managed by the EPA Office of Research and Development).

[3] For example, the proportion of EPA SAB members representing industry rose from 5% in 2008 to 11% in 2016; this period of time reflected EPA leadership under Presidents George W. Bush (2001–2008) and Barack Obama (2009–2016). The proportion of EPA SAB members representing industry then jumped from 11% in 2017 to 34% in 2019, reflecting the first three years of the Trump administration. In this same period (2017–2019), representation on the EPA SAB by academic scientists fell from 78% to 50%.

At the same time, however, other polls reveal a significant partisan divide between members of the public regarding their concern about safeguarding the environment as a priority for policy. Less one-third (31%) of Republicans think that the environment should be a top priority for policymakers; this number jumps to 74% for Democrats. But the partisan divide on the public's highest public policy priority is considerably smaller: a majority of both Republicans (79%) and Democrats (64%) view the economy as the most important issue facing policymakers (Pew Research Center, 2019). It is reasonable to assume therefore that industry scientists may be perceived as placing greater emphasis on economic priorities given their affiliation with companies even if it means sacrificing some degree of environmental protection in the process. In turn, these data on public perceptions of policy priorities points to the *possibility* of broader public support for the EPA's reorganization of its SAB to include more scientists representing the business interests of private industry.

From a theoretical perspective, the group value model of procedural justice offers some insights about how the Pruitt directive to alter the balance of its SAB would be viewed by members of the American public. Prior research points to a positive relationship between the perceived acceptability and legitimacy of regulatory decision-making processes, and the degree to which observers of (e.g., Arvai, 2003)—or participants in (e.g., Arvai, Gregory, & McDaniels, 2001)—the decision-making process judge it to be fair and unbiased (see also Colquitt, 2001; Phillips, 2002). The underlying mechanism of this relationship is thought to be linked to certain signals being sent by the process itself; the process in which regulatory decisions are made communicates symbolic information to observers about whether the decisionmakers themselves have the appropriate standing or expertise, and whether they are impartial and trustworthy (Lind & Tyler, 1988; McComas, Tuite, Waks, & Sherman, 2007).

Applying this group value model of procedural justice to the Pruitt directive, it is conceivable that the scientists serving on it would be viewed by outside observers as having the appropriate standing or expertise. (As we note above, scientists who serve on SABs must be verifiable experts in their field; e.g., according to the EPA SAB's own charter, its members must be scientific experts who, together, can assess the scientific and technical aspects of environmental issues facing the agency). However, it is equally conceivable that scientists working for industry may be perceived as lacking in impartiality because of their relationship with their industry employers.

Specifically, the relationship between these scientists and their employers—many of which represent industries that fall under the regulatory scrutiny of the EPA[4]—may be seen by outside observers as causing them to think and act in the interests of their employers, and not necessarily in the interests of the environment or the American public. Indeed, outside perceptions of a lack of impartiality among industry scientists may be the mechanism behind the observation (Besley et al., 2017) that they tend to be viewed with greater skepticism when compared with academic scientists. In support of this assertion, other research has suggested that perceptions about the presence (or absence) of conflict of interest may be used by observers as a heuristic for more negatively judging the legitimacy of a process, or their satisfaction with the outcomes that result from it (McComas et al., 2007; Thibaut & Walker, 1975).

An alternative theoretical perspective on the question of public support for the Pruitt directive comes from research on judgment and decision making. It is generally accepted by decision scientists that the quality of a decision is best measured by the process used to arrive at it. Beyond the symbolic information conveyed by a deliberative process, a well-structured decision-making process works to clarify and define the problem (or opportunity) that is to be the focus of analysis; identify objectives (and associated performance measures) from stakeholders and relevant experts; develop alternatives that are responsive to these objectives and then forecast their performance; and systematically confront the tradeoffs that arise when objectives and alternatives inevitably conflict (Campbell-Arvai, Bessette, Wilson, & Arvai, 2018; Gregory et al., 2012; Keeney & Raiffa, 1993). These are the components of decision making that fall under the direct control of decisionmakers (whether or not the outcomes of these processes actually unfold as predicted—or hoped—often does not), hence their importance in evaluating decision quality.

However, from the standpoint of outside observers, including those affected by decisions,

[4]At the time this research was conducted, the employers of scientists serving on the EPA SAB included chemical companies (e.g., Dow), consumer products manufacturers (e.g., Procter and Gamble), industry lobby associations (the American Chemistry Council), and oil and gas companies (e.g., ExxonMobil).

positive (or normative) *outcomes* tend to be more highly valued than *process* in evaluations of decision quality (Arvai & Froschauer, 2010; Baron & Hershey, 1988; Lipshitz & Barak, 1995). The importance of outcomes to outside observes makes intuitive sense: Insofar as these individuals have little or no control over—or agency in—the decision-making process, whether decision is judged to be "good" or "bad" will depend upon whether people received what they expected or were promised. Applied to the question of balance between academic and industry scientists on an SAB, all that may really matter to outside observers is whether or not its decisions or recommendations conform with some expected or normative standard.

In the remainder of this article, we present and discuss the results from an experiment aimed at improving our understanding of how the composition of the EPA's SAB is perceived by the public. Specifically, we were interested in the question of how SAB composition—namely, the balance between academic and industry scientists—effects people's satisfaction with, and their ratings of the legitimacy of processes leading to risk management recommendations from the SAB to policymakers.

We presented a nationally representative sample of participants with hypothetical EPA SABs composed of varying proportions of academic and industry scientists. We then asked participants to rate their satisfaction with, and the legitimacy of decision-making processes employed by these boards in light of their recommendations in the context of two hypothetical scenarios based on actual EPA SAB deliberations about pesticides. One scenario focused on protecting environmental health and the other focused on safeguarding human health.

Participants were asked to consider a recommendation from the SAB to either relax or strengthen an existing EPA rule about pesticide use. We relied largely on prior research on procedural justice as the entry point to hypothesis development. We therefore hypothesized that SABs dominated by industry scientists would be perceived to be more motivated to make decisions to protect business interests (H1), while SABs dominated by academic scientists would be perceived to be more motivated to make decisions to protect the interests of human (H2) and environmental health (H3). Finally, we hypothesized that participants would be more satisfied with more restrictive regulations (H4); we also hypothesized that advisory boards composed of a higher proportion of academic scientists (relative to industry scientists) would be viewed as making more legitimate recommendations (H5).

2. METHODS

2.1. Participants

Participants in this research were citizens of the United States over the age of 18 and were recruited from an online panel maintained by Dynata ™ (formerly known as Survey Sampling International ™). We worked with Dynata ™ because, at the time this research was conducted, they maintained their own large panel (with more than 3 million opt-in/first-party participants based in the United States); thus, we not confronted with the need to aggregate data from multiple panels as is often the case with other platforms (e.g., Qualtrics ™). Participants were randomly drawn from a probability sample of U.S.-based panel members in the Dynata ™ database (Table S1).

For a desired sample of 2,400 participants, a total of 3,180 participants were initially recruited to participate in this study. A power analysis for our planned three-way ANOVA, conducted using *G*Power*, suggested that we needed to recruit 1,302 to participants to have 95% power to detect a small effect size of Cohen's $f = 0.1$ at $\alpha = 0.05$ (Faul, Erdfelder, Buchner, & Lang, 2009). A total of 227 participants were removed from the data set because they failed to complete the experiment. An additional 453 participants were removed from the data set for spending less than half of the median time (4.6 minutes) reading their assigned scenario and answering the accompanying questions, and for straight-lining (i.e., no variation in responses) on the Likert-scale questions. After data cleaning, the total sample size was reduced to 2,500.

Overall, the sample was 56% female ($n = 1{,}383$) and 43% male ($n = 1{,}082$); a combined 1% of the sample ($n = 29$) self-identified as nonbinary ($n = 14$), self-described their gender ($n = 7$), or preferred not to report it ($n = 8$). The average age of participants was 46 ($SD = 15.5$). The majority (60%) of participants attended some college ($n = 1{,}490$); 21% ($n = 527$) of participants reported a high school education or lower and 19% ($n = 477$) reported an education level beyond a bachelor's degree (Table S1).

2.2. Experimental Design and Data Analysis

The experiment utilized a 2 (board composition) × 2 (scenario) × 2 (recommendation)

between-subjects design. After obtaining informed consent,[5] participants read a short introduction to the EPA and its SAB, and then were randomly assigned to read about one of two 40-member board compositions: one was composed of 80% academic scientists and 20% industry scientists (i.e., academic-heavy), and the other was composed of 20% academic scientists and 80% industry scientists (i.e., industry-heavy); see the Supporting Information section (Table S2) for the specific wording of these scenarios. A pie chart depicting the ratio of academic scientists to industry scientists was included to help participants visualize these differences.

Next, participants were randomly assigned to one of two EPA policy scenarios. In the first scenario, participants were told about an unnamed pesticide that kills insect pests, but that may also kill nonpest insects such as pollinators (bees, butterflies) that are beneficial for environmental health. In the second scenario, participants read about the same unnamed pesticide; however, rather than being harmful to nonpest insects, participants were told that the chemical may cause cancer in humans.

Participants were then randomly assigned to one of two different SAB recommendations. In one, the SAB recommended that the regulation of the pesticide be made *more* restrictive (e.g., allowing the pesticide to be used less frequently and at lower concentrations); in the second, the SAB recommended that the regulation of the pesticide be made *less* restrictive (e.g., allowing the pesticide to be used more frequently and at higher concentrations).

Participants were asked to indicate their perceptions of the assigned SAB's underlying motivations: to support policies that promote *business interests*, to support policies that promote *human health*, and to support policies that promote the *natural environment*. These responses were collected on seven-point Likert scales from "not at all motivated" to "completely motivated." Participants were also asked how *satisfied* they were with the SAB's recommendation, on a seven-point Likert scale from "not at all satisfied" to "completely satisfied."

Next, participants were asked to provide ratings of the decision-making process employed by the SAB based on two criteria thought to be important aspects of procedural justice (per Tyler, 2000): the SAB's *standing* as a group of scientific experts and the SAB's *neutrality* when it comes to the issues put before its members. To this end, participants were asked about the extent to which they thought the SAB made its recommendation based on the best available science (i.e., standing) and to what extent they trusted the SAB to make an unbiased recommendation (i.e., neutrality). Responses to both questions were collected on seven-point Likert scales from "not at all science-based" to "completely science-based" for the first question, and from "very low trust" to "very high trust" for the second question. Participants' responses to these two items were highly correlated ($r = 0.75$, $p < 0.001$), so they were combined to form a single measure we termed "legitimacy" (Cronbach's $\alpha = 0.86$).

We performed three-way analyses of variance to measure the effect of SAB composition, scenario, and recommendation on the dependent variables (satisfaction, underlying motivations, and legitimacy).

3. RESULTS

3.1. Perceived Motivation to Protect Business Interests

We did not observe a significant two- or three-way interaction between composition, scenario, and recommendation on judgments about a SAB's motivation to protect business interests (Table I). Similarly, we did not detect a main effect of scenario on the perceived motivation to protect business interests. However, both recommendation and board composition exhibited significant main effects. Supporting H1, participants thought that protecting business interests was a stronger motive for the industry-heavy SAB ($n = 1{,}263$, $\bar{x} = 4.55$, $SD = 1.92$) than it was for the academic-heavy SAB ($n = 1{,}244$, $\bar{x} = 4.34$, $SD = 1.97$). Participants also judged the motivation to protect business interests as greater when the SAB recommended a less restrictive regulation ($n = 1{,}252$, $\bar{x} = 5.19$, $SD = 1.76$) versus when it recommended a more restrictive regulation ($n = 1{,}255$, $\bar{x} = 3.70$, $SD = 1.83$).

3.2. Perceived Motivation to Protect Human Health

We observed a significant three-way interaction between board composition, scenario, and recommendation for judgments about the SAB's

[5]This project was approved by the Health Sciences and Behavioral Sciences Institutional Review Board (protocol number HUM00156806) at the University of Michigan.

Table I. Three-Way ANOVA for Perceived Motivation to Protect Business Interests, Human Health, and Environmental Health as a Function of Board Composition, Scenario, and Recommendation

		Motivation: Business			Motivation: Human Health			Motivation: Environment		
Variables		*F*	*p*	*Part.*η^2	*F*	*p*	*Part.*η^2	*F*	*p*	*Part.*η^2
Main effects	*Board composition (C)*	4.77	0.029	0.002	1.45	0.228	0.001	3.81	0.051	0.002
	Scenario (S)	0.34	0.563	0.000	3.16	0.075	0.001	12.08	0.001	0.005
	Recommendation (R)	422.09	<0.001	0.144	1,174.93	<0.001	0.320	1,201.89	<0.001	0.325
Interaction effects	$C \times S$	0.08	0.780	0.000	1.07	0.300	0.000	0.23	0.629	0.000
	$C \times R$	0.58	0.447	0.000	0.81	0.370	0.000	1.80	0.180	0.001
	$S \times R$	0.01	0.915	0.000	15.63	<0.001	0.006	3.42	0.064	0.001
	$C \times S \times R$	2.14	0.144	0.001	6.38	0.012	0.003	2.83	0.092	0.001

$df = (1, 2{,}499)$

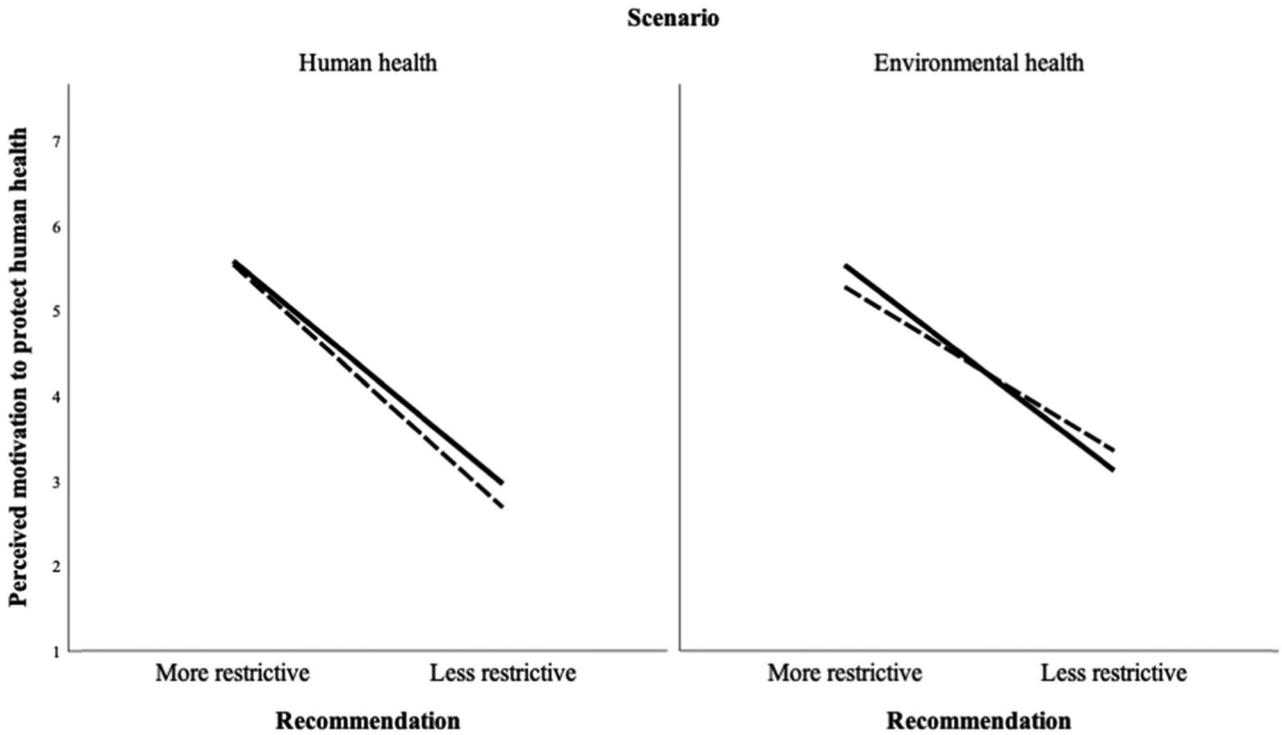

Fig 1. Estimated marginal means of the extent to which the SAB was perceived to be motivated to protect human health as a function of board composition, scenario, and recommendation. The solid line represents the academic-heavy SAB and the hatched line represents the industry-heavy SAB. For the nonsignificant three-way interactions, see Figures S1–S3.

motivation to protect human health (Table I, Fig. 1). Statistical significance was accepted at the Bonferroni corrected $p < 0.025$ level for simple two-way interactions and simple-simple main effects. There was a statistically significant simple two-way interaction between board composition and recommendation for the environmental health scenario ($F_{(1, 2,499)} = 5.89$, $p = 0.015$) but not the human health scenario ($F_{(1, 2,499)} = 1.32, p = 0.251$).

Exploring this simple two-way interaction further, we observed a significant simple-simple main effect for the environmental health scenario in both the academic-heavy ($F_{(1, 2,499)} = 284.41$, $p < 0.001$) and industry-heavy SAB conditions ($F_{(1, 2,499)} = 183.18$, $p < 0.001$). Simple-simple pairwise comparisons were carried out for those in the environmental health scenario with an academic-heavy and industry-heavy SAB with a Bonferroni correction once again

applied. The pattern was the same for both SAB compositions: participants perceived the SABs to be more motivated to protect human health ($p < 0.001$) when the SAB made a more restrictive recommendation (academic-heavy: $\bar{x} = 5.54$, $SD = 1.52$; industry-heavy: $\bar{x} = 5.28$, $SD = 1.62$) than when it made a less restrictive recommendation (academic-heavy: $\bar{x} = 3.12$, $SD = 1.97$; industry-heavy: $\bar{x} = 3.35$, $SD = 2.00$). However, H2 was not supported as there was no significant difference in perceived motivation to protect human health between academic-heavy and industry-heavy SAB compositions ($F_{(1, 2,499)} = 1.45$, $p = 0.228$).

3.3. Perceived Motivation to Protect Environmental Health

We did not observe any significant two- or three-way interactions between composition, scenario, and recommendation for judgments about the SAB's motivation to protect environmental health (Table I). Significant main effects were observed for scenario and recommendation only. Participants thought the SAB were more motivated to protect environmental health when it issued a more restrictive ($n = 1{,}252$, $\bar{x} = 5.49$, $SD = 1.54$) versus less restrictive recommendation ($n = 1{,}255$, $\bar{x} = 3.00$, $SD = 2.01$). Participants also indicated that protecting environmental health was a more powerful motive within the environmental health context ($n = 1{,}262$, $\bar{x} = 4.45$, $SD = 2.18$) than the human health context ($n = 1{,}245$, $\bar{x} = 4.04$, $SD = 1.12$). H3, predicting that perceived motivations to protect environmental health would differ by SAB composition, was not supported ($F_{(1, 2,499)} = 3.81$, $p = 0.051$).

3.4. Satisfaction With the SAB's Recommendation

We did not detect any significant two- or three-way interactions between composition, scenario, and recommendation on participants' satisfaction with the recommendation made by the SAB (Table II). Neither board composition nor scenario exhibited a main effect for participants' satisfaction with the SAB's recommendation. However, satisfaction was significantly different between the two recommendation types. Supporting H4, satisfaction was significantly higher for a more restrictive regulation ($n = 1{,}252$, $\bar{x} = 5.70$, $SD = 1.62$) versus a less restrictive regulation ($n = 1{,}255$, $\bar{x} = 2.74$, $SD = 1.98$).

3.5. Perceived Legitimacy

We observed a significant three-way interaction between composition, scenario, and recommendation for participants' judgments about the legitimacy of the process employed by the SAB (Table II, Fig. 2). Specially, significant effects were observed at the Bonferroni corrected level of $p < 0.025$ for simple two-way interactions and simple-simple main effects. We detected a significant simple two-way interaction between composition and recommendation in the environmental health scenario ($F_{(1, 2,499)} = 7.91$, $p = 0.005$), but not the human health scenario ($F_{(1, 2,499)} = 0.05$, $p = 0.819$).

Looking more closely at the simple two-way interaction, we observed a significant simple-simple main effect of environmental health scenario with an academic-heavy ($F_{(1, 2,499)} = 274.8$, $p < 0.001$) and an industry-heavy SAB ($F_{(1, 2,499)} = 161.25$, $p < 0.001$). However, H5 was unsupported as there was no significant difference in perceived legitimacy by board composition ($F_{(1, 2,499)} = 1.36$, $p = 0.243$). Simple-simple pairwise comparisons were carried out for the environmental health scenario combined with an academic-heavy and industry-heavy SAB; a Bonferroni correction was once again applied. The perceived legitimacy of the academic-heavy SAB was significantly higher ($p < 0.001$) when it made a more restrictive recommendation ($\bar{x} = 5.25$, $SD = 1.37$) compared to when it made a less restrictive recommendation ($\bar{x} = 3.18$, $SD = 1.69$). The perceived legitimacy of the industry-heavy SAB was also significantly higher ($p < 0.001$) when it made a more restrictive recommendation ($\bar{x} = 5.01$, $SD = 1.43$) when compared to a less restrictive recommendation ($\bar{x} = 3.44$, $SD = 1.75$).

4. DISCUSSION

We examined public judgments about their satisfaction with, the motivations behind, and the legitimacy of risk management recommendations made by a federal SAB (namely, the EPA's SAB) as a function of its composition (i.e., dominated by academic vs. industry scientists), the scenario it was addressing (i.e., human or environmental health), and the type of recommendation made (i.e., suggesting a less or more stringent regulation).

We found that, independent of SAB composition and scenario, people demonstrated higher levels of satisfaction with more restrictive recommendations; this finding was in line with our hypothesis (H4).

Table II. Three-Way ANOVAs for Participant Satisfaction With the SAB's Recommendation and Perceived Legitimacy as a Function of Board Composition, Scenario, and Recommendation

		Satisfaction			Legitimacy		
Variables		*F*	*p*	*Part.*η^2	*F*	*P*	*Part.*η^2
Main effects	*Board composition (C)*	3.10	0.078	0.001	1.36	0.243	0.001
	Scenario (S)	3.14	0.076	0.001	1.66	0.198	0.001
	Recommendation (R)	1,653.68	<0.001	0.398	898.75	<0.001	0.265
Interaction effects	$C \times S$	0.37	0.545	0.000	1.96	0.162	0.001
	$C \times R$	0.01	0.946	0.000	3.32	0.069	0.001
	$S \times R$	0.20	9.652	0.000	0.60	0.439	0.000
	$C \times S \times R$	1.38	9.241	0.001	4.60	0.032	0.002

$df = (1, 2{,}499)$

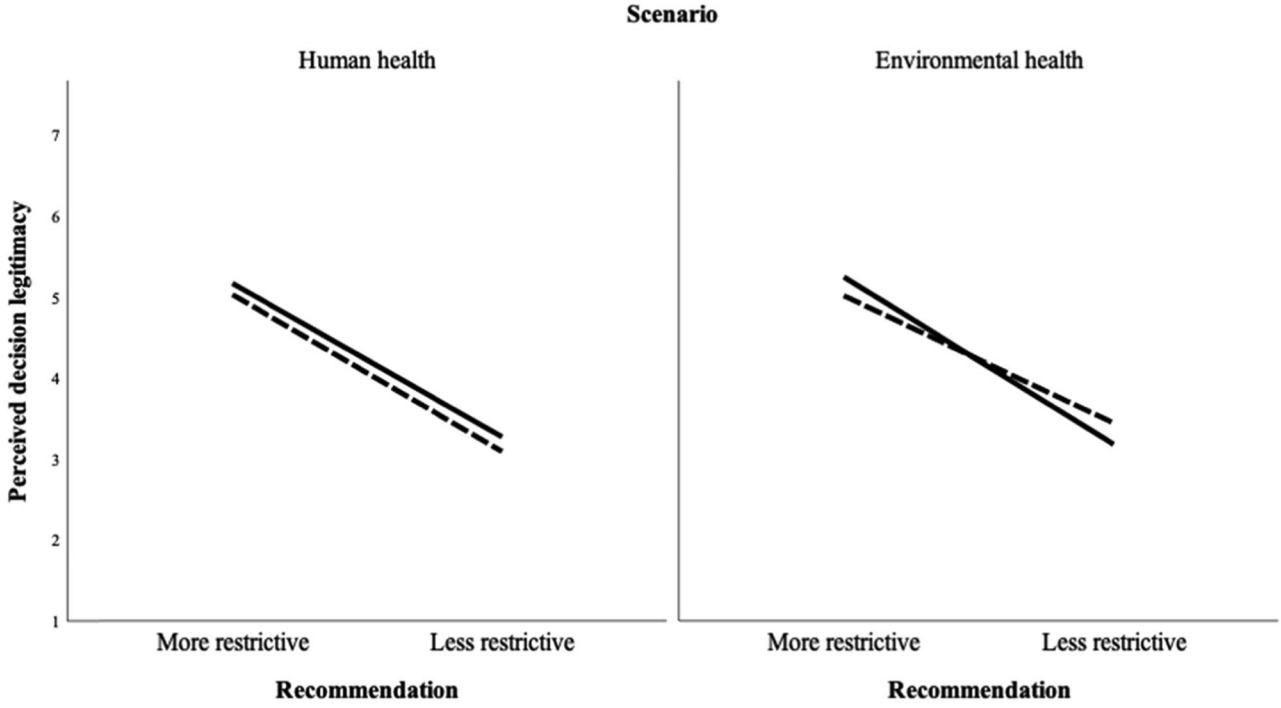

Fig 2. Estimated marginal means of the perception that the SAB made a legitimate decision as a function of board composition, scenario, and recommendation. The solid line represents the academic-heavy SAB and the hatched line represents the industry-heavy SAB. For the nonsignificant three-way interactions, see Figures S1–S3.

More restrictive recommendations also led people to believe that an SAB was strongly motivated to safeguard environmental health, and less motivated to protect the interests of businesses regardless of SAB composition; this finding did not support two of our hypotheses (H3 and H1). Similarly, people exposed to an SAB making a more restrictive recommendation believed that it was more motivated to protect human health and judged the legitimacy of the decision-making process leading to the recommendation to be higher; these findings did not depend on SAB composition, and therefore, did not support our hypothesis (H2 and H5). Unsurprisingly, participants exposed to an industry-heavy SAB judged it to be more strongly motivated to protect business interests when compared to an academic-heavy SAB; this finding was in line with our hypothesis (H1).

Consistent with research on procedural justice (McComas et al., 2007), we hypothesized that

an advisory body composed mainly of academic scientists—versus industry scientists who are more often perceived as having conflicts of interest (Besley et al., 2017)—would be perceived as making more legitimate recommendations (i.e., recommendations that were perceived to be unbiased and science-based). However, our results suggest that board composition is not the determining factor in judgments about legitimacy. Rather, it was the stringency of the SAB's recommendation that determined legitimacy in this study; recommendations by an SAB for *more* stringent regulations were viewed as more legitimate when compared to recommendations that regulations be *less* stringent. Similarly, SAB composition was not related to participants' satisfaction; once again, recommendations by an SAB for *more* (vs. *less*) stringent regulations were met with higher levels of participant satisfaction.

One of the reviewers of this article pointed out that the mechanism underlying this result may be that respondents did not understand the difference between academic scientists and industry scientists. This is possible, but given the clear differences in perceptions of academic and industry scientists observed in other studies (e.g., Besley et al., 2017), and because academic and industry scientists were clearly differentiated in the experiment's preamble (see the Supporting Information), we believe that this would *not* have been the case here. Alternatively, participants may have believed that academic scientists are just as conflicted (e.g., in terms of their financial or research ties to companies) as are industry scientists. Indeed, it is true that academic scientists are often recruited by (and receive compensation from) regulated industries to assist with research and development; Similarly, they may lead research efforts, or are quite likely to be employed by universities that are funded (in part) by grants from industry. We did not ask participants rate their perceptions of conflict of interest as they relate to academic versus industry scientists; thus, we are unable to test for this possibility. We intend to address this question in a future study.

It is also noteworthy from our results that people judged both academic- and industry-heavy SABs as equally motivated to protect human and environmental health. As we note above, these results ran contrary to our hypothesis. SAB composition had a significant main effect only when participants were asked to evaluate the SABs motivation to protect business interests; specifically, an SAB with a high proportion of industry scientists was judged by participants to be more motivated to protect business interests.

These results are surprising on two levels. On the one hand, they unfold in sharp contrast to the concerns raised by academic scientists and members of the general public about the inclusion of more industry scientists on federal SABs (such as the EPA's Chartered SAB). In spite of recent criticism of the EPA for terminating the service of academic scientists and replacing them with more industry scientists (e.g., see Boyle & Kotchen, 2018; Malakoff, 2017; Tonko, 2017), members of the public do not seem to see these changes as problematic from the standpoint of their satisfaction with an SAB or the legitimacy of its recommendations. On the other hand, these results suggest that the public's expectation is that advisory bodies—the EPA's Chartered SAB in this study—will protect human and environmental health when they are at risk. That these expectations are prevalent even when an SAB dominated by industry scientists is seen as being motivated to protect business interests is important because it implies that the objectives of a committee's work—namely to protect people and the environment from risk—ought to trump the committee's underlying ideology (e.g., to promote a free market).

However, there is an alternative explanation for our results, which is that participants in this study are basing their judgments about satisfaction, underlying motivations, and legitimacy on their negative or positive perceptions of the SAB's recommendation. Specifically, these findings are also consistent with prior experimental work (Arvai & Froschauer, 2010; Baron & Hershey, 1988; Lipshitz & Barak, 1995) that demonstrated that people judged the quality of decision-making processes (and their satisfaction with those who made them) as either positive or negative based on the whether the outcomes resulting from them were either positive or negative. Here, decisions were coded as "good" based on the realization of positive outcomes even if they were the result of substandard decision-making processes.

Thus, participants in the research reported here may have been willing to abandon any preconceived notions about SAB bias when the board made a recommendation in the direction of more restrictive regulation. In this sense, the halo effect (Thorndike, 1920) associated with a more or less stringent risk management recommendation may be "spilling over" to influence participants' judgments about other attributes of an SAB (e.g., satisfaction and legitimacy).

Taken together, our results suggest that people may be relying on desirable outcomes as a heuristic for assessing the legitimacy of, and their satisfaction with an SAB. Prior research (van den Bos & Miedema, 2000; van den Bos, Vermunt, & Wilke, 1997) suggests that people rely on judgments about procedural fairness as a means of evaluating an outcome when the degree of "goodness" or "badness" associated with it is ambiguous. In the case of the study reported here, the reverse appears to also be true. Research on people acting as jurors in legal matters (Skitka & Houston, 2001) supports this suggestion; it shows that normative positions—what the authors termed "moral mandates" such as punishing the guilty—act as determinants of how people make judgments about process.

Applied to the research reported in this article, the normative response to a pesticide that poses an unacceptable risk to either environmental or human health is to regulate it more stringently, even if would be advantageous to the financial bottom line of companies to relax the rules governing its use. This perspective aligns with the growing number of Americans—63% in 2019, which is up from 59% in 2017—who believe that stricter environmental regulations are "worth the cost" (Pew Research Center, 2019). It stands to reason therefore that any (academic-heavy or industry-heavy) SAB that takes such an action will be rewarded with positive ratings of both satisfaction with and legitimacy.

From a practical perspective, the results from this research suggest that members of the public are supportive of SABs regardless of their composition, but only if they take actions (e.g., make risk management recommendations) that are consistent with normative expectations about either the board's mandate, or the target of their deliberations. This presents both good news and bad news from the standpoint of the EPA's recent agency directive aimed at, the agency's words, "ensuring the integrity" of the EPA's chartered SAB.

It is good news because people seem willing to accept SAB compositions that alter the historic balance that strongly favored academic scientists in the direction of greater representation by scientists from regulated industry. However, it is bad news if one accepts the criticisms leveled against the EPA that the ulterior motive of this directive is to weaken regulations that safeguard environmental and human health; our results suggest that people look to SABs for recommendations that uphold normative standards exemplified by the mission of the agency that they serve. In the case of the EPA, it is to protect environmental and human health.

The research reported here was not without limitations that, taken together, open the door to future studies. Our study design did not provide information about hypothetical SAB members or their qualifications. This is an important omission because not all scientists—whether they work for industry or in the academy—are equal in terms of their qualifications and motivations. As of this writing, for example, some members of the current iteration of the EPA's Chartered SAB are climate change skeptics, while others are known for their previous efforts aimed at rolling back human and environmental health safeguards. We intentionally withheld information about the qualifications and past work of individual SAB members so that we may better understand participant perceptions of SAB composition as a whole. However, members of the public have access to information about individual SAB members, and this may strongly influence their perceptions in a real-world setting.

We also limited both the number and types of scenarios shown to participants. Future studies could consider a broader range of scenarios where the normatively "correct" recommendation is less clear to participants. Results from our research lead us to believe that SABs that acted to protect human and environmental health were rewarded with more positive ratings of satisfaction and legitimacy. In the absence of a normatively correct recommendation, participants would be required to look more closely at other contextual cues—such as board composition or member qualifications—to evaluate these variables. This, in turn, would add important detail to our understanding of how members of the public feel about changes to federal SABs like those enacted by the EPA.

In spite of these limitations, our research sheds light on the importance of the activities and the recommendations of SABs as variables that influence the public's ratings of satisfaction and legitimacy. Our research is both important and timely because it demonstrates that SAB composition may not be as important as SAB behavior. SABs, such as the EPA's Chartered SAB, are assembled to offer science-based advice to policymakers in a manner that is consistent with an agency's mission and mandate. Changing the rules by which SABs are structured to either satisfy a fleeting political agenda, or as a vehicle for enacting regulatory rollbacks, is likely to be met with continued resistance.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Comparison Table of U.S. Census Data and Demographic Responses From Participants.
Table S2. Study vignettes.
Table S3. Correlation Matrix.
Figure S1. Estimated marginal means for participant satisfaction with the SAB's recommendation as a function of board composition, scenario, and recommendation.
Figure S2. Estimated marginal means of the extent to which the SAB was perceived to be motivated to protect business interests as a function of board composition, scenario, and recommendation.
Figure S3. Estimated marginal means of the extent to which the SAB was perceived to be motivated to protect environmental health as a function of board composition, scenario, and recommendation.