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HOW EXPERTS VIEW THE LEGAL SYSTEM'S USE OF SCIENTIFIC EVIDENCE

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Legal scholars and courts frequently write about how scientific evidence is vetted and presented in legal proceedings, but the views of experts themselves have received little attention. Our research aims to fill that gap. This paper reports some of what we learned from a series of surveys we conducted, beginning with a survey in 2016 of scientists who had been elected to membership in the American Academy of Arts and Sciences.[3] Subsequent surveys were directed to subscribers of the journal Science who identified as scientists and engineers and to self-identified experts who advertised their availability as experts to lawyers or appeared in the expert listings on Westlaw. Responses from those surveyed capture how they regard key actors in the legal system (Judges, Jurors, Lawyers, Other Experts) as well as the weaknesses these experts see in how the legal system treats scientists and handles scientific evidence. We also examine the extent to which expert evaluations of these issues are mediated by their experience in testifying in legal proceedings.

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[3] Shari Seidman Diamond & Richard O. Lempert, *When Law Calls, Does Science Answer? A Survey of Distinguished Scientists and Engineers*, 147 DAEDALUS 41 (2018).

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I. INTRODUCTION

Science and technology shape modern societies. So it is not surprising that the legal system is regularly called upon to deal with scientific issues. Yet only a small proportion of the legal system's key decision makers—lawyers,[4] judges[5] and jurors—have scientific backgrounds. Thus, the system depends on expert inputs to resolve many of the questions it confronts. Suits for injuries allegedly caused by chemical exposure may require evidence on exposure effects from scientists with expertise in chemistry, biology, epidemiology, and pathology; resolving disputes arising out of a bridge collapse or a patent claim may require engineering and technological expertise; and DNA evidence may be key in identifying criminals and excluding innocent individuals from prosecution. New developments in genetics, AI, neuroscience, material sciences, and other fields mean that the law's need for scientific expertise will only increase.

Against this backdrop, the relationship between science and law is frequently strained. Observers have suggested that respected scientists are reluctant to get involved with the legal system. In 2001, the National Research Council reported, "[S]cientists tend to be leery of lawyers and the legal process, preferring not to venture into the courtroom."[6] Yet studies show that experts appear frequently in court, often presenting scientific, engineering, or medical testimony.[7] Observers

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[4] Frank McIntyre & Michael Simkovic, *Value of a Law Degree by College Major*, 68 J. LEGAL EDUC. 585, 605 (analyzing census data and finding that only 6% of lawyers had STEM degrees).

[5] Christa Laser et al., *Scientific Educations Among U.S. Judges*, AM. U. L. REV. (forthcoming 2025) (manuscript at 1) (finding that only 7.35% of federal judges have undergraduate degrees in science and technology fields).

[6] NAT. RSCH. COUNCIL, A CONVERGENCE OF SCIENCE AND LAW 2 (2001).

[7] *See* Samuel R. Gross, *Expert Evidence*, 1991 WIS. L. REV. 1113, 1119 (1991); Andrew W. Jurs, *Expert Prevalence, Persuasion and Price: What Trial Participants Really Think About*

often characterize testifying experts as "hired guns."[8] One may ask whether this characterization is fair, and how experts themselves view the legal system.

Some tension between science and the law is inevitable, for the demands and values of the two systems differ in important ways. As one respondent in our 2016 survey of scientists who had been elected to membership in the American Academy of Arts and Sciences perceived it:

> Science is about truth. The legal system is about spinning, distorting, or suppressing the truth in order to win. The ethos of the two fields is fundamentally different.[9]

One need not, however, be as cynical as this respondent sounds to recognize the inevitability of tension, for structural differences between the two disciplines mean that science and the law cannot proceed in the same way. Scientific judgments, for example, are, at least in theory, always open to revision as new information emerges, and scientists may entertain inconsistent theories without needing to choose among them. The law, however, must resolve the cases brought before it, even if conflicting conclusions are plausible. Hence, the law relies on default rules regarding burdens of proof to choose among the possible conclusions.[10]

The law similarly recognizes values that science does not recognize, and it may do so even when values interfere with the truth-finding goals the law aims to achieve. Jennifer Mnookin, for example, describes a Pennsylvania state case in which a trial judge refused to allow a pretrial hearing on the admissibility of testimony linking bite marks on the body of a murder victim with an accused's dentition. The judge was unwilling to hold the hearing, even though, by the time of the motion, the scientific validity of bitemark evidence was being seriously questioned, and at least twenty-four DNA exonerations involved cases in which bitemark evidence had been introduced against an innocent accused.[11]

The judge reached this result because she was following precedent and her view of the letter of the law. The first time bitemark evidence had been admitted in Pennsylvania over objection, it would presumably have had to pass the *Frye* test, which meant that its proponent would have had to show to show that bitemark identifications were generally accepted within the field of dentistry as a

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Experts, 91 IND. L.J. 353, 355 (2016); Stephen Breyer, *Introduction*, *in* NAT. RSCH. COUNCIL, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 1, 3-4 (3rd ed. 2011).

[8] *See, e.g.*, Michael C. Kovac, "*Hired Guns": Establishing the Scope of the Proper Cross-Examination and Argument Relating to Expert Witness Compensation in Criminal Trials*, 2 GA. CRIM. L. REV. 1, 1 (2024).

[9] Diamond & Lempert, *supra* note 3, at 42.

[10] *See id.* at 5-6 (listing further structural differences between science and law).

[11] *See* Jennifer L. Mnookin, *The Uncertain Future of Forensic Science*, 147 DAEDALUS 99, 107-109 (2018). For a discussion of the history and validity of bitemark evidence, see generally Michael J. Saks et al., *Forensic Bitemark Identification: Weak Foundations, Exaggerated Claims*, 3 J.L. & BIOSCIENCES 538 (2016).

scientifically valid way of linking individuals to tooth marks on a body.[12] In seeking a new *Frye* hearing, the defendant sought to show that the consensus within dentistry had changed over time, and bitemark identifications were no longer generally regarded as scientifically valid.[13] The judge seemed prepared to believe this. She nonetheless denied the claim because bitemark testimony was not a novel form of scientific evidence, and Pennsylvania's *Frye* test applied only to novel forms of scientific evidence.[14]

Given the existing tensions between the scientific and legal systems, it is not surprising that some scientists feel uneasy about getting involved in legal processes. One question this raises is whether the country's most able scientists are unwilling to aid litigants and courts. Previous work on differences between the language and culture of science and that of law, suggests that tensions caused by these differences are serious and may substantially affect the willingness of scientists to act as experts in legal proceedings.[15] However, only a few limited surveys[16] and two case studies[17] have looked empirically at how experts see the legal system, and none has probed the relationship between experts' experience with and their views of the legal system. Our study aims to fill this gap.

In Parts II and III, we begin by reviewing what the few previous surveys of experts have found. In Part IV, we describe our own expert surveys and some of

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[12] Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923) (holding that in order for expert testimony to be admitted, the scientific principle on which it is based "must be sufficiently established to have gained general acceptance in the particular field in which it belongs.")

[13] *See* Commonwealth v. Ross, No. 1738 WDA 2018, 2019 WL 6211324, at *7-8 (Pa. Super. Ct. Nov. 21, 2019) (summarizing appellant's argument in the lower court).

[14] *See id.* at *1 (summarizing the lower court's reasoning). But the Pennsylvania Superior Court ultimately vacated the order denying the *Frye* hearing. *Id.* at *15. One should not assume that every judge would decide this way, but there have been a number of cases in different states where trial judges have admitted bitemark evidence despite strong evidence questioning its validity, Saks et al., *supra* note 11, at 545-546, and the same has been true for other kinds of questionably valid "scientific" evidence, *see generally* EXECUTIVE OFFICE OF THE PRESIDENT PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY, FORENSIC SCIENCE IN CRIMINAL COURTS: ENSURING SCIENTIFIC VALIDITY OF FEATURE-COMPARISON METHODS (2016). This is usually not because of the niceties of the *Frye* test, since that test is no longer used in most states. Rather it is because there is scientifically dated precedent admitting the evidence, and lower courts see themselves as obligated to follow precedent. *See, e.g.,* Saks et al., *supra* note 11, at 545 (discussing People v. Marx, 26 Cal. Rptr. 350 (Ct. App. 1975), and its precedential effect in admitting bitemark evidence in later cases).

[15] *See, e.g.*, NAT. RSCH. COUNCIL, *supra* note 6; Mnookin, *supra* note 11, at 107-109.

[16] Nathaniel Hafer et al., *How Scientists View Law Enforcement*, SCI. PROGRESS, Feb. 2009, at 1; Anthony Champagne et al., *An Empirical Examination of the Use of Expert Witnesses in American Courts*, 31 JURIMETRICS J. 375 (1991); Daniel W. Shuman et al., *An Empirical Examination of the Use of Expert Witnesses in the Courts – Part II: A Three City Study*, 34 JURIMETRICS J. 193 (1994); Jonathan Baker & M. Howard Morse, *Final Report of Economic Evidence Task Force*, 2006 A.B.A. SEC. ANTITRUST L. REP. 1 app. II (Aug. 1, 2006); Andrew W. Jurs, *supra* note 7.

[17] NAT. RSCH. COUNCIL, THE EVOLVING ROLE OF STATISTICAL ASSESSMENTS AS EVIDENCE IN THE COURTS (Stephen E. Fienberg ed. 1989); MICHAEL J. SAKS & RICHARD VAN DUIZEND, THE USE OF SCIENTIFIC EVIDENCE IN LITIGATION (1983).

what our respondents told us. To anticipate, the majority of experts in the three groups we surveyed regard the legal system as at least somewhat successful in dealing with science, even though, on average, they are slightly more negative than positive when asked to assess the overall scientific competence of judges, attorneys, and juries. Those who have experience as testifying experts, however, tend to be quite positive when assessing the ability of the attorney who hired them and relatively positive about their overall experience testifying. Participation in the legal system tends to be associated with a greater belief in the ability of the legal system to deal well with scientific matters. Professional experts, the group most likely to make a living from testifying, have the most favorable assessments on most items, but those in the other two samples with substantial experience testifying provided assessments that mirrored the favorable reactions in the professional group. Greater familiarity with the legal system was generally associated with more positive views about the system and its participants.

II. PRIOR SURVEYS OF EXPERTS ON THE LEGAL SYSTEM

Few efforts have been made to assess how scientific and engineering experts view the legal system, but four earlier surveys provide some evidence of their views. The most recent survey of experts, done by Andrew Jurs, did not limit respondents to scientific experts. Jurs invited participation from all 135 experts who in 2012 had testified in at least one of thirty-three civil cases in a medium-sized urban county in Iowa and obtained responses from thirty-two experts.[18] Most of the experts (91%) agreed with the general statement that "[e]xperts are helpful in resolving disputes," and a majority said that judges (84%) and juries (66%) understand expert testimony.[19] Our research differs from Jurs' in that we are interested in scientific experts, both those who have been involved as experts with the legal system and those who have not. Also, we were able to survey many more scientists than Jurs, or any other researcher, has been able to do.

A survey by Hafer and his colleagues focused, like ours, on scientists, but it was specifically concerned with attitudes toward law enforcement, as opposed to the legal system as a whole.[20] The purpose of their survey, conducted "in conjunction with the Federal Bureau of Investigation ("FBI"), was 'to evaluate working relationships between FBI field agents and scientists.'"[21] Respondents to the survey reported they were scientists specializing in biology, chemistry, physics, earth science, or engineering.[22] Noticeably lacking from the population surveyed were behavioral (social, economic, psychological) scientists and statisticians. The self-identified scientists invited to respond to the survey were members of the American Association for the Advancement of Science ("AAAS"),[23] a subgroup of the one of

[18] *See* Jurs, *supra* note 7, at 355-58, 368.

[19] *Id*. at 376 tbl.6.

[20] Hafer et al., *supra* note 16.

[21] *Id.*

[22] *Id.* at 4.

[23] *Id*.

the three groups we sampled in our current research. We have no way of knowing whether any of those who participated in our study had previously participated in the Hafer survey, but no one spontaneously mentioned this.

Nearly all of the questions on the Hafer survey probed overall attitudes toward, as opposed to experience with, the FBI or law enforcement, or asked about the appropriateness of certain law enforcement behaviors (e.g., talking with scientists for various purposes, such as evaluating the scientist's research as a potential national security risk).[24] Only one question attempted to obtain information on scientists' actual experience with law enforcement ("Have you or any of your colleagues ever been approached by [a member of law enforcement] [an FBI agent] to discuss something related to your work as a scientist?"). If yes, respondents were asked to describe the circumstances under which they were approached.[25] Among respondents, 15% reported having been approached, but the lack of further follow-up provided little information about that experience.[26] A single open-ended question asking "what can law enforcement do to improve relations with the scientific community" was somewhat more revealing of the sources of suspicions some scientists harbor about law enforcement, if not the legal system as a whole (e.g., the most commonly suggested improvement was to have the requester state the goals and motives of the contact upfront (26%), a response that may have reflected the nature of FBI inquiries and earlier questions on the survey).[27] Two other themes that respondents identified as areas for potentially improving relations with law enforcement appear more generally applicable: improved scientific literacy (19%) and being less adversarial/more respectful (18%).[28] Our surveys are broader. They include questions about the legal system's capacity to understand and appropriately apply scientific advice, as well as questions about the reactions of scientists to the adversarial context of court proceedings.

The other prior surveys of scientists focused explicitly on those who had served as experts in litigation, most of whom were scientists. The first was a pilot survey of forty-two experts who testified in court civil cases,[29] with a follow-up survey of eighty-five experts who had recently served as expert witnesses.[30] About half of the respondents in both surveys were experts on medical matters. Other responses came from experts with a wide range of specialties, such as accounting, biology, economics, engineering, law enforcement, mathematics, and psychology.[31] The professional credentials of the experts varied substantially. While 58% and 50% of the testifying experts held Ph.D.s or M.D.s in the pilot and follow-up surveys, respectively, 25% in the pilot and one-third in the follow-up had no more than a

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[24] *See id.* at 5-6 tbl.1.

[25] *Id.*

[26] *Id.* at 2.

[27] *Id.* at 3.

[28] *Id.*

[29] Champagne et al., *supra* note 16, at 380.

[30] Shuman et al., *supra* note 16, at 197.

[31] *See* Champagne et al., *supra* note 16, at 381; Shuman et al., *supra* note 16, at 204.

bachelor's degree.[32] These data were collected before the U.S. Supreme Court emphasized the judge's role in gatekeeping for expert testimony;[33] so it is unclear whether educational expectations have increased since 1993. Still, these figures hint at limitations in the scientific quality of expert testimony, at least in ordinary state court trials.

The questions in both the pilot and follow-up expert surveys covered two primary topics: expert fees and expert views of the characteristics important to being retained as experts and for presenting effective expert testimony. Most respondents reported that their fees amounted to less than 5% of their yearly income,[34] countering at least for this sample, the image of full-time hired expert witnesses that some have used to portray experts who provide scientific testimony in court.[35] Experts in the follow-up survey were asked about their expectations of the legal system. A minority agreed with the statements "Lawyers try to intimidate their experts to weaken unfavorable testimony and strengthen favorable testimony" (22%) and "Lawyers try to get their experts to testify to material that lacks scientific basis" (22%).[36] A majority agreed that "Lawyers urge their experts to be less tentative" (57%) and "Lawyers coach their experts about how testimony should be presented" (58%), and a large majority (77%) agreed that "Lawyers manipulate their experts to weaken unfavorable testimony and strengthen favorable testimony."[37] To the extent that these results are accurate perceptions and representative of the experience of scientific experts in general, the results provide evidence that the legal system tends to nudge scientific testimony in the direction of the hiring attorney and to push experts toward expressing confidence in ways often inconsistent with scientific standards.

The third survey of experts focused on the quality of expert advice in antitrust litigation. It was a small, admittedly unrepresentative, survey of forty-two antitrust economists conducted on behalf of the Antitrust Section of the American Bar Association.[38] The authors identified potential respondents by contacting consulting firms, government enforcement agencies, and academic economists.[39] The survey examined respondents' views concerning economic testimony in antitrust litigation.[40] The median respondents had worked on twelve cases in the past decade, which, given the length and complexity of antitrust litigation, indicates that the sample was, on the whole, quite experienced with litigation in this field.[41] Respondents answered eleven multiple choice or short answer questions online,

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[32] *See* Champagne et al., *supra* note 16, at 381; Shuman et al., *supra* note 16, at 204.

[33] *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 597 (1993).

[34] Champagne et al., *supra* note 16, at 383.

[35] *See, e.g.*, David Bernstein, *Out of the Fryeing Pan and into the Fire: The Expert Witness Problem in Toxic Tort Litigation*, 10 REV. LITIG. 117, 141 (1990).

[36] Shuman et al., *supra* note 16, at 201 tbl.3.

[37] *Id.*

[38] Baker & Morse*, supra* note 16, app. II, at 1.

[39] *Id.*

[40] *Id*.

[41] *Id*. app. II, at 1-2.

covering their views on the quality of economic testimony in antitrust litigation, observations of unprofessional or uninformative economic testimony, and views as to how (if at all) to address any problems identified.[42]

Although respondents "overwhelmingly" reported that economic testimony contributes to the quality of antitrust analysis in litigated cases, only a bare majority (53%) said that judges understand the economic issues in a case usually (24%) or frequently (29%).[43] A substantial minority (42%) said that judicial understanding occurs only sometimes (38%) or rarely (4%).[44] The survey explicitly asked about the frequency of unprofessional economic testimony, defined as "arguments so far out of the mainstream that they do not count as serious economics"—as opposed to "good faith arguments on the other side of a case with which the respondent disagreed, differences in opinion that simply reflect ongoing debate in the economics literature, or testimony that is flawed because it is unclear or confusing."[45] Although a minority (30%) said this problem of serious unprofessional testimony rarely or never occurred, two-thirds (67%) said it sometimes (57%) or frequently or usually (10%) occurred.[46] A follow-up question asked, "whether unprofessional economic testimony is a problem sufficiently significant that it calls for a remedy."[47] Half of the respondents agreed that a remedy is needed.[48] When asked to suggest potential remedies, two-thirds of all respondents called for independent (in addition to party) expert support for the judge, and half suggested that judges should receive more education in antitrust economics.[49] Other procedural suggestions included allowing experts to cross-examine each other or allowing the jury to ask questions of experts (22% suggested one of these procedures).[50]

The results of this admittedly limited survey provide additional evidence that the legal system often receives less than optimal scientific advice. In a group of economists who are active as experts in complex litigation, half voiced dissatisfaction with the quality of economic testimony, and a majority thought that changes could improve how the legal system receives and handles scientific input.

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[42] The survey instrument was not included in the report. It appears that the multiple-choice questions used the scale to report perceptions of frequency with the choices "usually" "frequently" "sometimes" rarely" and "never."

[43] Baker & Morse*, supra* note 16, app. II, at 2.

[44] *Id.*

[45] *Id*. (indicating lack of clarity in how the definition and distinctions were conveyed to the respondents).

[46] *Id.*

[47] *Id*. app. II, at 5.

[48] *Id.*

[49] *Id.*

[50] *Id.*

III. PRIOR CASE STUDIES OF EXPERTS IN LITIGATION

More than forty years ago, Saks and Van Duizend (1983) recognized that the role of scientific evidence in litigation, while important, was not well understood.[51] Conducting what they characterized as a "frankly preliminary effort,"[52] they consulted informally with judges, lawyers, and experts to identify nine cases that involved scientific evidence. In each case, they conducted an intensive examination of court documents and interviewed sets of judges, lawyers, and experts involved in the case.[53] The six criminal and three civil cases ranged from homicide and arson to employment discrimination and personal injury.[54] The interviews revealed some common themes: Although expert referral services (e.g., TASA: Technical Advisory Service for Attorneys) had existed for more than twenty years by the time of the research, the experts tended to be selected based on informal referrals and prior experience.[55] The attorney interviews also revealed that all experts were frequently criticized, although most attorneys "singled out (voluntarily, without prompting) psychiatry and clinical psychology for special contempt."[56] Experts reported that they were virtually never informed about the ultimate outcome of the case.[57] It is unclear whether these cases are representative, whether this terrain has changed over time, or how dependent these patterns may be on the nature of the scientific expert and the scientific expertise at issue.

A second analysis of scientific evidence in the courts focused exclusively on statistical evidence.[58] The National Research Council appointed a panel on Statistical Assessments as Evidence in the Courts to clarify the issues raised by statistical evidence in legal proceedings.[59] The Panel closely examined six federal cases (three involving alleged employment discrimination; one antitrust case; one environmental case; and one criminal case involving hair identification).[60] Based on their analysis, they raised serious questions about the institutional competence of courts to effectively deal with the relevant statistical evidence, identifying a variety of factors contributing to the problems faced by the courts in these cases. Factors they cited included variations in the ability of courts to understand statistical evidence; limitations in the investigation (e.g., analyses not conducted);[61] and difficulties caused because the "fundamental disjunction between law and

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[51] SAKS & VAN DUIZEND, *supra* note 17, at 114.
[52] *Id.* at 4.
[53] *Id.* at 15.
[54] *Id.* at 15-49.
[55] *Id.*
[56] *Id.* at 74.
[57] *Id.* at 51-57, 74-93.
[58] *See* NAT. RSCH. COUNCIL, *supra* note 17, at 1.
[59] *Id*. at xi.
[60] *See id*. at 10.
[61] *Id.* at 74-78.

statistics [lies] in the attitude each takes toward uncertainty."[62] They also identified the legal system's adversary procedures as an additional source of tension.[63] The Panel concluded by recommending several ways to improve the ability of courts to deal with statistical evidence, including more structured pretrial discovery, further education of judges, and greater use of court-appointed experts.[64]

Four years after this report was published, the U.S. Supreme Court decided *Daubert v. Merrell Dow Pharmaceuticals, Inc.* (1993), explicitly highlighting the obligation of federal judges to serve as gatekeepers for scientific evidence.[65] The Federal Judicial Center, the research arm of the federal courts, and others, began to offer seminars and workshops for judges on scientific topics. In 1994, the Federal Judicial Center published the first edition of the *Reference Manual on Scientific Evidence*, designed as a "bench book" for judges on topics from epidemiology to statistics.[66] The forthcoming fourth edition, scheduled for publication in 2025, has expanded its coverage to include additional topics (e.g., neuroscience).[67] Although the *Reference Manual* is frequently cited in court opinions, it is not clear whether that recognition reflects the improved judicial knowledge that the Panel called for in 1989.

IV. OUR SURVEYS

We began this research with a study of the distinguished scientists and engineers who are elected members of the American Academy of Arts and Sciences.[68] This elite sample allowed us to see whether the legal system was calling on the nation's most distinguished scientists for assistance and whether, when asked, they were agreeing to participate. Although our invitation to participate in the survey said that we were interested in the responses of Academy members who

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[62] *Id*. at 78; *see generally* Richard Lempert, *Befuddled Judges: Statistical Evidence in Title VII Cases*, *in* LEGACIES OF THE 1964 CIVIL RIGHTS ACT 263 (Bernard Grofman ed., 2000).

[63] NAT. RSCH. COUNCIL, *supra* note 17, at 79-80.

[64] *See id.* at 10-16.

[65] Daubert v. Merrell Dow, *supra* note 33.

[66] FED. JUD. CTR., REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 1 (1994).

[67] *Science for Judges - Development of the Reference Manual on Scientific Evidence, 4th Edition*, NAT. ACADS. OF SCI., ENG'G & MED., https://www.nationalacademies.org/our-work/science-for-judges-development-of-the-reference-manual-on-scientific-evidence-4th-edition, https://perma.cc/LT72-UNPJ (last visited Mar. 6, 2025).

[68] *See* Diamond & Lempert, *supra* note 3, at 44 (describing the sampling method for the Academy survey). We invited all of the members of the Academy in Class 1 (mathematical and physical sciences); Class 11 (biological sciences) and Class III (social sciences) to complete an online survey (n = 3328). *Id.* We obtained a response rate of 11.0% for the full questionnaire, and an additional 7.6% for a short follow-up version of the survey. Although a higher response rate would have been desirable, our response rate was similar to the 12.1% response rate obtained by Hafer. *See* Hafer et al., *supra* note 16, at 1. We were able to compare the sample of respondents with the population on some demographic characteristics: gender, age, and Class. Diamond & Lempert, *supra* note 3, at 44. Women, older Academy members, and Class III members had higher response rates. *Id.* For an analysis of how web survey contact design influences response rates, see Stephen R. Porter & Michael E. Whitcomb, *The Impact of Contact Type Web Survey Response Rates*, 67 PUB. OP. Q. 579 (2003).

have had no engagement with the legal system as well as the views of those who have been engaged, those with participation experience may have been more interested in participating. Nonetheless, we were still somewhat surprised to find that more than half of our respondents had been asked for assistance, and most of those asked had participated at least once.[69]

To learn about the perceptions and experiences of a more diverse set of experts, we conducted additional surveys aimed at populations not limited to the most elite scientists and engineers. This article reports results from three groups. The first group consists of the elected members of the American Academy of Arts and Sciences ("Academy group") (n = 367) we surveyed in our previous study.[70] The other groups we surveyed are scientists and engineers who belong to the American Association for the Advancement of Science ("AAAS group") (n = 2211) by virtue of their subscriptions to the journal *Science*,[71] and professional experts ("Professional group") (n = 207) who have paid to have their biographies and contact information included in a commercial directory of experts or who have included their vitas on Westlaw's expert file.[72]

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[69] Diamond & Lempert, *supra* note 3, at 45.

[70] In the earlier paper, we reported the number of Academy group respondents as n = 366. *Id.* at 44. The correct number is n = 367.

[71] With the assistance of the AAAS, we were able to send email invitations to complete the survey to all 38,090 of the 108,448 AAAS members who had not opted out of receiving third party communications. The AAAS members consist of both scientists and engineers, but also laypersons who are interested in science. *Membership: Why Join*, AM. ASS'N. FOR THE ADVANCEMENT OF SCI., https://www.aaas.org/membership/why-join? (last visited Mar. 6, 2025). We asked the respondents to our survey if they considered themselves a scientist, an engineer, a layperson interested in science or science policy, or other. Our survey asked only the 2211 of the 3395 respondents who indicated they were scientists and engineers the survey questions reported on in this manuscript about their experience with the legal system.

AAAS provided us with data showing that AAAS members in the subgroup willing to be contacted included a lower proportion of members who joined AAAS in 2010 or later (58% versus 66%), suggesting that the willing subgroup was somewhat older than the entire population. About 70% of the AAAS members join a section that focuses on a particular area of science or on engineering. The distribution of top section affiliations for the total population and the willing subgroup were similar. The top section was Biological Sciences (18% versus 19%) and the second was Medical Sciences (9% versus 10%).

The overall response rate for the survey was 8.13% (3095/38,050). In light of the topic of the survey, we suspect it was higher for scientists and engineers than for laypersons. However, although we know that scientists and engineers constituted two-thirds of our respondents, AAAS was unable to provide the number of AAAS members who are scientists or engineers rather than laypersons. The scientist and engineering respondents were less likely to have joined AAAS in 2010 or later (32%). The distribution of top section membership mirrored the population and the willing subgroup, with Biological Sciences (24%) and Medical Sciences (10%) most heavily represented.

[72] The Professional group was obtained by gathering names and emails from the ALM LAW.COM free online Expert directories, sampling experts who paid to have their information listed in the ALM expert directories (n = 446) or who supplied their vita and contact information for a Westlaw expert listing (n = 829). The characteristics and responses from these two sources did not differ, so we combined them to form the Professional group, but while we know they are more active in legal proceedings and earn more of their income from them than the respondents in our Academy and AAAS samples, we have no way to assess how representative our respondents

The three groups differ substantially in the frequency with which they supplied assistance to the legal system. When asked how often they had participated in litigation as experts, both the Academy and AAAS groups had medians of 0; only 5.0% of the Academy group and 6.2% of the AAAS group had assisted more than 10 times; and only a third of the respondents in these two samples (37.8% and 32.7%, respectively) had assisted at least once. In contrast, the median times participated for the Professional group was 81; 86% assisted more than ten times, and a quarter assisted 200 times or more. Moreover, only 1.4% of the AAAS group reported that they earned at least 50% of their income from consulting. We did not ask this question on the Academy survey but suspect that the percentage would be similarly small. In contrast, 68.2% of respondents in the Professional group reported earning 50% or more of their income from consulting.

A. Overall Reaction to How the Legal System Handles Science

Respondents in all three groups saw the legal system as at least somewhat successful in dealing with science. On a 4-point scale with the choices being "very unsuccessful," "somewhat unsuccessful," "somewhat successful," and "very successful," 60% of the Academy sample and 60% of the AAAS sample rated the legal system as somewhat successful or very successful in dealing with science. The Professional group was even more positive, with 79% seeing the legal system as somewhat successful or better.

B. Reaction to Participants and Procedures in the Legal System

i. General Impressions of Legal System Participants

The overall positive reaction to how the legal system handles science does not mean that our respondents viewed all participants and procedures in the legal system favorably. We asked two types of questions about how they viewed other legal system participants. The first set of questions probed general reactions (Table 1). The second set of questions asked experts who had testified about their last experience testifying (Tables 2 and 3). Table 1 shows how the three groups of respondents evaluated the other primary players in the legal system:

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in the Professional group are of the population of individuals who offer their services as experts in legal proceedings. The response rate from this set of invitations was 16.2%.

Table 1: Extent of Agreement/Disagreement with Statements about other Participants in Legal Proceedings involving Science

	Academy (n = 325)	**AAAS (n = 1955)**	**Professional (n = 140)**
When science is important:			
most judges can understand the science	2.82_a	2.75_a	3.34_b
most lawyers can understand the science	2.94_a	2.84_a	3.64_b
most juries contain jurors who can understand the science	2.42_a	2.37_a	2.76_b
Scientific experts who participate in the legal system tend to be more competent than other scientific professionals in my profession	2.28_a	2.43_b	3.04_c
Many experts in the legal system compromise their scientific standards	3.25_a	2.81_b	2.81_b
Scientists are treated with appropriate respect when they testify	3.26_a	3.23_a	3.73_b

NOTE: Responses were given on a 5-point scale (1 = strongly disagree to 5 = strongly agree). Responses were reverse coded in the questionnaire. Values in the same row with different subscripts indicate a significant difference ($p < .05$).

With 3 as the scale midpoint, the views of both the Academy and AAAS respondents were, on average, somewhat negative (below 3) when they were asked to assess the competence of judges, lawyers, and jurors in dealing with science.[73] The same mean patterns emerged when these respondents were asked to assess the competence of experts who participate in the legal system relative to other scientists in the respondents' fields. The Academy respondents, the most elite of our three groups, were more negative than the AAAS respondents and significantly more negative than those in the Professional group. Only the Professionals rated the judges and attorneys positively and viewed experts who participated in the legal system as more competent than other scientific professionals. In evaluating the likelihood that legal system experts would compromise scientific standards, only the Academy group thought, on average, that it was more likely than not that many experts would do this, but even in the two groups that on average took a more favorable view, the favorable tendency was not strong. All three groups were on average somewhat positive in their perception of how the legal system generally

[73] The one measure that is positive with a value of 1 and negative with a value of 5 is the sixth of the seven measures, which measures the degree to which experts compromise their standards.

treats scientists, but the Professionals were significantly more positive than the other two groups.

ii. Experience During Testimony

Moving from the general to the particular, we asked respondents who had served as testifying experts to rate the actors they had encountered during their last experience testifying.[74] Their opinions were far more positive about some of the actors than the general opinions expressed in Table 1. Table 2 shows these results:

Table 2: Comparisons across the Samples on Mean Ratings of Other Actors and of their Overall Experience in the last case in which they testified

Question: How would you rate each of the following in this case (the most recent one in which you testified)?

Subject of rating	Academy	AAAS	Professional
Your lawyer	4.58_{ab}	4.35_{a}	4.63_{b}
Opposing lawyer	2.89	2.74	2.91
Opposing expert	2.58	2.60	2.55
Judge	3.97	3.89	3.88
Your direct examination	4.41	4.36	4.44
Your cross-examination	3.13	2.95	3.07
Your opportunity to communicate all the information you thought was important	3.78_{a}	4.30_{b}	4.58_{c}
The adversary nature of the proceedings	3.47_{a}	2.74_{b}	3.04_{c}
The overall experience	3.68_{a}	3.95_{a}	4.38_{b}

NOTE: Responses were given on a 5-point scale (1 = very negative to 5 = very positive, and 3 = neutral). Values in the same row with different subscripts indicate a significant difference ($p < .05$).

Sample sizes for "opposing expert" are: Academy (n = 59), AAAS (n = 253), Professional (n = 117). For all other items, sample sizes are: Academy (n = 70-81), AAAS (n = 324-342), Professional (n = 130-139).

[74] We asked respondents about their most recent experience testifying to maximize their ability to recall and evaluate their experience, but we also asked those who had testified more than once whether they would characterize that recent experience as fairly typical. Most of them reported it was fairly typical: 81% for Academy members, 84% for AAAS respondents, and 93% for the Professional group.

Ratings were more mixed when our expert respondents were asked about their personal encounters with legal actors and the legal system on the most recent occasion when they testified as experts. The most positive ratings in all three samples were for the lawyers with whom the scientists worked and their experience with direct examination (4.58-4.63 for "your lawyers"; 4.36-4.41 for "direct examination"). The similar ratings for "your lawyers" and "direct examination" are not surprising since the experience of direct examination is likely to strongly influence how experts perceive their lawyers. The high ratings on each are notable because they suggest that whatever complaints scientists have about the legal system are, generally speaking, not attributable to the side that hired them.

The judge too was rated positively. The opposing attorney, in contrast, received negative ratings. However, the opposing attorneys' ratings are near the midpoint of the scale and not near the bottom. This suggests that, on average, the behavior of opposing counsel is not a great problem. Consistent with this, all three groups rated cross-examination fairly neutrally, and there were no significant differences across groups. Contrasting these ratings with the ratings of direct examination, there is a clear but unsurprising difference. Experts seem to enjoy presenting evidence, but being cross-examined on their presentations—not so much. This difference may exist because people do not like to have their views challenged, because of the different attitudes and manners of direct and cross-examiners, because of resistance to leading questions, which are permitted in cross but not on direct, or for a combination of these and other reasons.

The opposing expert received the lowest ratings across all three groups, and there were no significant differences across groups. However, in evaluating the adversary system, the groups differed significantly from one another. Although the AAAS sample rated the adversary nature of the proceedings below the mean (2.74), the Professionals were neutral (3.04), and the Academy members rated it positively (3.47). The groups also differed significantly in how they viewed their opportunity to communicate important information. All were positive, but the Professionals reported the greatest opportunity to communicate, and the Academy respondents the least. All groups reported that their experience in the most recent case in which they testified was, on the whole, a positive one, although the Professionals were significantly more positive than the other two groups. Only 21.5% of Academy respondents, 13.7% of AAAS respondents, and 4.3% of Professional respondents rated their last experience negatively, and of these only a handful (7.0%, 4.1%, and 0.7%) rated it as very negative.

The Professionals were more positive than the other two groups when asked about their ability to communicate fully and about their experience overall. These differences may reflect sample selection biases and/or experiential effects. Selection bias is likely to exist because experts are unlikely to make a business of testifying or to remain long in that business if they are uncomfortable with the overall experience and features of it. By the same token, experience may make experts more comfortable and better able to communicate what they have to say in the courtroom setting. In this connection it is interesting that Professionals were not

significantly different from other experts when they rated opposing experts, opposing lawyers and judges.

We took a closer look at the large AAAS sample to see whether experience was associated with greater comfort on any of these measures. We compared the responses of those who had testified once or twice (n = 196), those who had testified between three and ten times (n = 155), and those who had testified more than ten times (n = 152). Only two items produced significant differences: cross-examination (1-2 times = 2.85; 3-10 times = 2.68; more than 10 times = 3.18) and the adversary system (1-2 times = 2.65; 3-10 times = 2.69; more than 10 times = 3.08). Thus, comfort levels differed significantly only for the two aspects of the legal system most unfamiliar to scientists. In both cases, more positive responses came from those who had done the most expert witnessing: the group that had testified more than ten times. The causal direction is, however, ambiguous. Frequently testifying may make scientists more comfortable when they testify as experts, and/or scientists who are comfortable with the adversary system may be more frequently asked to give expert testimony or, if asked, may be more likely than those less comfortable to consent. Nonetheless, the locus of the differences associated with experience level provides further evidence of the trial characteristics that are likely to lead many scientists and the legal system to be at odds.

3. Perceived Understanding of Science by Legal Actors

We also probed respondents' impressions of how well they thought the various actors in the courtroom understood the relevant scientific issues in the most recent case in which they testified. Table 3 shows these results:

Table 3: Comparison across Samples on the Mean Scientific Understanding of the Other Actors

Question: What was your impression of how well each of the following understood the relevant scientific or engineering issues involved in the case?

Subject of rating	Academy	AAAS	Professional
Your lawyer	4.06	4.09	4.25
Opposing lawyer	3.03	3.12	3.22
Judge	3.40	3.48	3.52
Jury	2.65_a	2.97_a	3.39_b

NOTE: Responses were given on a 5-point scale (1 = not at all well, 2 = not well in most respects, 3 = well in some respects but not well in others, 4 = well in most respects, 5 = extremely well). Values in the same row with different subscripts indicate a significant difference ($p < .05$).

Sample sizes for lawyer and judge ratings are: Academy (n = 68-78), AAAS (n = 288-338), Professional (n = 117-134). For jury ratings: Academy (n = 20), AAAS (n = 116), Professional (n = 64).

The overall patterns mirror the ratings for the attorneys and judges, with "your lawyer" being rated higher than the "opposing lawyer" and with judge ratings in between (though closer to the "opposing lawyer" than to "your lawyer"). Comparisons across groups revealed only one significant difference: Professionals were more likely than respondents from the other two groups to see the jury in their most recent case as having understood the scientific issues.[75] Although differences across expert groups on only one item are significant, the pattern of differences appears to track the relative stature of the scientists in the various samples, with the Academy scientists giving the lowest average ratings on some variables and the AAAS scientists giving the next lowest. If more elite scientists are disproportionately likely to be called on in more complex cases, the different ratings may reflect either the actual ability of legal actors to understand the science in the case reported on or assumptions that experts make about that ability in light of the complexity of the science involved in the case.

4. Evaluation of Opposing Experts

Cases with scientific evidence that go to trial often have experts on both sides. We asked respondents who had testified to evaluate the testimony of the opposing expert in their most recent case. Table 4 shows their responses.

[75] Extent of experience had no impact on any of these responses.

Table 4: Comparison across Samples of Perceptions of the Opposing Experts

Question: If there was an opposing expert in this case, how would you characterize the opposing expert's position? (check all that apply)

Position	Academy (n = 58)	AAAS (n = 238)	Professional (n = 118)
Reflected good fair arguments, even if you disagreed	44.8%$_a$	26.9%$_{ab}$	19.5%$_b$
Presented difference in opinion that reflect ongoing debate	27.6%	26.5%	28.0%
Scientifically flawed	56.9%	50.0%	35.6%
Flawed because the evidence presented was unclear or confusing	13.6%$_a$	29.8%$_{ab}$	39.0%$_b$
So far out of the mainstream as to leave doubt about the witness's science or engineering expertise	15.5%$_a$	16.8%$_{ab}$	27.1%$_b$

NOTE: Values in the same row with different subscripts indicate a significant difference ($p < .05$).

The only significant differences occurred between the Academy group and the Professional group. They differed substantially on two of the five items: whether the opposing expert's arguments were fair and whether the opposing expert's presentation was unclear or confusing. On another item, whether the opposing expert's position was so far out of the mainstream as to call the witness's expertise into question, the Academy group and the Professional group also differed, albeit more modestly. In each of these cases, Academy members were far less critical of opposing experts than Professional respondents. This pattern may reflect the elite nature of the Academy sample, which might make them more likely to be hired in high stakes cases where both sides seek to hire distinguished experts. Moreover, if one party is known to have hired a leading expert, this may lead an opponent to upgrade the quality of the experts it hires. The kinds of cases that lead to expert involvement may also play a role in these differences. A subset of the Professional experts may testify frequently as defense experts for insurance companies in

relatively low stakes cases, like many personal injury cases. Plaintiffs' experts in these cases may be relatively inexperienced or unqualified—for example, they may be the plaintiff's treating physician—while the defense expert may have specialized knowledge about the injury giving rise to the lawsuit.

On each of these three items, responses from AAAS sample members were between those from the Academy and Professional groups. The same is, on average, likely true of the relative prestige of the members of the three samples.

The overall pattern shows that although nearly half of the experts found the position of the opposing expert to be scientifically flawed, only a minority in the Academy and AAAS samples viewed it as far out of the mainstream, and more than one in four in each group saw differences in opinions as reflecting ongoing debates. While it is easy to focus on negative views about opposing experts, expert witnesses, for the most part, indicated respect for the opinions of the other side's experts, even if they disagreed with aspects of opposing experts' analyses and regarded them as scientifically flawed.

5. The Impact of Participation on Attitudes Toward the Legal System

The results we have presented thus far suggest that experts reflecting on the most recent case in which they testified have a more positive evaluation of the other actors in the legal system compared to their more abstract overall impressions of actors in the legal system. There is, however, one additional important difference between the bases for the responses to these two sets of questions. In Table 1 (overall impressions), the responses came from both scientists who had assisted in legal proceedings and those who had not. In Tables 2, 3, and 4, the responses came only from those who had testified. This difference raises the possibility that firsthand experience with the legal system is associated with more favorable assessments of legal actors. We explore the hypothesis that participation in the legal system is responsible for the difference with the data presented in Tables 5 and 6. These tables compare the evaluations of the Academy and AAAS sample members who had never assisted in a legal proceeding with those who had, and they include a quasi-control group consisting of those who had agreed to participate but did not end up participating. This occurred from time to time, as cases settled before trial or for other reasons. The tables also include a smaller fourth group consisting of the remaining respondents who were asked but never agreed to participate.

The logic of this analysis has two parts. First, those who participated should differ from those who never participated. Second, if attitudes are affected by being the kind of scientist who is sought out as an expert, then those who were asked but did not participate should respond more like the "asked and participated group" than like the "never asked" group. If, however, participation is the key to shaping attitudes, then the "agreed but did not participate" group should be more like the "never asked" group than the "asked and participated group." The control group represents the kind of scientist who is asked to participate. This is what we found:

Table 5: Academy Sample Extent of Agreement/Disagreement with Statements about Other Participants in Legal Proceedings involving Science and Percentage of Respondents Viewing the Legal System as Successful in Dealing with Science

	Never Asked (n = 153)	**Asked but never agreed (n = 16)**	**Participated (n = 124)**	**Agreed but did not Participate (n = 32)**
When science is important:				
most judges can understand the science	2.79	2.69	2.85	2.94
most lawyers can understand the science	2.81_{a}	2.59_{ab}	3.18_{b}	2.75_{ab}
most juries contain jurors who can understand the science	2.42	2.63	2.39	2.41
Scientific experts who participate in the legal system tend to be more competent than other scientific professionals in my profession	2.29_{a}	2.13_{ab}	2.38_{a}	1.87_{b}
Many experts in the legal system compromise their scientific standards	3.18	3.19	3.37	3.10
Scientists are treated with appropriate respect when they testify	3.15_{a}	2.94_{ab}	3.43_{b}	3.24_{ab}
Legal system is successful in dealing with science	$52.1\%_{a}$	$66.7\%_{ab}$	$70.0\%_{b}$	$51.6\%_{ab}$

NOTE: Responses to the first six statements were given on a 5-point scale (1 = strongly disagree to 5 = strongly agree). Responses were reverse coded in the questionnaire. Values in the same row with different subscripts indicate a significant difference ($p < .05$).

The small number of respondents in the "asked but never agreed" and "agreed but did not participate" groups makes it difficult to discern reliable differences between the views of respondents in these groups and those in the two larger groups, but the pattern of the differences is consistent with the hypothesized participation effect. In the comparison involving lawyer competence and the one involving an assessment of the legal system in dealing with science, the "participated" group was significantly more positive than the "never asked" group, and the "agreed but did not participate" group was closer to the "never asked" group than to the "participated" group, consistent with the hypothesis that contact with the legal system as an expert leads to a more favorable impression of lawyers and the legal system. The pattern of differences is particularly striking for overall judgments of the success of the legal system in dealing with science, where the "never asked" and the "agreed but did not participate" groups have almost identical mean responses that are 20% below the mean response among those who were asked and did participate.

The small group of respondents who were asked but never agreed to participate (n = 16) appeared to be more like the participants in their assessment of the legal system's ability] to handle science, but the small sample size made it difficult to find any significant differences in comparisons with members of other groups. Table 6, which is based on the larger sample of AAAS respondents, presents a clearer picture. It more or less replicates the findings from Table 5, suggesting that participation is associated with more positive attitudes toward attorneys and the legal system.

Table 6: AAAS Sample Extent of Agreement/Disagreement with Statements about Other Participants in Legal Proceedings involving Science and Percentage of Respondents Viewing the Legal System as Successful in Dealing with Science

	Never Asked (n = 1184)	**Asked but never agreed (n = 89)**	**Participated (n = 646)**	**Agreed but did not participate (n = 39)**
When science is important:				
Most judges can understand the science	2.70_{a}	2.47_{a}	2.87_{b}	2.82_{ab}
Most lawyers can understand the science	2.74_{a}	2.59_{a}	3.07_{b}	2.62_{a}
Most juries contain jurors who can understand the science	2.33_{a}	2.24_{ab}	2.48_{b}	2.23_{ab}
Scientific experts who participate in the legal system tend to be more competent than other scientific professionals in my profession	2.40_{a}	2.12_{b}	2.52_{c}	2.23_{abc}
Many experts in the legal system compromise their scientific standards	2.84	2.99	2.74	2.56
Scientists are treated with appropriate respect when they testify	3.12_{a}	2.95_{a}	3.46_{b}	3.13_{ab}
Legal system is successful in dealing with science	$56.9\%_{a}$	$52.9\%_{a}$	$65.9\%_{b}$	$59.5\%_{ab}$

NOTE: Responses to the first six statements were given on a 5-point scale (1 = strongly disagree to 5 = strongly agree). Responses were reverse coded in the questionnaire. Values in the same row with different subscripts indicate a significant difference ($p < .05$).

On six of the seven items, responses from the "participated" group were significantly more positive than those from the "never asked" group. On five of the

seven items, the responses from the "participated" groups were also significantly more positive than those from the "asked but never agreed group." For five of the seven questions, the "agreed but did not participate" respondents' ratings were numerically closer to the "never asked" than to the "participated" group. Similarly, on five of the seven questions, the "agreed but did not participate" respondents were closer to the "asked but never agreed" than to the "participated" group. The "participated" group rated the success of the legal system significantly higher than the "never asked" group. The AAAS "participated" group also rated lawyer competence as significantly greater than the other three groups. With larger numbers, responses from the "asked but never agreed" group did not differ significantly from the "agreed but did not participate" group on any item and differed significantly from the "never asked" group on only one item.

Our attempt to control for selection suggests that there are real participation effects, but only for certain responses. In both samples, when asked whether lawyers can understand science, the "agreed but did not participate" respondents and the "never asked" respondents differed significantly from "participated" respondents in their assessments but did not differ from each other. In each case, participants were, on average, significantly more likely than non-participants to believe lawyers can understand science. Differences between the mean scores are not large, but when compared to score differences on other items, they are, on average, the largest.

This makes sense. Participants will interact substantially with the lawyers(s) who hired them and will be well-positioned to assess their lawyer(s)' understanding of the science relevant to the case. Often, however, they will not be better positioned than non-participants to assess a judge's or jury's understanding of the scientific evidence. The role played by scientific testimony in jury's verdict is opaque, and a trial judge's rulings will be mainly about evidentiary issues, most of which may reveal little about whether the judge understands the science offered. Moreover, most scientific experts will observe little of what takes place at trials when they are not on the witness stand. Some will not even learn of the verdict in the case. Thus, it is not surprising that, in the Academy sample, the four groups do not differ significantly in their evaluations of the judge and jury.

Perhaps because sample sizes are larger, the situation differs somewhat in the AAAS sample. Although only on lawyer ratings was there a significant difference between those who participated and those who agreed but did not participate, those who participated were, on average, significantly more likely to think that judges and jurors can understand science than those who were never asked and, in the case of judges, than those who were asked but never agreed. Those who participated were also more likely than those never asked to think that experts who participate in the legal system are more competent than other scientists in their profession. They were also more likely than those in the other groups to agree that scientists are treated with appropriate respect when they testify, with the mean differences between participants and those in the other three groups being in every case larger than they are on every other item except lawyer evaluations. The pattern is not much different in the Academy sample. It is strongly suggestive of a participation

effect, since participants can generalize from their firsthand knowledge of how they were treated in court and whether their attorneys had a good understanding of the scientific issues in their case.

Finally, the participants in both the Academy and AAAS samples had the most positive views about the ability of the legal system to deal with scientific issues. In addition, in analyzing the level of participation in the larger AAAS sample, we found that frequency of testifying was associated with more positive attitudes.[76] While the causal direction, as noted in our discussion of the effects of participation on comfort in testifying, is ambiguous,[77] this pattern is consistent with our other results suggesting that familiarity may breed greater respect for the ability of the legal system to handle scientific evidence.

V. CONCLUSION

In this study, we have compared respondents whose day jobs rarely involve serving as expert witnesses (the Academy and AAAS groups) and those who make or seek to make a business out of offering expertise to litigants (the Professional group). We also examined the effects of participating in the legal system on judgments about the legal system and key legal actors. We find that, with respect to some judgments, each of these variables matters. Generally, participation in the legal system is associated with increases in approval of how the law works and of the actors involved, both within our two more academic samples (Academy and AAAS) and in comparing them to our more actively involved Professional sample. The major exception appears to be in evaluating the quality of arguments made by opposing experts. On the three items where differences between the responses of those in the different groups were significant, the Professionals tended to be considerably more negative than those in the Academy and AAAS groups. We cannot explain why this is the case, but it might reflect the true difference in the quality of the opposing experts that those in the different groups encountered.

The real story of our surveys may not, however, lie in the differences we found, but in the level and consistency of responses. Even when mean differences across samples or by participation are significant, the differences, although real, are often small in absolute terms. They do, however, tend to be largest on the two items, lawyer ratings and respect shown to experts, where we would expect participation to most affect respondents' judgments. Participation need not, however, lead to positive views of legal actors and the legal system, since participation may also provide opportunities to experience poor treatment by courts and to see firsthand the scientific incompetence of attorneys. Therefore, it matters that the experience of those who participate is more likely to lead to positive rather than negative assessments. The largest differences between participants and non-participants in both the Academy and AAAS samples were associated with the ability of lawyers to understand science and the sense that the legal system treats scientists with

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[76] Percent positive (1-2 times = 63.0%; 3-10 times = 76.6%; more than 10 times = 84.3%); Chi-Square = 11.11, $p<.005$.

[77] *Supra* p. 16.

appropriate respect. Positive effects of participation were further and perhaps most importantly manifested in the degree to which scientists believe that the legal system is successful in dealing with science.

Yet we must be cautious not to read too much into these positive results. Selection bias, to the extent we can control for it, does not appear to explain our results, but it cannot be fully ruled out. Some differences we find may exist because it is mainly those who think well of the legal system who participate in it. Also, on most of the questions that seek respondents' views on the quality of the legal system or key actors in it, not only are mean response levels similar between participants and non-participants, but they cluster around the mean of the 5-point scale that we use to assess system and actor approval, with a number of them leaning slightly in the negative direction. These means reflect the aggregate of divergent views. That is, each mean includes not just responses at the scale means of three, but more extreme judgments in both directions. The next task will be to look more closely at individual responses to see if we can identify factors that lead different individuals to positively or negatively assess those aspects of expert testimony and the legal system that we have asked our respondents to evaluate.

As for the mean views, what are we to make of them? Is the glass half full or half empty? If one begins with a pessimistic view of how well the legal system deals with expert testimony and scientific evidence, these results are perhaps encouraging. While the legal system's capacity to handle science is not, on average, seen by scientists as wildly successful, neither is it seen as an abject failure, contrary to the expectations of some critics. In addition, the greater a scientist's involvement in the legal system, the greater the likelihood that the scientist will think well of it. When seen through expert eyes, the legal system does not dazzle when dealing with science; rather, it somewhat successfully muddles along. Muddling, however, is not what we should strive for. There remains considerable room for improvement.[78]

[78] The responses we discuss in this paper offer few clues about changes that might enhance the willingness of scientists to participate in the legal system or improve the quality of their participation. In our earlier work that looked only at the responses of Academy members, we found that a majority of our respondents said that they would be more likely to serve if they were asked by a judge to be a court-appointed expert. *See* Diamond & Lempert, *supr*a note 3, at 52-53. Most also liked the possibility of meeting privately with the opposing expert to prepare a joint report as well as giving jurors an opportunity to pose questions. *Id.*