

JUDGES' FORECASTS AND PREFERENCES FOR MANAGING SCIENTIFIC EVIDENCE IN COMPLEX CASES 2020 - 2030

A REPORT OF A SURVEY OF STATE AND TERRITORIAL COURTS

Technically Confirmed Version October 17, 2020



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This report presents the results of the “Decadal Science in the Courtroom 2020 Survey.” The survey was designed by the National Courts and Sciences Institute (NCSI) and conducted for NCSI by Hon. John M. Leventhal, Associate Justice, Appellate Division, Second Judicial Department of the New York State Supreme Court, between June 24, 2020 and August 17, 2020.

The survey instrument was developed by Dr. Franklin Zweig, NCSI Vice President and Senior Fellow, and was approved and endorsed by NCSI’s Chair Hon. Robert M. Bell, Chief Judge of the Court of Appeals of Maryland (Retired), and NCSI’s President, Hon. Zel M. Fischer, Judge of the Supreme Court of Missouri, following an initial review by the project oversight group, noted below.

Justice Leventhal directed the survey team and served as a prime contributor to this report. Dr. Zweig served as the project’s liaison with NCSI. Hon. Michael F. Pietruszka, Erie County Court Judge (retired), and Robert Elting, Esq., Law Clerk to Justice Leventhal, monitored the process and assisted report formulation. Four second year law student interns engaged by Justice Leventhal’s Chambers shouldered the survey’s implementing burden. They included: Ryan Baal (Benjamin Cardozo School of Law); Gabriel Boni (Temple University Law School); Olivia Stein (Cornell University Law School); and Yue Yang (Cornell University Law School).

The survey team and NCSI recognizes with gratitude the chief judicial officers’ and administrative directors of courts’ facilitation of our request to distribute the survey instrument to judges of each State and Territorial Court jurisdiction. The request was made of all 50 states in the United States, 5 territories, and Washington D.C. Special thanks go to the Judiciaries of 29 jurisdictions that responded affirmatively to our request. They included the following court systems: Alaska; District of Columbia; Florida; Illinois; Maryland; Massachusetts; Michigan; Missouri; Nebraska; New Hampshire; New Jersey; New Mexico; New York; North Carolina; Northern Mariana Islands; Ohio; Oklahoma; Oregon; Pennsylvania; Puerto Rico; South Carolina; South Dakota; Tennessee; Texas; U.S. Virgin Islands; Utah; Vermont; Washington; and Wyoming.

Due to the Coronavirus pandemic and resulting Judicial Branch dislocations, many state courts were unable to participate. We look forward to their ideas with respect to this report.

We express our gratitude to the 790 judges who participated in the survey. Their valuable responses are the foundation of this survey report. Their comments were vital to forecasts of science’s march into the courtroom during the 2020-2030 decade.

Finally, we owe a debt of thanks to the survey report’s reviewers. They included members of the NCSI Survey Project Oversight Group - Hon. Donald W. Beatty, Chief Justice of South Carolina; Hon. Michael G. Heavican, Chief Justice of the Nebraska Supreme Court; Hon. Lloyd A. Karmeier, Justice of the Supreme Court of Illinois; and Hon. Judith N. Nakamura, Chief Justice of the New Mexico Supreme Court. We also acknowledge with gratitude the manuscript reviews conducted by Peter R. Marksteiner, Circuit Executive, U.S. Court of Appeals for the Federal Circuit; Hon. Michael A. Wolff, Dean, retired, Saint Louis University School of Law; Hon. Brian C. Wimes, District Judge, U.S. District Court for Western Missouri. Dr. Joshua Starmer, President of StatQuest, provided statistical design, analysis and consultation. Dr. Daniel T. Lackland, Professor of Epidemiology, Medical University of South Carolina, offered technical assistance.

We appreciate all help extended and reserve to ourselves responsibility for this report. We hope that the State and Territorial courts will find it useful to manage criminal and civil cases; train judges for rapidly expanding scientific evidence; and plan for rules of evidence — as novel scientific and technical research morphs into evidence on the margins of new knowledge in complex cases.

The Directors of the National Courts and Sciences Institute
Washington, DC
October 12, 2020

Section 1 EXECUTIVE SUMMARY

About This Survey

This mid-summer 2020 survey of 790 state and territorial judges solicited their thoughts about the extent to which issues related to novel scientific and technical evidence will feature more prominently in criminal and civil litigation in the coming decade, as well as their suggestions about how best to meet that challenge. The results of this survey will help NCSI determine priorities for training of science and technology resources judges – court jurisdictions’ “go-to colleagues” prepared to bring specialized knowledge tools to bear in support of the art of judging in an environment where the pace of scientific advance is straining the law’s ability to keep up. This report could also be a valuable resource for jurisdictions as they plan their judicial conferences, as well as institutes and academies involved in, or seeking to become involved in, the support of judicial science education.

The survey asked judges to predict subject matter areas in which scientific and technical evidence will become more important to case outcomes, and to identify the types of educational opportunities in which they’d be inclined to participate in order to best prepare to manage those issues when they arise. Additionally, it sought their input on three new proposals with the potential to support judges’ needs when dealing with complex scientific and technical matters; those proposals include creating “Court Science Officer” positions, using introductory/background briefings for juries, and expanding the use of appointed science masters in select cases. Finally, the survey solicited judges’ thoughts about the impact of what appears to be a question being asked with increasing frequency: What happens in ongoing litigation or a closed case when a peer reviewed scholarly article referenced or in some way relied upon in such a case is later retracted?

The survey was a full sample, non-representative, standard instrument inquiry. In this Executive Summary, we present the survey’s findings. We also present scenarios that capture and combine issues posed by those findings. Our task has been to illuminate science in the courtroom’s problems and prospects through this decade. Our quest is to optimize NCSI’s resource judge training programs and to aid planning by jurisdictions’ education divisions — as this decade unfolds.

All 56 State and Territorial jurisdictions were invited to participate in this study. 29 State and Territorial jurisdictions accepted the invitation; and 790 judges submitted completed surveys. That distribution roster is presented in Table ES 2.1, below. Participating jurisdictions are listed.

With respect to the applicable law of evidence, there is a continuum from the statutes and rules of the various states, some of which have adopted the FRE language and some of those (but not all) have adopted the Daubert approach, and some of which remain followers of Frye or some other expression of standards in statutes, rules, or case law, as the case may be. Please refer to Appendix E for a detailed presentation of cases thought to channel that continuum. We regret that we were unable to include U. S. Courts or Native American/Tribal Courts in this survey.

We employ three kinds of graphics in order to aid visualization of this survey’s findings: tables, bar charts, and box-plots. The first two are likely to be familiar to many readers. Box-plots contain a treasure-load of information and we include, below, a one-page tutorial to aid their reading.

Table ES 2.1. Participating States Rank Ordered by the Number of Completed Surveys

Jurisdiction	Completed Surveys	Applicable Law of Evidence
Illinois	151	<i>Frye</i>
New Jersey	89	<i>Frye</i>
Missouri	71	<i>FRE 702-705 by 2017 MO Statute</i>
Maryland	71	<i>Frye-Reed</i>
Michigan	51	<i>Daubert</i>
Massachusetts	46	<i>Daubert</i>
New York	46	<i>Frye</i>
Puerto Rico	46	<i>Daubert</i>
New Mexico	30	<i>Alberico/Daubert</i>
Pennsylvania	27	<i>Frye</i>
Ohio	20	<i>Daubert</i>
North Carolina	20	<i>Daubert</i>
Vermont	19	<i>Daubert</i>
Utah	17	<i>Frye</i>
Oregon	14	<i>Daubert</i>
South Dakota	14	<i>Daubert</i>
Tennessee	14	<i>Daubert</i>
Florida	13	<i>Daubert</i>
Texas	10	<i>Daubert</i>
Alaska	8	<i>Daubert</i>
Nebraska	7	<i>Daubert</i>
South Carolina	7	<i>Jones</i>
Washington	5	<i>Frye</i>
Oklahoma	5	<i>Daubert</i>
Wyoming	2	<i>Daubert</i>
Northern Mariana Islands	2	<i>Daubert</i>
US Virgin Islands	2	<i>Daubert</i>
New Hampshire	2	<i>Daubert</i>
Washington D.C.	1	<i>Frye</i>

Cases Adjudicated Past Three Years by Length of Bench Tenure - Bar Chart -

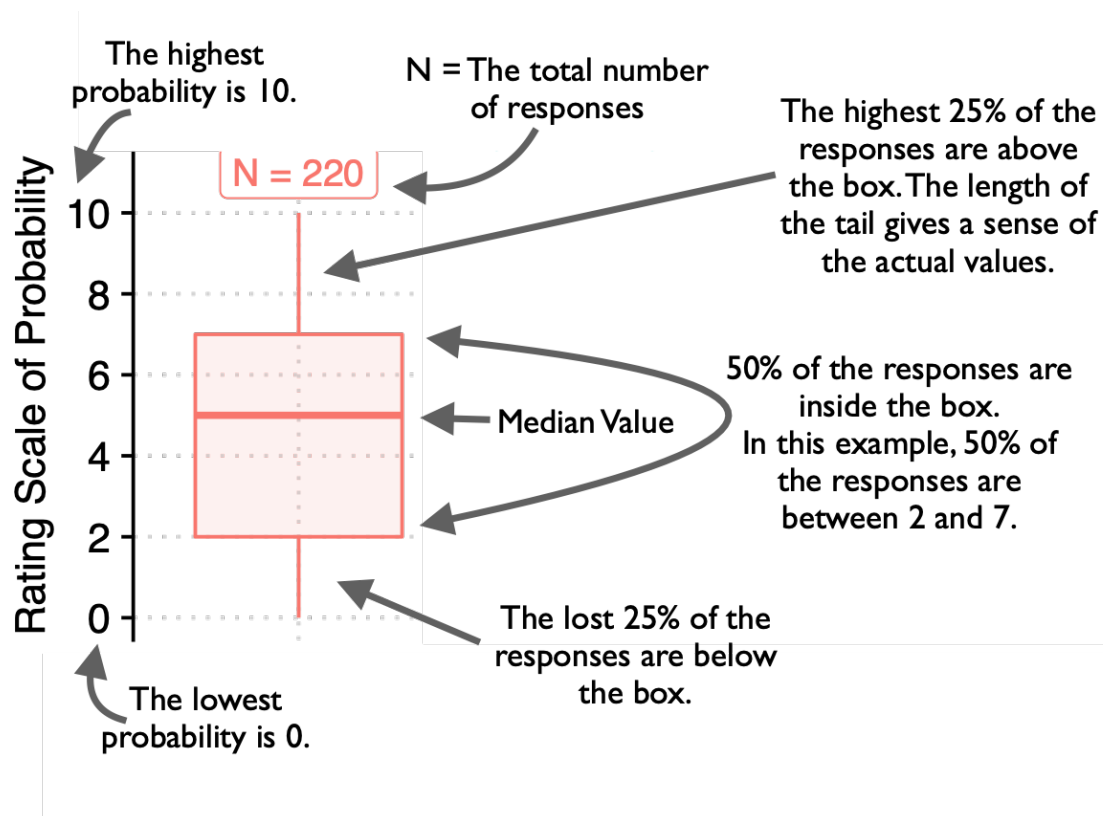
Figure ES.1.

We asked judges about their recent experience in adjudicating cases arguably with substantial scientific evidence. We then divided respondents by length of time on the bench, because in all the statistical gymnastics we put the data through it is the *only* judges' background variable that disclosed statistically significant association with forecasts made and preferences expressed. Little difference was found to exist in this judges' background variable. But we thought readers would be interested in recent adjudication experiences reported by the survey's participants.

Figure ES 2. Cases Adjudicated by Newer and Longer Serving Judges in Past Three Years, Orange Bars = Shorter Service, 4 years or fewer; Blue Bars = Longer Service, 5 years or longer.



It is said that a picture is worth a thousand words, so we limit comments and hope the following graphic illustration is useful for reviewing Box-plot figures used in this report.



“Probability” in the illustration above refers specifically to questions included in the survey. Judges were asked to rate the probability of a case being filed during this decade with several different kinds of novel scientific or technical evidence: forensics; Covid-19 test-related; health care outcomes research; data science; developmental neurobiology; genetic engineering and climate science. The higher the probability, the more robust the forecast that judges expected to see such cases in their courtrooms. Conversely, the lower the probability rating, the weaker the forecasts for encountering such evidence-prominent cases in the period from 2020 to 2030. Median values refer to the exact midpoint calculated for respondents’ answers from all judges’ ratings.

We can now go on to present Box-plot findings for forecasts of novel evidence. We present this in two forms: (1) all judges; (2) divided between shorter-serving judges (four years or fewer) and longer-serving judges (five years or greater).

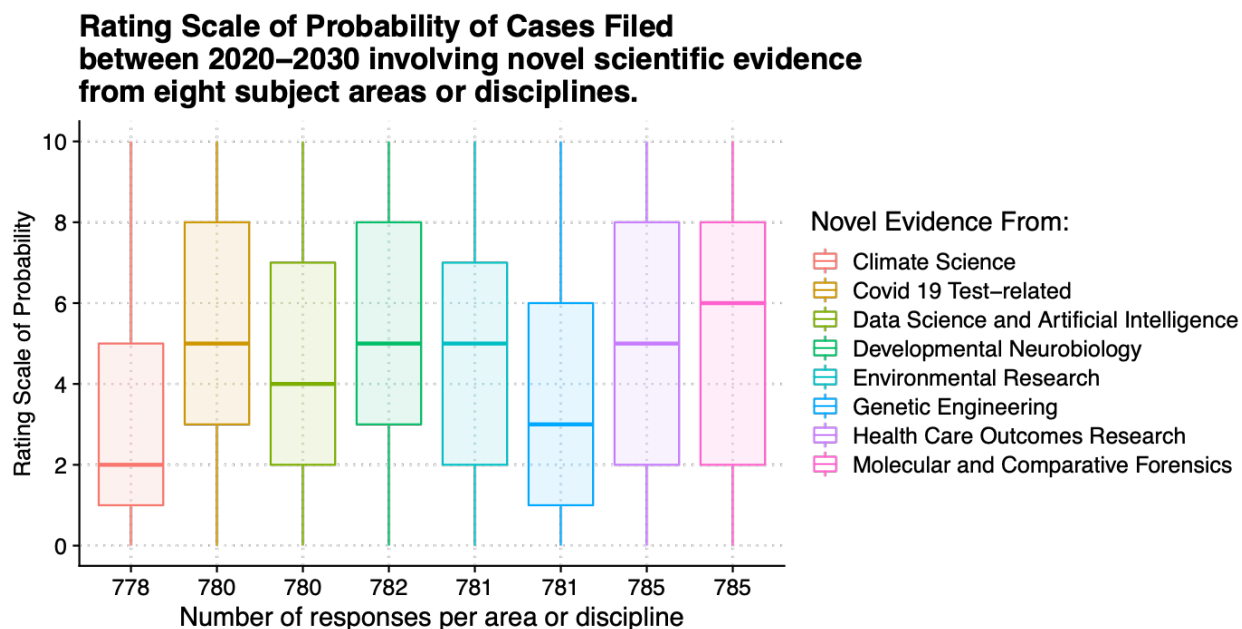
All Judges’ Forecasts for Novel Scientific Evidence in Cases, 2020-2030

Readily visualized in Figure ES.3, immediately below, judges’ forecasts from the entire survey

sample rated as highly probable to be filed in their courts cases with evidence related to molecular and comparative forensics; Covid-19 test-related; health care outcomes research; developmental neurobiology; environmental research; GeneticEngineering; and climate science.

We expected that forensics would draw high ratings given the courts' criminal caseloads. But, Covid-19 and developmental neurobiology evidence drew surprisingly high ratings as well. Expectations for climate science evidence and genetic engineering evidence ranked lower among judges' forecasts. Data science and artificial intelligence evidence-related cases, and involving environmental research ranked in the middle of judges' forecasts.

Figure ES.3

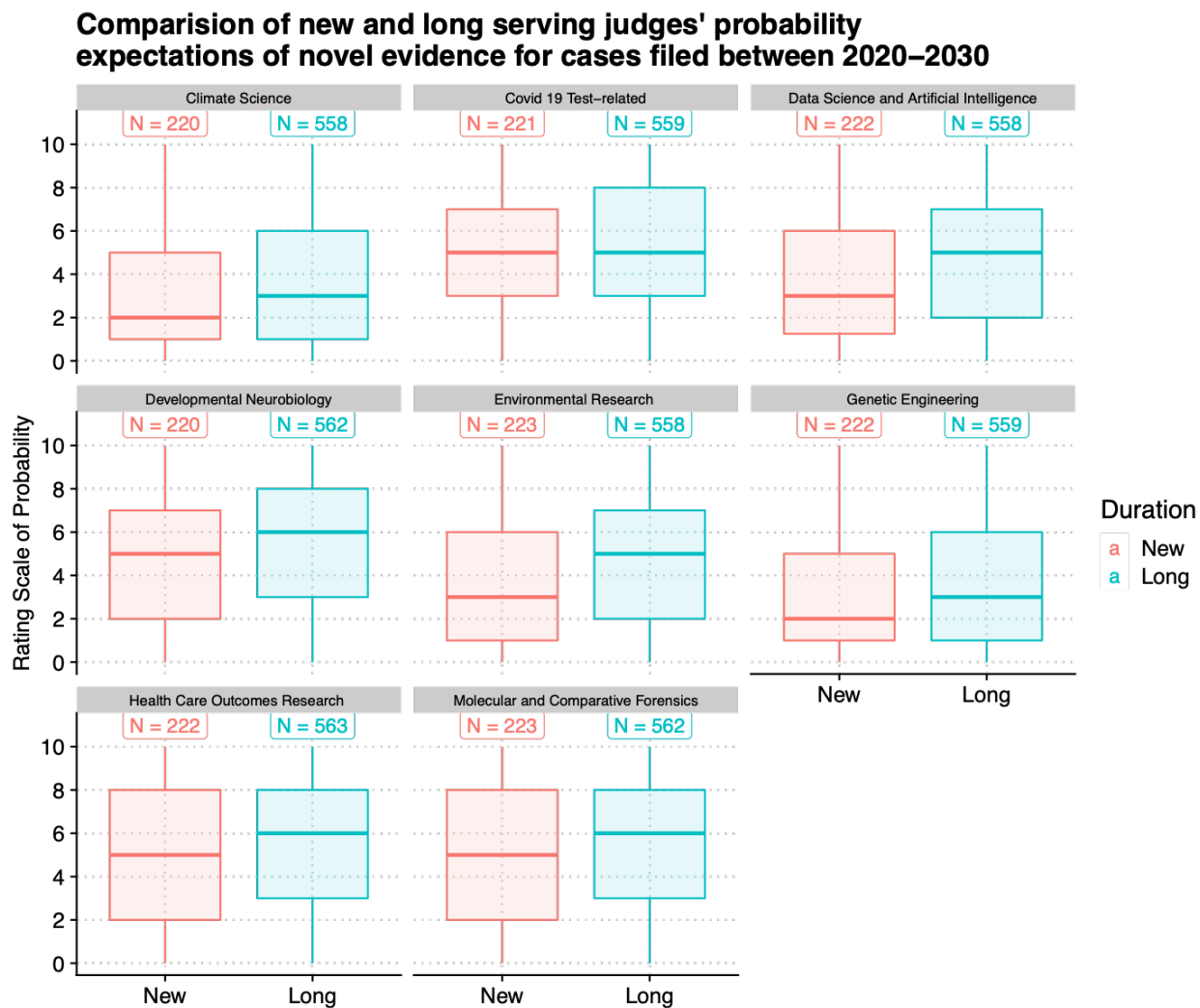


We explore this aggregate data in greater detail in this report's Section 7. But since duration of Bench service appears to have significant correlations with forecasts, we present that data immediately below. How did shorter and longer serving judges forecast novel evidence in cases expected to be filed in their courts this decade?

Duration of Bench Service as a Forecasting Factor with respect to Novel Scientific Evidence in Cases, 2020-2030

Longer serving judges had higher expectations for novel evidence in cases this decade when compared with their more newly installed colleagues. The difference between forecasts was found to be significantly different for each novel evidence category with the exceptions of Molecular & Comparative Forensics and Covid-19 Test related evidence. In those cases, shorter and longer serving judges shared similar forecasts, both revealing higher expectations for case filings.

Figure ES.4
Shorter and Longer Serving Judges' Forecasts for Cases with Novel Scientific or Technical Evidence, 2020-2030, New=4 years or fewer; Long=5 Years or more.

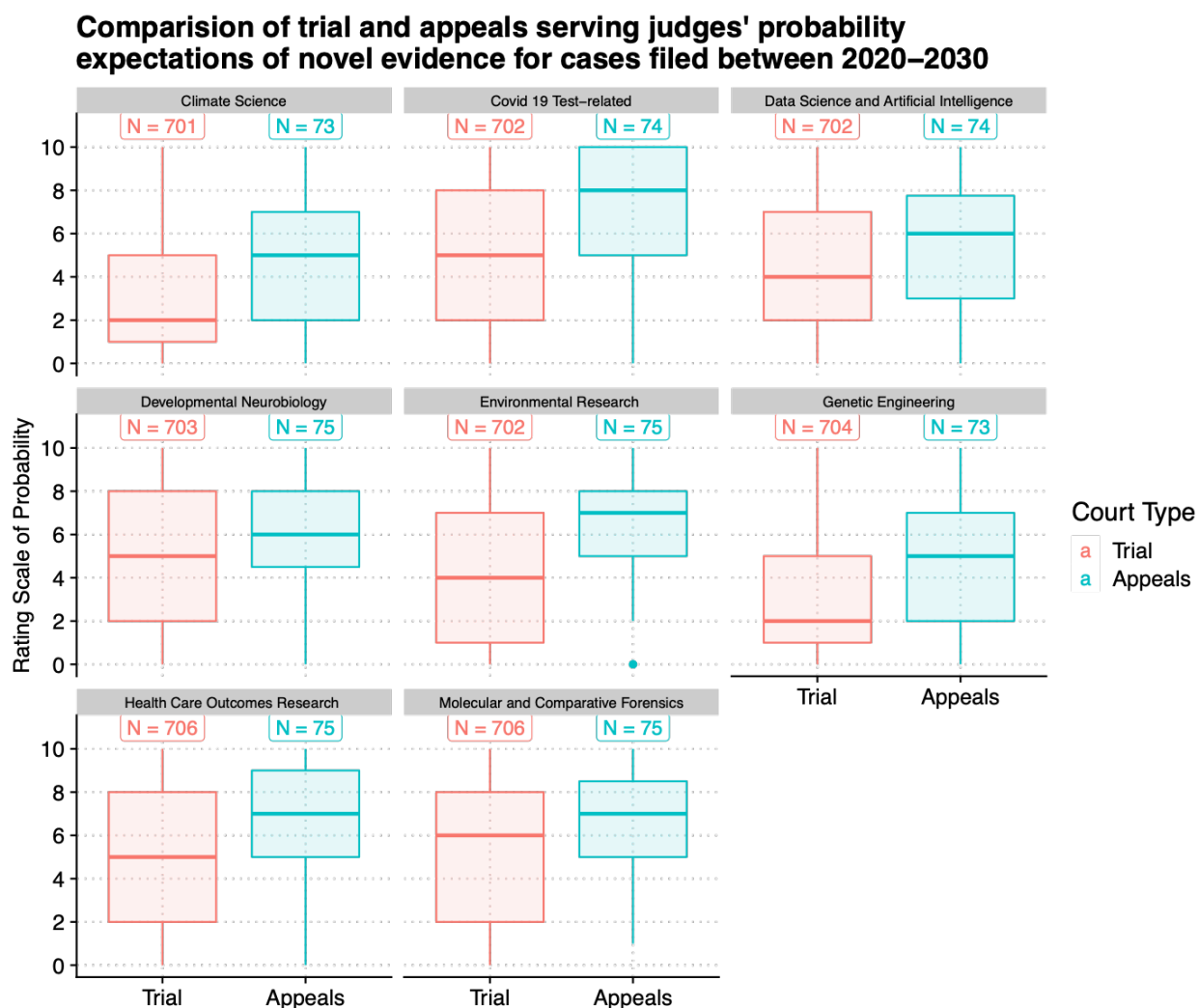


Do Trial and Appellate Judges Agree or Differ with Respect to Novel Scientific Evidence Forecasts?

While appellate judges' forecasts were higher for all evidence categories, Figure ES.5,

immediately below, discloses systematic differences, drawn into sharper relief if one focuses

Figure ES.5



upon the medians - the bold lines within the boxes representing the middle 50% of rating responses, how low trial judges forecast climate science evidence and how relatively high appellate judges forecast Covid-19 Test related evidence and health care outcomes research evidence. Here are a few additional comparisons, packaged without graphics, with no statistically significant differences, and elaborated in this report's Section 7.

- Appellate Judges' three highest evidentiary probabilities (in rank order): Covid-19 related cases; Molecular and Comparative Forensics; Health Care Outcomes Research Evidence.

- Appellate Judges' three lowest evidentiary probabilities (in descending rank order): Data Science and Artificial Intelligence; Genetic Engineering; Climate Science.
- Trial Judges' three highest evidentiary probabilities (in rank order): Molecular and Comparative Forensics; Health Care Outcomes Research; Covid-19 related cases.
- Trial Judges' three lowest evidentiary probabilities (in descending rank order): Environmental Research; Genetic Engineering and Climate Research (tied for lowest).

We also found some similarities in trial and appellate judges' forecasts:

- The highest probability rating for case-related evidence was shared by appellate and trial judges: **molecular and comparative forensic evidence**. Appeals judges offered a median rating of 6.59; trial judges offered a median rating of 5.41. While ratings were separated as between appellate and trial judges, the difference was not found to be significant.
- **Climate research evidence and genetic engineering** evidence were rated the lowest of eight scientific evidence domains by both appellate judges and trial judges, each with median scores of 5.5 and 2.0, respectively. Despite this commonality, the probability rating of appellate judges was significantly higher than among trial judges.
- And then there were the similar ratings for **developmental neurobiological evidence**, medians of 5.94 among appellate judges and 5.09 among trial judges — more probable scores for one of the most highly invested research areas in American public research programs and research universities before the Covid-19 pandemic's onset.

Judges' Judicial Science and Technology Education Preferences

With relatively robust expectations for new cases with novel scientific and technical evidence this decade, we asked judges to list their recent science-related training and to rank their preferred content for judicial science and technology education over the next five years. Following content, we inquired about preferred delivery.

Presented with a list of possible continuing judicial science education subjects, responding judges were definite in their priorities from among a fixed number of alternatives.

- ***Judges' recent on-the-job science and technical education*** - Hundreds of educational events were listed - seminars, workshops, conferences and webcasts sponsored by jurisdictions and other court-related providers. We derived no meaningful categories. We also detected no significant correlation with forecasts of evidence expected to be filed, judicial science education preferences or views about structural innovations to assist adjudication of novel evidence in complex cases.

Second, we presented respondents with a list of possible continuing judicial science education subjects, and asked them to select as many as they thought expressed their on-the-bench educational priorities from among a fixed number of alternatives.

- ***Ranked science and technology education preferences*** —rank ordered by all responding judges from most frequently selected to least frequently selected and with the actual number of judicial choices in parentheses:
 - Principles of forensic science (412)
 - Forensic technologies (336)
 - State of mind and predisposition for violence (293)
 - New brain modification technologies to treat mental disorders (260)
 - Best practices with respect to forensic laboratories (255)
 - Health care outcomes research evidence (218)
 - Artificial intelligence and big data (211)
 - Techniques for sampling environmental conditions (115)
 - Genetic engineering technologies (74)
 - An array of additional, more specialized subjects (69)
 - Designer babies (37)
- ***Additional educational preferences*** have been grouped as follow from nearly 100 comments and observations volunteered by survey respondents:
 - Addictions-related science, pharmaceutical treatment assessment, and treatment protocols
 - Updates on DNA technology-related evidence
 - Digital technology-related scientific underpinnings and practices of private sector companies
 - Sentencing-related neuroscience’s reliable perspectives, including ability to form intent
 - Gatekeeping/reconciling forensics with unreliable underlying science influence of junk science

Preferred On-the-Job Science Education Settings

Perhaps equally important to the content of continuing judicial science and technology training is the preferred method of any subject matter’s delivery. Here’s what the survey’s respondents told us:

- Irrespective of their adjudication locales or duties, judges overwhelmingly preferred single-day, onsite workshops, conferences or seminars to all other approaches.
- 2-3 day onsite conferences ranked second, with combined on-site preferences (one day and 2-3 days onsite) accounting for 64% of preferences.
- On-line education methods paled in preference to onsite methods, but webcasts occupied a healthy third place in judges’ ranking. Pre-recorded science education segment, such as YouTube or edX courses drew low ratings.
- On-site laboratories and clinics also were disfavored with low ratings. (This result runs counter to NCSI’s experience and ASTAR’s earlier eight year run, but may be explained by the self-selection of judges who seek training to facilitate colleagues via NCSI when compared with judges who seek solely to improve their case adjudication skills.)
- Only 2% of respondents preferred combinations of online and onsite science training.

Judges’ Views About Structural Innovations to Assist Courts’ Adjudication Tools

With reasonably high expectations for novel evidence this decade, the survey sample expressed ambivalence about structural additions to strengthen courts’ capacities to adjudicate complex science and technology dependent cases. With no statistically significant difference between

Frye and *Daubert* jurisdictions, length of time in bench service, and trial and appellate courts, here is what judges thought about three proposed assistive techniques:

- ***The employment of a scientific staff officer by state and territorial jurisdictions*** — was disfavored by responding judges, 51.3% rating the helpfulness to judges low to moderate, with ratings moderate to high characterizing 41.4% of judges ratings. 14.3% fell on the rating scale median, 5 points on the ten point scale. Concerns about *ex parte* communications were prominent, although such an officer can be bound by the same confidentiality rules as govern law clerks and other Chambers and administrative staff.
- ***The provision of juries' science background briefings*** — apart from the particular case in which complex evidence is proffered — was disfavored by 46.4% the national judicial sample, with 38.9% favoring. 14.7% fell on a median scale rating of 5. But the number of judges enthusiastically rating the innovation was surprisingly high, comprising 22.4% of responses.
- ***Funds for judges to acquire science masters in indicated cases*** — gained the most support from among these three structural innovations intended to assist case management of scientifically complex cases: 38.2% rated low to moderate; 49% rated moderate to high; a 5 point rating median accounted for 12.8% while 103 judges rated this option at a full 10 points. Objectors seemed most concerned about how to operationalize the procedure.

Jurists' Views About Impact of Peer-reviewed Scientific Journal Retractions

Valid research is frequently reported in respected peer-reviewed academic and professional journals. Expert witnesses in court proceedings frequently reference their opinions in published, high-impact articles. The publication process is often slow-but-sure — with authors waiting a year or more between their articles' submission for publication and their appearance in print. Over the past several years, some prominent researchers' articles have been retracted after publication when major errors were discovered in spite of peer review. Our survey sought to document how much impact such retractions might have upon fully resolved cases in judges' opinions.

- ***Responding judges split nearly equally on the the impact of retraction in the 2020-2030 decade***, with judges impact ratings 42.9% lower and 39.5% higher than the 133 judges median choosing 5 points on a ten point rating scale. Appellate opinions were somewhat higher, but did not pose a statistically different result from trial judges' forecasts.
- ***Why we posed the journal retraction matter*** — Scientific discoveries typically derive novel evidence much more quickly than the law's ability to keep up. But with Covid-19 evidence highlighted as a case filing probability, and with new studies announced and published daily, the retraction of the scientific underpinning in some criminal and civil cases could lead to legal actions to nullify convictions and compensatory awards, respectively. Retractions could open a new back door for junk science in the courtroom. The detailed opinion data with respect to journal article retractions may be found in this report's Section 10.

Comparing Opinions Among State/Territorial Jurisdictions; And from Regional Clusters of States About Novel Evidence Forecasts this Decade

Section 7 of this report concerns regional clusters of States and Territories comprising nation-wide polities, compensating in part for the 26 jurisdictions that were not able to participate in this study. Differences in forecasts are included, some informative, and some starkly unexplainable with the data at hand. We left other ratings and opinions for later secondary analyses. The patterns of suggested regional priorities for this decade's novel evidence linked cases is thought-provoking; and may stimulate ideas for collaboration. We adapt some observations into judicial education scenarios outlined at the end of this executive summary, immediately below.

A Synthesized Conclusion from All Data

Judges offered significant forecasts for several types of novel evidence expected to be filed in cases in their courts this decade. They appear to welcome judicial science education to prepare for the backgrounds of such filings. They prefer one day on-site educational segments, but are not opposed to web-based offerings.

At the same time, survey respondents generally did not accept jurisdictional mechanisms to assist case management of novel, complex cases. Courts science officers were rejected more forcefully than background briefings for juries, but enthusiasm appears to be low for the latter as well. Funds for judges to acquire their own science masters in appropriate cases was a better accepted innovation, although its attractiveness appears to have been diminished over operational concerns for this assistive innovation's management.

From judges' ratings and their open-ended comments and observations, it appears that their bottom line might be expressed as follows: we recognize the challenges as new scientific and technical evidence is offered in cases, but we expect to depend upon our own case management resources to achieve fair trials and effective appellate decisions.

This conclusion places a high premium on preparing judges without additional institutional supports beyond judicial science and technology education. It appears to suggest an attitude that says, "Give us the knowledge tools as cases arise, but don't burden us with third party case management resources." If our apprehension of that attitude is generally correct, we are able to formulate some scenarios that might be usefully considered as this decade progresses.

Deriving Scenarios for the Emerging Decade

Scenario formulation is inherently speculative, a condition that adjudicators frequently avoid. Its virtue is its power to suggest alternative futures. And a decade is a long time, making new problems, unanticipated factors, and priorities likely to emerge. Moreover, this survey took place midway during the decade's first year, 2020, during which massive chaos emanated from the Covid-19 pandemic, a galvanized social justice movement widely termed "Black Lives Matter," and economic disruptions to the Nation's economy not seen since the great depression of the 1930's. These forces should temper the scenarios suggested below.

A large number of judges responded to this survey. They work in only about half of State and Territorial court jurisdictions, and they well may not be representative of all judges or all jurisdictions. They were nevertheless generous in their supply of background statistical information and their opinion rating, comments, and observations — sufficient to pose scenarios

that later this decade can be tested for consistency and continuity. Here are several conclusions from this survey and few scenarios derived from them — food for thought about judicial training for novel evidence in complex cases in the coming years.

Scenario No. 1 - Forensics. A drive toward more effective applications of forensic evidence drives out tolerance for additional gatekeeping enhancements between 2020 and 2030. ***A counter scenario*** is that court systems merge forces in a forensics network that operates as a spiral gain support system and relieves judges of forensic science education priorities sufficient to motivate court systems' educational divisions to respond to other novel evidence subject matter.

Scenario No. 2 - Covid-19 Test-Related Cases. While we specifically asked survey respondents to rate Covid-19 Test-related cases, a surge between 2020 and 2024 will occur on many evidentiary issues in criminal, civil and equitable cases. Rapid shifts regarding Covid science and technology have resulted in confusion in 2020, and new research is in the pipeline. It will likely be equally controversial. Adjudication of mounting cases, however, is handicapped by a judicial prejudice against neutral, independent science advice from beyond court systems, and limited by judges' resistance to trade their robes for lab coats in hands-on educational settings, such as laboratories and clinics. The expert witness industry is diminished as a trustworthy source for cases involving Covid-19. Cases that go to the jury could be denied the benefit of authoritative background science and technology. Presiding judges become further confused about evidence admissibility as claims of junk science are traded among the litigants. Appeals increase, impelled by objections based upon advocates' charges of trial judges' abuse of discretion in admitting or excluding novel evidence.

Scenario No. 3 - Additional Covid Perspectives. Judges turn to one another for assistance with respect to the putative scientific reliability underlying proposed testimony about short and long term illnesses caused by Covid-19 infections, and disputes over the genomics underlying the effectiveness or ineffectiveness of vaccines hurriedly marketed to the U.S. population. Mutual assistance also increases over an expanding number of fraud claims against pharmaceutical companies and health care providers alleged to have sold worthless treatments for combination of seasonal flu and Covid-19 cases. Several journal articles relied upon by defendants have been retracted after jury verdicts, resulting in appeals to overturn them.

Scenario No. 4 - Environmental research, climate science and genetic engineering evidence suddenly flood court systems. A cluster of cases in the Mountain West is filed alleging that several new disease-causing microorganisms have resulted from the negligent release of genetically-engineered mosquitos into the environment as a preventive for new disease carrying forms that have emerged from wildfire smoke experienced locally but carried across the Nation. The GMO mosquitos have been, the public is told, engineered to mate with emergent, disease-carrying strains, and to render the latter infertile. In allegedly panicked attempts to prevent Zika-causing infections, emergency release of GMO mosquitos has been authorized by the Federal Environmental Protection Agency and state-level counterparts. Law suits brought by State environmental agencies against academic health centers allege that research facilities lacked the proper containment equipment and procedures, resulting in the negligent release of the engineered insects. The academic health centers offer to show that the government's claims are scientifically unwarranted. Motions to dismiss and their rulings are furiously argued by a host of appellate conferences over the academic health centers' claims that the new infection agents arose from a combination of climate-related factors, including unprecedented levels of long-term heat, evaporation of usual water sources, and the new micro-organisms use of fire detritus as a source of nutrition.

Scenario No. 5 - Data Science and Artificial Intelligence Evidence Whipsaws a Court — After a three-week trial, a jury returns a class action verdict on behalf of 600 individuals, a \$990 Million compensatory civil verdict plus punitive damages. In debriefing the jury, the presiding judge learns that the testimony

of one expert witness citing a large-scale study using databases from the U.S. and three other nations on three different continents was uniformly convincing to the jury. A weekend passes, and on the Monday following the verdict, the large-scale study is retracted by a world-class, peer reviewed journal that published the statement used as the convincing experts witnesses' opinion foundation. The journal's executive editor embarrassingly informs the press that the artificial intelligence algorithms used to process data upon which the expert witness's opinion relied was fabricated by one of the journal article's co-authors. The entire article is labeled fraudulent by the journal. The civil action's losing counsel petitions the trial court to issue an order to dismiss the lawsuit notwithstanding the jury's verdict. A companion appeal is filed to reduce the compensation to zero and to request court costs from the opposing class.

This report's Sections 11 and 12 interface the State and Territorial courts' and NCSI's possible encounter with these scenarios and others closely related to the survey's direction findings. Implications are posed for jurisdictions in this report's Section 11. Science and technology resource judge training implications for NCSI's planning this decade are discussed in Section 12.

SECTION 2. THE SURVEY'S GOALS AND METHODS

Goals

The survey's *primary goals* are to document, classify and quantify sitting judges' expectations for complex cases and transmute those expectations into forecasts for this decade's official dispute resolution. By so doing, we seek to highlight science and technical evidence that judges, both in the trial and appellate courts, perceive will expand their roles as gatekeepers. The survey sought to tap into judges' perceptions of the high profile and less important scientific and technical evidence; but it also measures the content and delivery preferences for judicial science education and institutional changes to help courts master explosive scientific discovery. That discovery's exponential rate and expansive volume can be expected to stress management of the applicable law of evidence between 2020 and 2030. This project is intended to help State court jurisdictions respond to these challenges.

The results of the survey will help NCSI determine priorities for training of science and technology resource judges — court jurisdictions' "go-to people" prepared to adapt special knowledge tools to the art of judging. This report could also aid the various participating jurisdictions to plan their judicial conferences, institutes and academies over the next several years.

The National Courts and Sciences Institute (NCSI) is a not-for-profit — 501 (c) (3) — public charity dedicated to sustainable preparation of judges to manage technically complex cases, boost their home courts' case-related science and technology education offerings, mentor their colleagues and contribute to jurisdiction evidence rules and oversight.

The survey's goals are intended to develop pathways for NCSI's missions. With this survey, we set out to generate a report that forecasts science and technical subject matter and evidence that will affect judges' adjudication techniques as gatekeepers, in both in the trial and appellate courts.

Methods

The *survey's methods* were not remarkable. Nevertheless, the reader is entitled to their enumeration in this report's early notes.

Letters from NCSI's Board Chair and President requested survey participation from each chief judicial officer of all State and territorial court. Similar letters sent to the administrative officers of each State's and each territory's courts asked that the survey instrument be sent to all general jurisdiction trial judges and appellate court judges, including the State court of last resort. Instructions for direct return to the survey team accompanied the request letters. Those instructions also were prominently displayed on the survey instrument's cover page. Judges had access to a survey form formatted in MS Word and an on-line version. The MS Word formatted instrument could be returned to Justice Leventhal directly via email, a judge-to-judge transmission that assured each respondent's anonymity. The on-line version required no

transmission. It had no identifying origin except for each respondent's notation of their appointed or elected State or Territory.

This survey is a special purpose survey. It is meant to illuminate and provide insight with respect to sitting judges' forecasts for civil and criminal cases involving novel science and technical evidence. It is *not* a representative sample survey. Selection bias is minimized and estimated in a representative sample survey. Our results contain biases and their influence is unestimated. Our decision to utilize a general solicitation warrants a brief explanation.

Asking for jurisdictions' assistance to supply each judge with a survey instrument during the pandemic-caused court system dislocations was burdensome enough. We determined that we could not fairly request court administrators to select, monitor and certify a representative sample. We are grateful for the assistance provided by the 29 jurisdictions that accepted our request to distribute the survey to their entire judicial roster.

Those jurisdictions include court systems from all regions of the United States - Northeast and Mid-Atlantic, Southeast and Southwest, Midwest, and Mountain West / Far West. The survey is certain to contain selection biases, but we are pleased that all regions of the country have been represented. We are not satisfied with having to exclude Federal and Native American/Tribal courts from this survey's sample; hopefully that shortcoming can be remedied in the near future.

A copy of the form received by each judge is included in this document's Appendix A. Survey questions requested anonymous background information so as to correlate opinions with type of court in which the respondent serves; length of time on the bench; principal legal practice prior to ascension to the bench; formal academic training in the sciences, technology, engineering and mathematics; recent continuing judicial education in scientific/technological/engineering issues; and types of science/technological evidence experienced in cases managed within the last three years.

Participating judges were asked to rate the probability of cases featuring advanced scientific evidence over the next decade; their preferences for scientific evidence subjects they prefer over the next five years; and the nature of the educational setting they favor — the types of scientific or technological seminars, workshops or conferences they would prefer to attend in the next five years.

Completed surveys were assigned a reference number, and entered into data sets established in MS Excel worksheets and archived in Google Docs by the survey team's summer interns. All data sets were combined into a survey database that permits updates and inquiries. Working collaboratively, the intern team converted the raw data into tables and figures that summarize background information, science forecasts, and continuing preferences. A separate section sought to document the impact probability of proposed institutional changes to support evidence assessment. We posed a separate question - disconnected from the foregoing - inspired by recent developments: the probable impact upon case adjudication by a recent trend of peer-reviewed journals' retraction of articles following publication.

Dr. Joshua Starmer, President of StatQuest, served as this survey's consultant to critique tabulations and statistical processes. He reviewed the third report draft and made recommendations to simplify tabular and figure presentations. He assessed the strength of support for conclusions advanced by the survey team.

The draft report was then sent to two additional independent reviewers: Hon. Michael A. Wolff, judge retired of the Supreme Court of Missouri, and Professor of Law and Dean retired of the Saint Louis University School of Law; and Hon. Brian C. Wimes, U.S. District Judge for the Western District of Missouri, Kansas City.

Simultaneous with independent review, the draft report was sent to this project's oversight group for a final reading. NCSI's project oversight group was asked to detect problems of survey quality and lapses found in the integrity of the report. The oversight group includes the following members: Hon. Lloyd A. Karmeier, Justice of the Supreme Court of Illinois; Hon. Donald W. Beatty, Chief Justice of South Carolina; Hon. Judith N. Nakamura, Justice of the New Mexico Supreme Court; Dr. Daniel T. Lackland (Prof. of Epidemiology, Medical University of South Carolina).

Justice Leventhal and his Chambers staff and summer interns have tabulated initial responses without respondents' identification and prepared this report's early drafts. Confidentiality of survey respondents' MS Word forms was maintained as a judge to judge communication. (The interns comprising the survey team are held to the same standards of privileged courtroom communication as all law clerks and staff.)

Dr. Joshua Starmer and Dr. Franklin M. Zweig reviewed initial drafts. They integrated Michigan judges' 51 responses into all calculations following interns mid-August return to law schools. They repackaged statistical analyses and presentations to aid readers' access to the report. They prepared a near-final, still-provisional draft. Dr. Starmer provided new illustrative bar charts and box-plots to highlight data. Dr. Zweig edited text and circulated the draft report to reviewers on September 12, 2020. The near-final draft was presented in a Resolution Approving Release and Consent for Corrections and Technical Amendments to the NCSI Board of Directors timely for the Board's meeting on October 12, 2020.

The final report has been scheduled for dissemination via the NCSI web site and notice to all jurisdictions once NCSI Board of Directors approves its release.

Statistical Procedures

Following the submission of the intern team's final report, Dr. Starmer conducted an audit of that draft's statistical exhibits. He determined that additional procedures were needed to graphically portray findings, and thereby strengthen the foundation for conclusions. Dr. Starmer worked out two additional prototypes, Bar Plots and Box Plots for data visualization. Box-plots are particularly useful; they identify median responses of rating scales and set up the data in quartiles. He recommended that new bar charts and box-plots replace the Z distribution tables that were found to be difficult to interpret and did not include Michigan's late-arriving responses. He conducted a number of T-tests to determine whether responses differed significantly or not. As is set forth in this report's executive summary, above, and sections below, the only significant factor that could reliably account for difference in group responses was the length of time judges have served on the bench, noted as a two factor dichotomy, 4 years and fewer for shorter bench service, and five year and more for longer bench service.

While we believe that we have identified the principal, important messages the data can offer, we hasten to point out that a huge torrent of responses generously has been contributed by

this project's judicial respondents. Secondary analyses will be necessary to fully explore all the data. We believe we had detected the primary messages this survey has to offer, particularly its meanings for the first half of the 2020-2030 decade. It may well be that a follow-up survey in a few years will clarify judicial science education's needed directions for the second half of this decade.

Section 3. THE SURVEY INSTRUMENT

Overview

The survey instrument asked for semi-detailed multiple choice and open-ended answers to five general questions: (1) What variables contextualize the responding judges' adjudication practices? (2) What level of probability could judges assign to forecasts of novel, case-related evidence expected to be introduced in their courts in the years between 2020 and 2030? (3) What are judges' preferred science-oriented continuing judicial science education subjects and in what learning settings? (4) How helpful would judges regard several proposed jurisdiction innovations to assist gatekeeping of scientific evidence in complex cases this decade? (5) To what extent, if at all, in judges' opinions, does a recent article retraction trend among high profile scientific journals burden case adjudication? *

The survey instrument, entitled "The National Courts and Sciences Institute Anonymous Science in the Courtroom Decadal Survey 2020-2030," — set forth in its entirety in this report's Appendix A — secured vital statistics about responder's Bench setting; trial or appellate jurisdiction; length of time in judicial service; recently adjudicated cases; and responding judges' formal scientific education and recent on-the-job science and technology education provided by their respective court systems. It posed multiple choice questions in a fixed, ten-point rating scale for some questions and routine less followed with open-ended comment or observations invitations. The survey instrument thus sought to elicit a combination of quantitative and qualitative data that could contribute to a picture of case-related science expectations and means to achieve them in the ensuing ten years. The survey form required about 20 minutes to complete.

Pre-tests and the Email Version

The original survey was formatted in MS Word. It was expected to be completed by responding judges and returned by email to Hon. John M. Leventhal. That form was pretested with the NCSI Executive Committee and with NCSI Directors assembled as a project oversight group. With corrections recommended by pre-test judges and a science advisor, the survey team supplied initially approached jurisdictions with the email format. 199 judges responded in the email format out of a total sample of 790 returns.

Two Survey Forms Introduced and Utilized

The remainder of the survey's sample, 581 completed on-line fillable forms were determined by the survey team to be easier to use. It also obviated the source email to transmit it from participating judge to Justice Leventhal, ramping up appearances of a higher level of confidentiality.

The survey team intended the instruments to contain identical content. However, some changes crept into the two forms. Several changes did not convert essential response categories. One change,

however, converted a fixed rating scale initially posed in the email version to a nomination of as many options as could apply, eliminating its use for comparing immediate pre-Bench legal occupations with forecasts, preferences and opinions of structural change helpfulness.

Supply of Definitions for Survey Respondents' Use

The survey's sponsor, NCSI, was aware that most judges have pre-legal education in the humanities and social sciences. Scientific and technical terms may be unfamiliar. We wanted to avoid sending judges to reference sources in order to reply to survey questions. Additionally, a few judges and court administrators in reviewing early survey instrument versions opined that judges would be ill-equipped to forecast technical evidence. One jurisdiction declined to participate in the project on the basis that its judges would not be able to decipher the questions. However, 29 jurisdictions did not share that opinion and 790 respondents completed the instrument, apparently with little trouble, and, perhaps with a little help.

To reduce the possible diminishment of responses to unfamiliar terms, the survey added definitions to several query areas. We list definitions here. They were included in both the MS Works (email) and On Line Fillable versions of the survey instrument:

***Genetic engineering may be described as changing biological inheritance by the application of technologies to modify DNA, genes and development of humans, animals, plants, and microbes - virtually all life forms.**

***Data science may be described as evidence obtained from the analysis of large databases constructed for the purpose of understanding statistically the features and behaviors of large human populations; an example is risk of disease or comparative longevity of subpopulations. Artificial intelligence is a general term referring to statistical models derived from big data and contains algorithms claiming to be capable of answering inquiries posed by users: an example is determination of the risk of re-offending among individuals apprehended by law enforcement.**

***Developmental neurobiology may be described as fuller understanding of behavior by means of analysis of brain function from prenatal development through childhood and adult years via brain scans, chemical analyses of brain fluids, cells and tissues, and demonstrated understanding of the brain's complex circuitry.**

***Covid-19 Test-Related Evidence -Expectations for criminal, civil and equity case incidence and prevalence involving Covid-19 test data.**

***Health care outcomes research evidence may be described as procedures, often in phased clinical trials, to determine the safety and efficacy of treatments for human diseases and disorders.**

***Environmental research is frequently expressed in reports about environmental conditions, including impact statements produced under law to assess efforts to change land, water or soil use.**

*** Research from Climate Science - Expectations for criminal, civil and equity case incidence and prevalence involving climate science research reports on climate quality, degradation and changes over time.**

*** Journal Article Retraction Impact - A retraction is the extraordinary act of a journal editor or editorial board to withdraw post-publication a peer-reviewed research-based article, in which case it becomes a nullity in the scientific arena.**

The introduction of two forms and query-supportive definitions undoubtedly introduce a bias into the survey data. We were unable to measure the nature or extent of such bias. However, only with a follow-up study, would we be in a position to quantify it. Both changes — adoption of the online version of the survey instrument and supply of definitions in some rating questions — appear to have been met with responding judges' satisfaction. Once polling began,

the survey team received no complaints or revision suggestions with respect to either survey instrument adjustments.

An additional endnote, 3.1, presents additional survey team perspectives on the survey instrument and its management for readers seeking additional insight on this aspect of the survey project.

Section 4. THE SURVEY TEAM AND MANAGEMENT

The survey team — comprised of four second year law student interns in survey director Hon. John M. Leventhal's chambers — divided responsibility for survey instrument distribution and analysis into four national regions and established each as a regional overseer:*

Ryan Baal (Cardozo Law School) - Midwest State Court Jurisdictions

Gabriel Boni (Temple Law School) - Southwest, Mountain West and Far West State Court Jurisdictions, Pacific Territories

Olivia Stein (Cornell Law School) - Southeast, South and Southwest, including Puerto Rico and US Virgin Islands

Yue Yang (Cornell Law School) - Northeast, Mid-Atlantic State Jurisdictions, District of Columbia

The interns assigned above assumed responsibility as each respective court administrator's

- Initial point of contact;
- Repeated requests for participation;
- Enumerators for received completed surveys;
- Initial tabulation of survey responses and initial compilation of results.

Justice Leventhal convened weekly team meetings via Zoom conference and established the agenda for each meeting. Robert Elting, Esq., Hon. Michael F. Pietruszka, and Dr. Franklin M. Zweig also participated in weekly meetings.

Justice Leventhal consulted with interns between weekly meetings as needed. Weekly meetings were also supplemented among the intern unit with email correspondence and additional discussions by video conference or telephone, arranged in advance or on an ad hoc basis. In these informal meetings, returns were compared, analyzed, reassigned for aggregation related to survey questions, and for an initial draft of the report. The intern unit occupied a status analogous to a semi-independent research contractor organization. Interns processed multiple

iterations of analyses for discussion in successive weekly Zoom meetings. At the end of their service commitment, approximately August 17, 2020, the intern unit forwarded for review a rough draft of this report comprised of merged statistical and text analysis.

At the initial dissemination stage, court administrators were requested to disseminate the survey to appellate judges and judges presiding in courts of general jurisdiction. The law student interns followed up by email, phone, or both, with the various jurisdictions in response to questions raised or if a jurisdiction had not responded to the initial correspondences. Further follow up was conducted by Justice Leventhal who contacted, first via email and then by phone, various court administrators to urge participation and to answer their questions, if any. (Endnote 3.2 presents the intern unit's activities in greater detail.)

The survey was conducted at a time when the national judiciary's focus was on a multitude of pressing issues that included the ongoing global health pandemic; the closing of courts to in-person procedures; and the reopening of the courts as made possible by reduced infection rates. Recognizing the severe pressures faced by jurisdictions, we thank each participating jurisdiction's chief judicial officer and court administrator for facilitating this survey.

We trust the confidence that many readers will place in the survey — and by the effort its implementing team expended in its formulation — will result in utilization of this report in planning ahead for judicial science and technology education.

Section 5. THE SURVEY SAMPLE

National Distribution

56 State and Territorial jurisdictions received requests to participate in this survey. Each jurisdiction's chief judicial officer and court administrator received a request accompanied by a copy of the survey instrument.

29 jurisdictions responded to the survey team's outreach.

790 completed surveys were returned.

Return Rates

The survey was distributed to 10,993 judges by their respective court administrators. The resulting return rate is 7.2 per cent. That volume made possible development of a robust picture of judicial opinions, but as noted previously, the sample self-selected and cannot be termed representative.

While we had aimed at a 10% return, the high return rates from some states jurisdictions, Illinois, for example, with a 15% return rate, enabled an effective state by state analysis of judges' forecasts and preferences. The return rates for some jurisdictions were very low, as Table ES 1 on pages 5-6 indicates.

Regional Distribution

All regions of the Nation are represented in the survey's results. We have been able to conduct a regional comparison of judges' forecasts and preferences.

The following were the response totals by regions:

Region of the United States	Number of Completed Surveys
Midwest regional court jurisdictions	314
Northeast regional court jurisdictions	228
South / Southeast regional court jurisdictions	169
Mountain and West regional court jurisdictions	<u>79</u>
Total	790

Section 6. RESPONDING JUDGES' STATISTICAL BACKGROUNDS; NEXT FIVE YEARS' JUDICIAL SCIENCE / TECHNOLOGY EDUCATIONAL PREFERENCES

Background information Contributed by Responding Judges

The survey instrument contained three Parts - A, B, and C. Part A requested that judges provide anonymous, basic information related to their judicial positions and adjudication duties. These background items permitted inferences about the influence of job-related variables upon forecasts of future scientific and technical evidence and judicial science education preferences through this decade. The specific background variables comprised a means to characterize the survey's respondents in a statistical manner and included the following requested information:

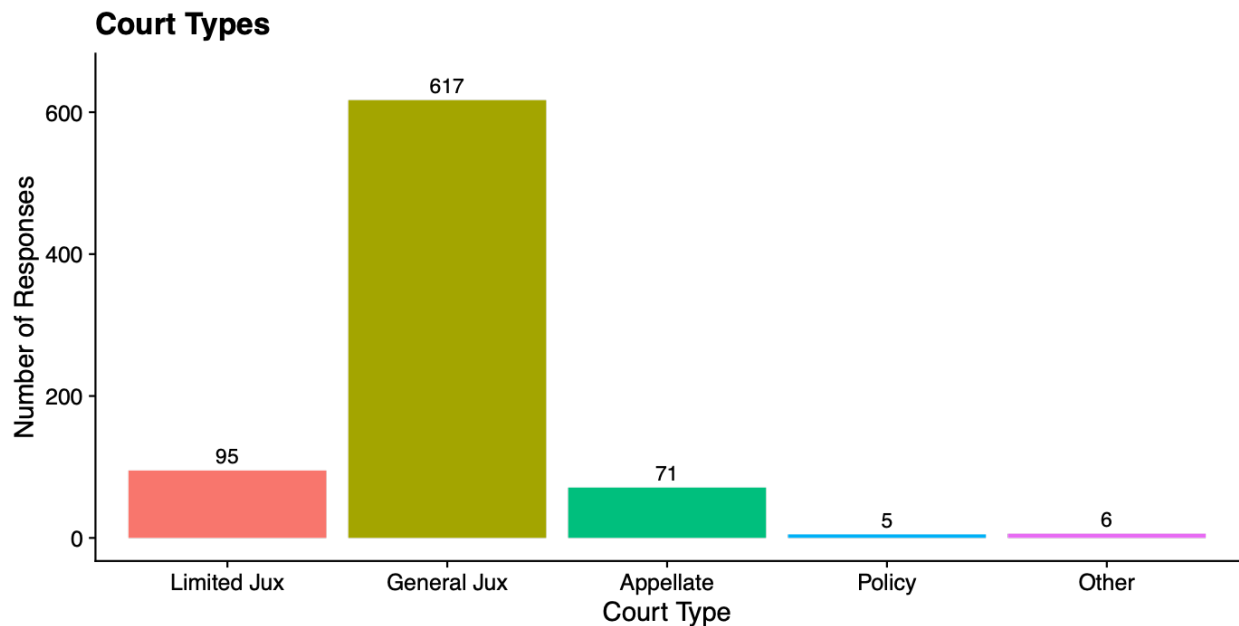
- Type of court in which the judge currently served by adjudication function - limited jurisdiction, general, trial jurisdiction, appellate, or policy courts.
- Length of service on the Bench from short duration - four years or less - to long duration - five years or more, irrespective of court type assignment.
- Primary legal practice immediately prior to initial judicial appointment or election.
- Type of scientific evidence-infused cases adjudicated over the past three years.
- Judicial education participation for the past three years with content noted.
- Priorities for judicial science / technical education over the next five years.
- Preferred settings and time allocated for judicial science / technical education over the next five years

In addition to the structured questions listed above, the survey asked judges — by means of brief, open-ended questions — about their formal scientific education and the subjects of recently-attended scientific evidence courses sponsored or approved by their jurisdictions.

Type of Court in Which Respondent Judge Currently Serves

Figure 6.1, immediately below presents the distribution of survey respondents by their current court type but not their assigned dockets. General jurisdiction trial courts were 79.2% of the total; limited jurisdiction trial courts comprised 11.1%; appellate courts accounted for 8.7%; and policy courts, with only four respondents, accounted for a half of one percent. We have no information about the type of courts four respondents reported as “Other.”

Figure 6.1. Court Type in Which Judges Serve. N=790



The survey did not ask judges to specify the specific subject-matter of their limited jurisdiction courts. As a consequence, we do not know how many shared concurrent jurisdictions with general jurisdiction courts, or whether some had authority to resolve disputes among certain classes of defendants and litigants — such as drug, mental health, traffic courts, family / domestic relations courts, juvenile courts defendants and litigants. Neither do we know which limited jurisdiction courts adjudicated cases solely by judges presiding in cases, while others may permit convening of juries.

64 appellate court judges and justices comprised the survey's final sample, 8.65%. Only four supreme court (courts of appeal in New York and Maryland) judges participated in the survey. No information is available about the courts nominated by four survey participants as "Other."

Judges' Duration of Service on the Bench

Figure 6.2 Length of Judges' Service on the Bench on the Date of Their Survey Responses N=790

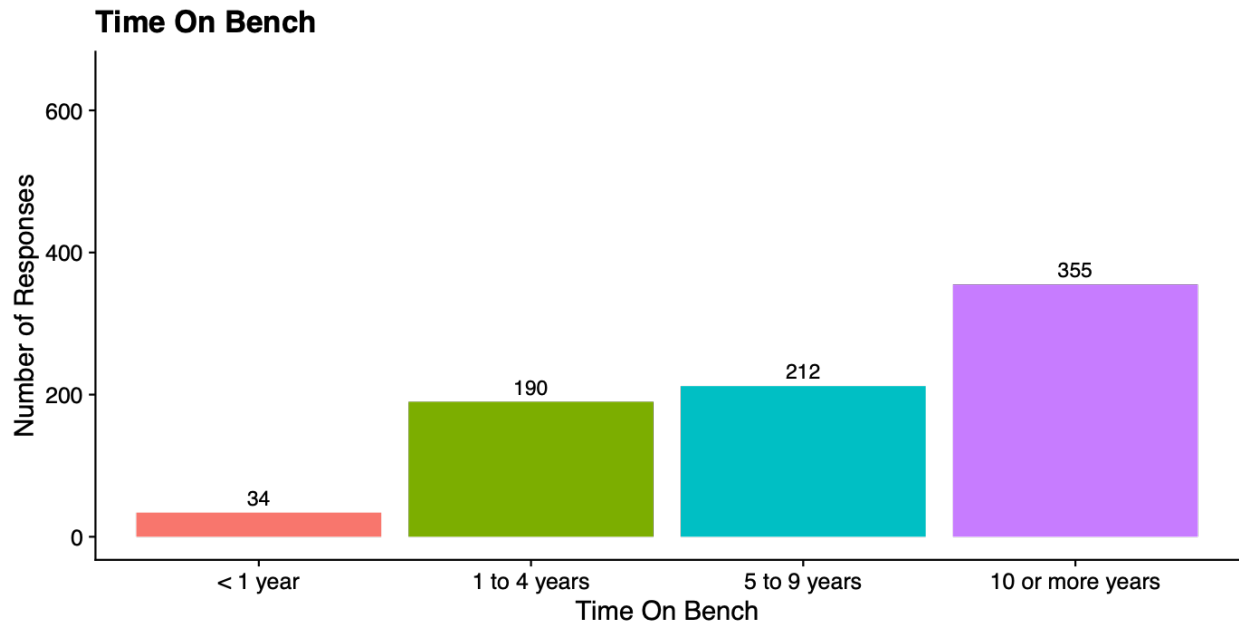


Figure 6.2 indicates judge's service time on the bench. We asked this question in an attempt to determine whether length of service influences scientific case forecasts and judicial science education preferences. From just the census created, however, it is clear that a larger proportion of longer-serving judges elected to take this survey (70.1% more than five years on the Bench) than did shorter-serving judges (29% having served four years or fewer). The 0.9% missing in the totals may be attributable to judges who served four to five years, but found no category to so indicate.

To distinguish between relative newcomers and relative old hands, we combined the four categories set forth in Table 6.2. We dichotomized the sample, combining less than one year's service with one to four years service, 224 respondents, 28.4 % of all responding judges. The second side of the dichotomy combined judges reporting bench service from five to nine years with those indicating a ten years or longer judicial service duration. The dichotomy made it possible to ask whether shorter or longer service as a jurist exerted an influence on case evidence forecasts and preferred subjects and settings for on-the-bench judicial science education.

Seeking to detect the influence of judicial role on forecasts and education choices over the current decade going forward, we also dichotomized trial and appellate judges. In that way we sought statistical insight into the possible ways that a particular judicial role, trial v. appeals, and associated duties might influence outlooks about science and technology.

Spoiler Alert from Dichotomous Analysis

Dichotomies are presented in some detail in this report's sections six, seven and eight. Here's a short cut to the project's conclusions. The survey's analysis —using T-tests to determine the significance of differences in forecasts, preferred educational subjects, and innovations in the ways courts access information underpinning scientific and technical claims — found the following:

- The sole background factor influencing forecasts was length of time on the bench. It accounted for significantly different forecasts, subject preferences and scientific assistance proposals.
- Trial judges and appellate judges differed slightly on these matters when the respondents' choices were added up. Those differences, however, were not statistically significant.

Type of Court Docket

Length of Bench Service Time

Trial v. Appellate Jurists

Spoiler Alert: Only A Single Background Factor Accounted for Differences in Outlook

Additional Background Factors

Legal practice immediately prior to assuming the bench

Scientific Evidence involved cases adjudicated over the past three years

Formal academic studies in science or technology

Recent jurisdiction-based education segments attended

For Court Educators: Judges' Science Training Preferences 2020-2030

Additional Background Factors

Legal practice immediately prior to assuming the bench

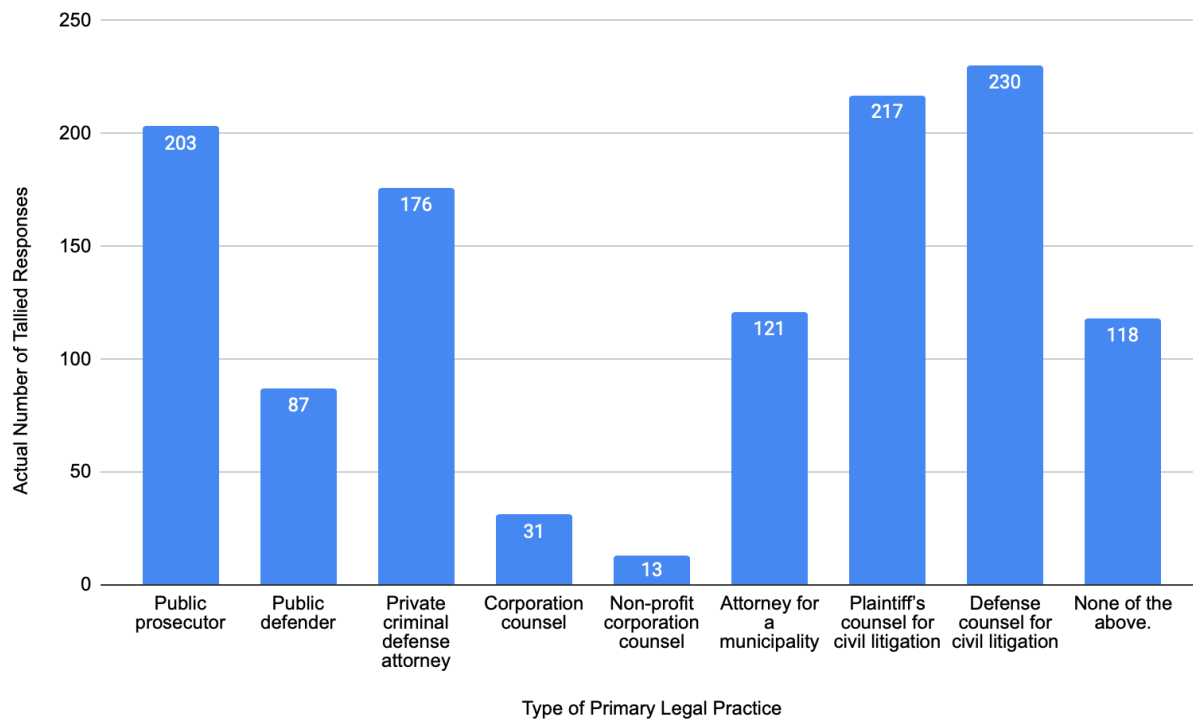
We planned on a dichotomous analysis of types of judges' primary legal practice prior to their judicial appointment or election. However, when we discovered that the two forms of the survey instrument contained different instructions, the obvious decision has been to present Figure 6.3, but not attempt more refined analysis. Repeating the issue initially reported in Section 3, the survey instrument, the MS Word instrument version asked for a single practice selection; the Google Online version prompted multiple choices. As a result the total responses exceeded the sample size. 199 judges responded with a single choice of immediately prior legal practice; 591 judges responded with multiple selections from the available array of choices.

Still it is possible to note that 421 legal practice histories line in the survey respondent's pre-Bench professional histories — a public-regarding legal practice when “public prosecutor”, “municipal

attorney” and public defender are combined. The remaining selections, combined, point to 667 instances of pre-bench private or corporate practice of law.

Interestingly, judges selected “Other” 118 times and offered 142 legal practice descriptions. What we can glean from open-ended comments offered to elaborate this choice is this: 25 among the “Other” category had served as a professional law clerk or ministerial officer of his or her court system. 5 notations entered nominated a public administrative role. 46 noted that they represented clients in the general field of family law. 39 nominations explained a commercial law background. These 115 background descriptions account for approximately 81% of “Other.” Taken together, the listed and “Other” category nominations represent an extraordinarily wide range of legal experience. They appear to enhance confidence in forecasts made for this survey.

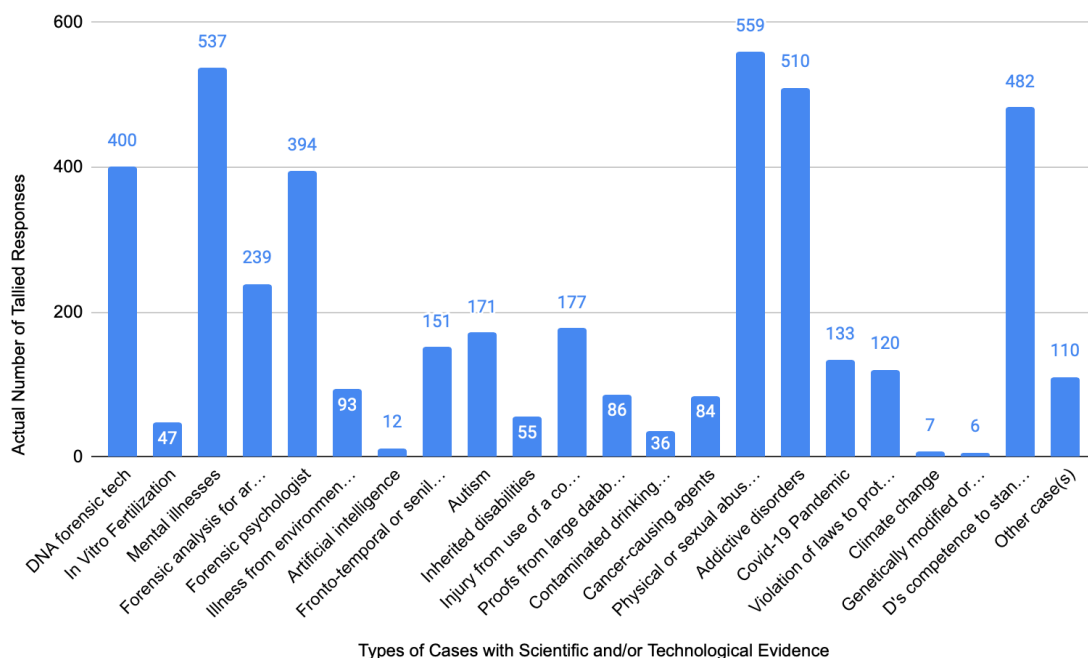
Figure 6.3. Primary Legal Practice Prior to Judges Bench Appointment or Election. N=1196.



Case types adjudicated during the past three years.

Figure 6.4 depicts the number of case types judges had been assigned and had adjudicated during the last three years. Judges were presented with a fixed list followed by an “Other” open-ended reply category. In this case, both the email and the Google online survey instruments invited judges to choose as many of the listed cases as applied to her or him. 81 open-end comments were received in this survey category. Again, we deferred dichotomous analysis, but determined that the richness of adjudicated case data warrants comment.

Figure 6.4. Cases with Scientific and/or Technology Evidence Adjudicated by Judges in the Last Three Years. N=4409 cases nominated by 739 responding Judges.



Case adjudication key: From Left to Right: DNA forensic tech, In vitro fertilization, mental illnesses, Forensic analysis for arson or homicide, Forensic psychologist, Illness from environmental sources, Artificial intelligence, Front-temporal or senile dementia, Autism, Inherited disabilities, Injury from use of commercial product, Proofs from large databases reflecting upon a P's claims made and burdens assumed in a civil action, Contaminated drinking water, Cancer-causing agents, Physical or sexual abuse of children, Addictive disorders, COVID-19 Pandemic, Violation of laws to protect the environment, Climate change, Genetically modified organisms, D's competence to stand trial, Other case(s).

21 case types were reported to have been adjudicated in the past three years. We divided them into two categories. The first category, termed “Higher Imputed Science-Related” is comprised cases where the evidence was established, widely accepted and derived from research for a relatively long period of time. The second category, termed “Lower Imputed Science-Related” is comprised of cases where the evidence could be attributed to expert witness opinion, but much less substantial scientific underpinning derived from research. While it would be possible to statistically relate each category to evidence forecasts and judicial science education preferences, we deferred that procedure pending a secondary data analysis.

The total number of cases reported is 4,409. The “Higher Imputed Science-related” subcategory comprised 60% of the total. The “Lower Imputed Science-related” subcategory comprised 40% of the total. Here’s the array with reported case numbers noted.

Figure 6.5 presents cases adjudicated over the past three years including Michigan.



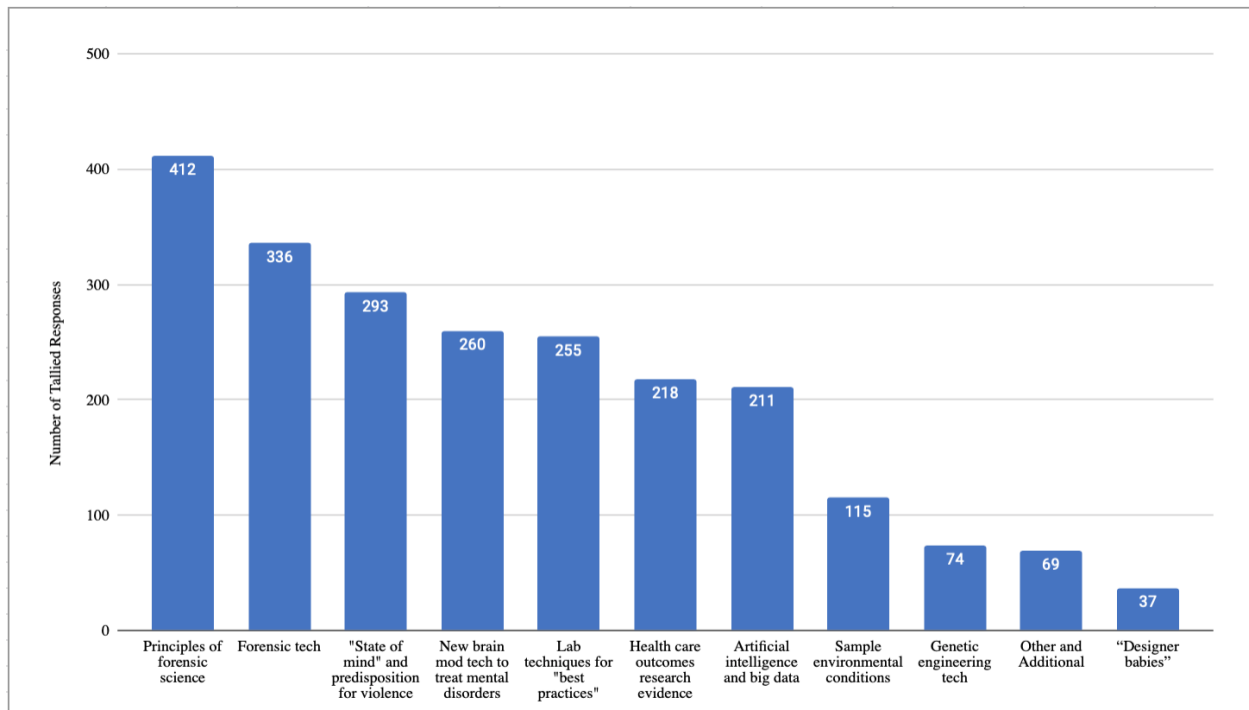
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Judicial Science / Technology Education Preferences for the Next Five Years

Figure 6.5 presents and compares the number of judges that selected each case type option in descending order from highest volume of selections to the lowest. A total of 738 judges made 2280 selections.

The most frequently expressed preference, 412 nominations, was principles of forensic science. The second most popular priority was forensic technology with 336 selections. We speculate these frequencies were related to a substantial proportion of judges who preside over criminal case dockets. This pattern will be seen to be repeated in evidence forecasts for the decade, Section 7, to follow.

Figure 6.5. Judges Priorities for Seminars, Workshops or Conferences Presenting the Current State of



Science, Technology or Engineering During the Next Five Years (e.g., to mid-decade 2025). N=2280, Michigan Omitted.

Figure 6.6 presents judges seminar priorities for next five years, N = 790
With comparison on trial and appellate court judges

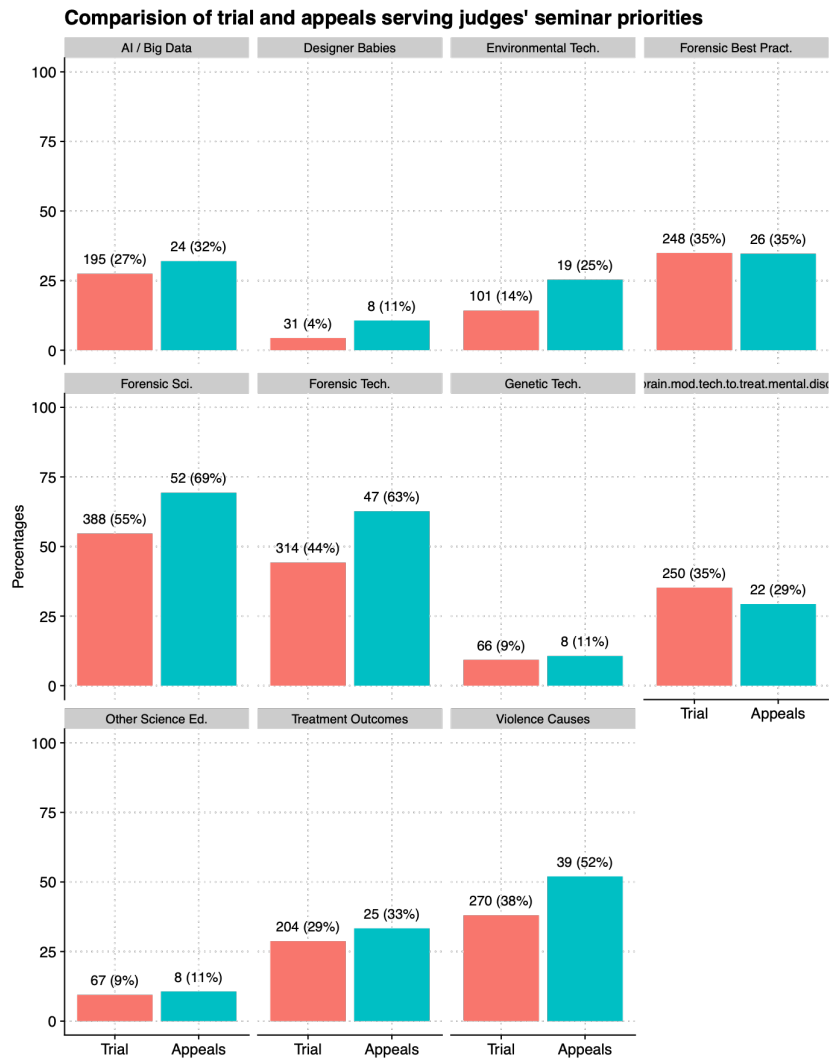
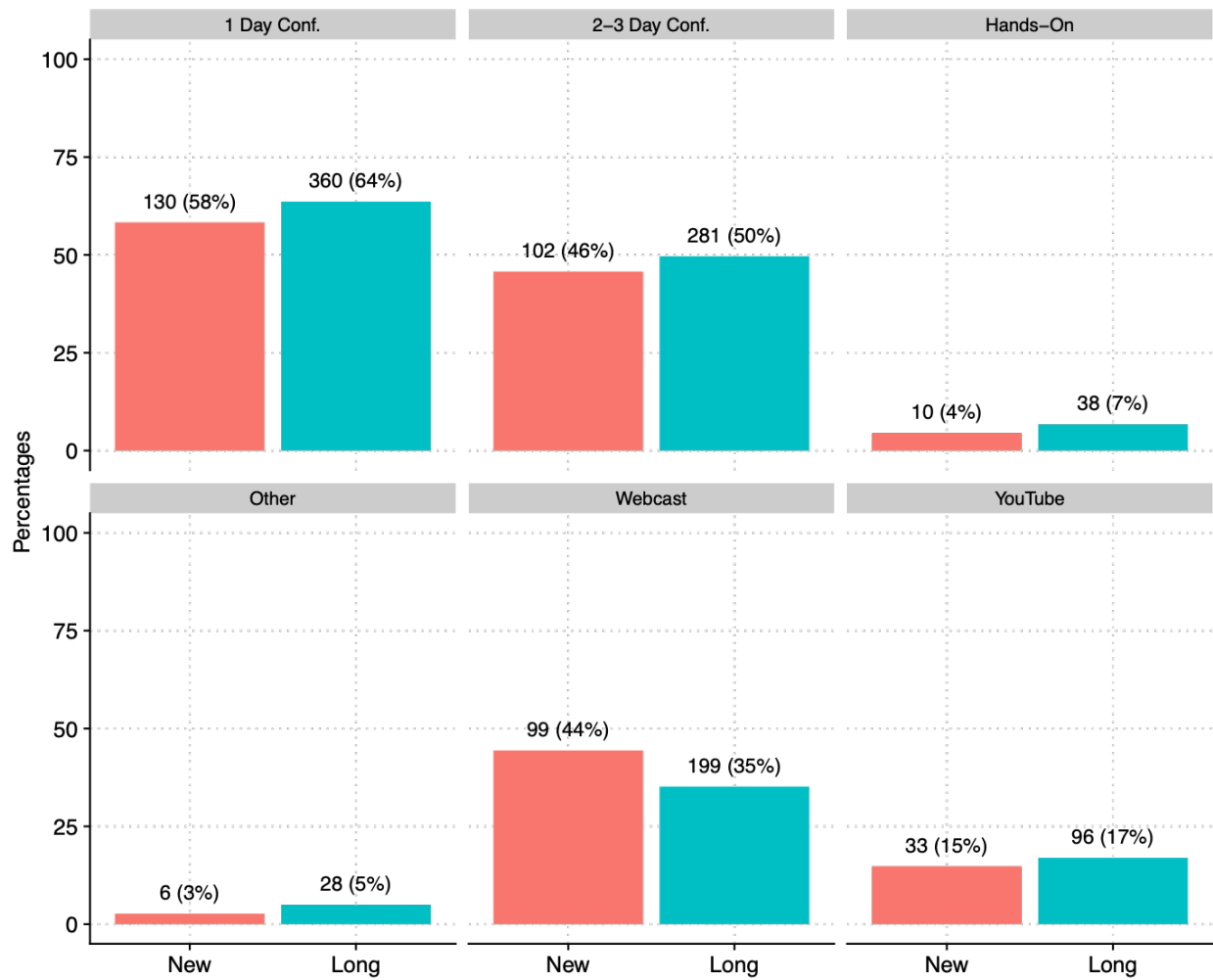


Figure 6.7 Presents another way to view judges science education preferences and contrasts trial judges with appellate court judges seminar priorities. The differences between the two judicial categories, while illuminating, was not found to be statistically significant.

Comparison of new and long serving judges' preferred method of education



Section 7. JUDGES' FORECASTS FOR NOVEL CASE EVIDENCE 2020-2030

Forecasts of Novel Evidence to be Filed in This Decade in Each Judge's Court

What kinds of novel scientific and technical evidence did judges forecast for filing in their court over the ensuing decade, 2020 to 2030? The survey team selected eight types of evidence and asked judges to rate the likelihood of such filings on a ten point, fixed interval rating scale where "10" was the highest score indicating very high filing probability, and "0" was the lowest score, indicating no or very little filing probability.

Table 7.1. National Judicial Forecasts for Cases with Evidence Likely to be Filed in Their Courts in the Decade from 2020 to 2030. Number of Surveys Submitted = 790. Not all judges answered all questions, average number of judges per evidence category was 781.

Evidentiary Case Type	Average Rating Score 0 = low/10 = high probability of Case Filed this Decade	Median. / Lowest 3 Scores / highest 3 Scores From Bar Plots	Interpretation of Judges' Forecasts
Molecular/Comparative Forensics	5.59	Med 6. 0-2 = 200 8-10 = 281	Moderately high likelihood of case filing trending higher
Covid-19 Test Evidence	5.36	Med 5. 0-2 = 190 8-10 = 222	Moderately high likelihood of case filing trending higher
Developmental Neuro-Biology Evidence	5.23	Med 5. 0-2 = 193 8-10 = 204	Moderate likelihood of case filing trending higher
Health Outcomes Research Evidence	5.22	Med 5. 0-2 = 204 8-10 = 218	Moderate likelihood of case filing trending higher
Environmental Research Evidence	4.54	Med 5. 0-2 = 279 8-10 = 169	Moderate likelihood of case filing trending lower
Data Science / Artificial Intelligence Evidence	4.48	Med 4. 0-2 = 270 8-10 = 161	Moderate likelihood of case filing trending lower
Genetic Engineering Evidence	3.66	Med 3. 0-2 = 387 8-10 = 110	Low likelihood of case filing trending lower
Climate Science Evidence	3.48	Med 2. 0-2 = 392 8-10 = 84	Low likelihood of case filing trending lower

The survey — as noted in the Table's second column — rank ordered scores as average probabilities from the highest statistical means to the lowest. Molecular and Comparative Forensics evidence was forecast to most likely be introduced in cases to be filed this decade. Climate science evidence was forecast to least likely to be introduced in cases to be filed in this decade.

Judges' strong forecasts of molecular and comparative forensics is not surprising, given the past decade's criticism from official, professional, and casual organizations that forensic evidence has often lacked an underlying scientific methodology; and that wrongful convictions followed.

Take an arson case at trial as an example. The testimony from a fire department chief that such-and-such incendiary material resulted in the damaging fire. The chief testifies from experience, an intuitive conclusion. That testimony lacks an underlying scientific methodology. However, if the chief testifies that a capture of vapors emanating from materials ravaged by the fire was tested by gas chromatography and mass spectroscopy to be highly flammable benzene, the testimony contains an underlying scientific methodology. And it can be reproduced experimentally for proof to a gatekeeping judge and a skeptical jury. Judges reported, in effect, that such evidence could be expected this decade. And they accompanied their forecast with with a strong preference for molecular and comparative forensics education, report, section 6.

This survey was undertaken as the global Covid-19 pandemic expanded in late spring and summer of 2020. We asked only one question about Covid-19 evidence to be filed in cases this decade, and judges responded robustly. They accorded the second highest score to forecasting that cases with Covid-19 test related evidence would be filed in this decade. We do not know how judges interpreted “test-related evidence.” We did offer a definition to help with each respondent’s rating.* We do expect that a full survey exploring tests, treatments and vaccines would produce a much more complete, more nuanced understanding. Thus we propose a followup survey as soon as possible.

To compare the most highly forecast case evidence types of the nine included in the rating scales, we adopted a standard statistical presentation termed “Box Plot.” Readers accustomed to reading tables may find a box plot formidable. We have included an explanation

to aid interpretation immediately following the exhibit, below. However, to assist, we follow

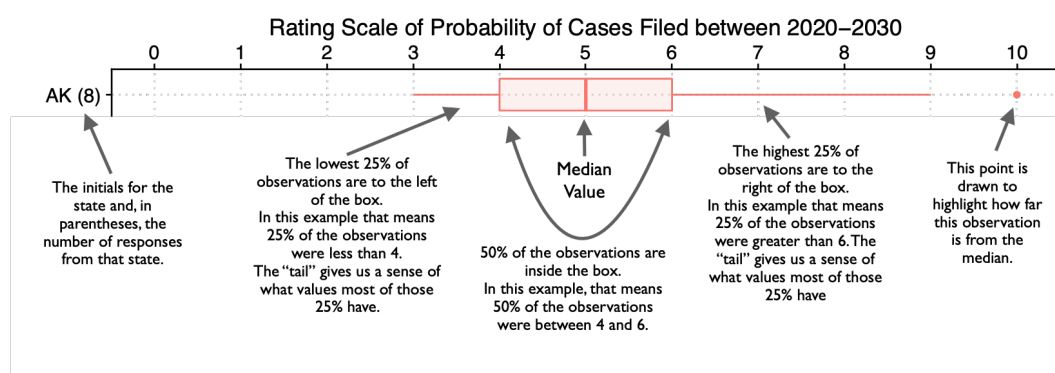
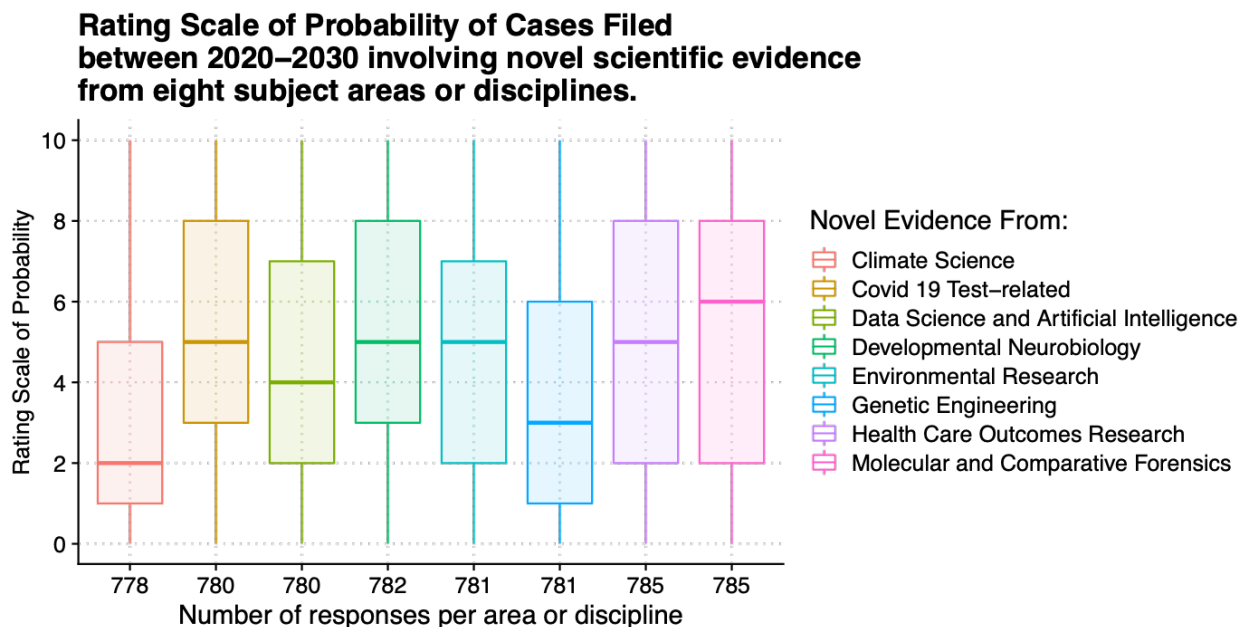


Figure 7.1 immediately above with a tutorial explaining how one reads the box-plot data. Doing so permits the reader to see additional dimensions of the opinions about the probability that evidence in the eight domains ranked in a ten point fixed interval scale by participating judges

Figure 7.2. Box-plot of National Survey Participants Forecasts for Cases Probably Filed



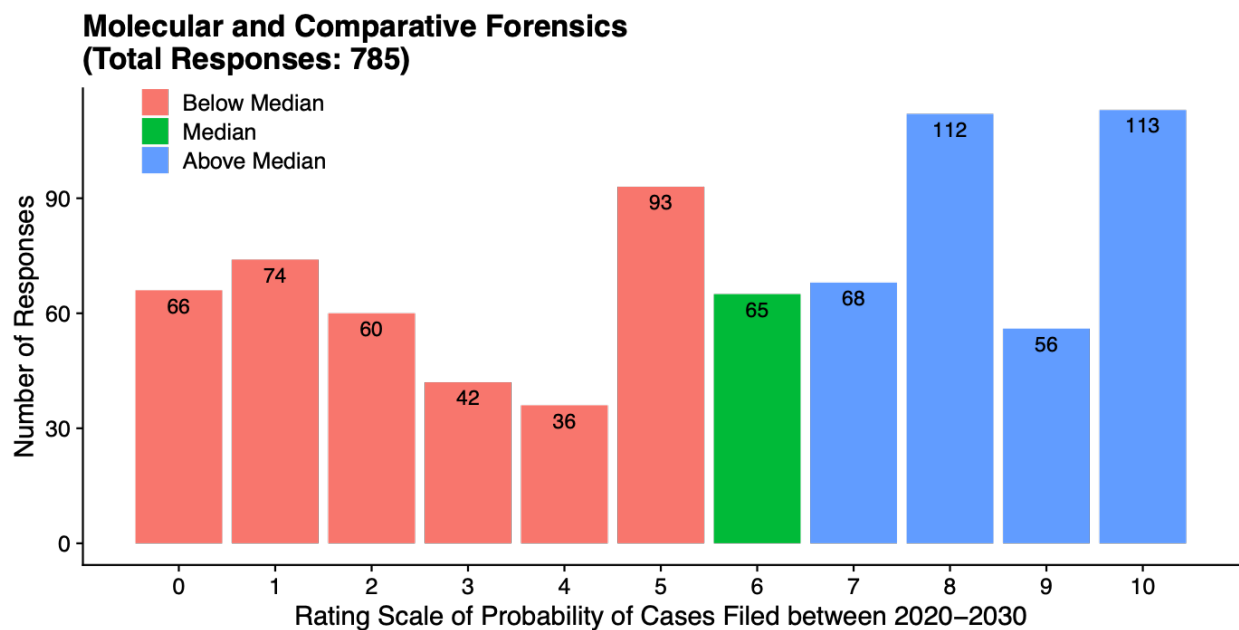
in Their Courts during the Decade 2020-2030

One can readily see from Figure 7.2 the same relative hierarchy of forecast case evidence as in Table 7.1. But there is an additional ingredient: By viewing where the medians are, the thick bands in the middle of the box, we get a clearer idea of the forecast's relative strength. Even more helpful, we can view the lines (and scores) comprising the top one-quarter of the forecasts and the bottom one quarter of the forecasts for a good assessment of how the data is trending. That is, does the data trend higher or lower. And we can record that information in Table 7.1's interpretation column. Let's apply these observations to an evidence domain.

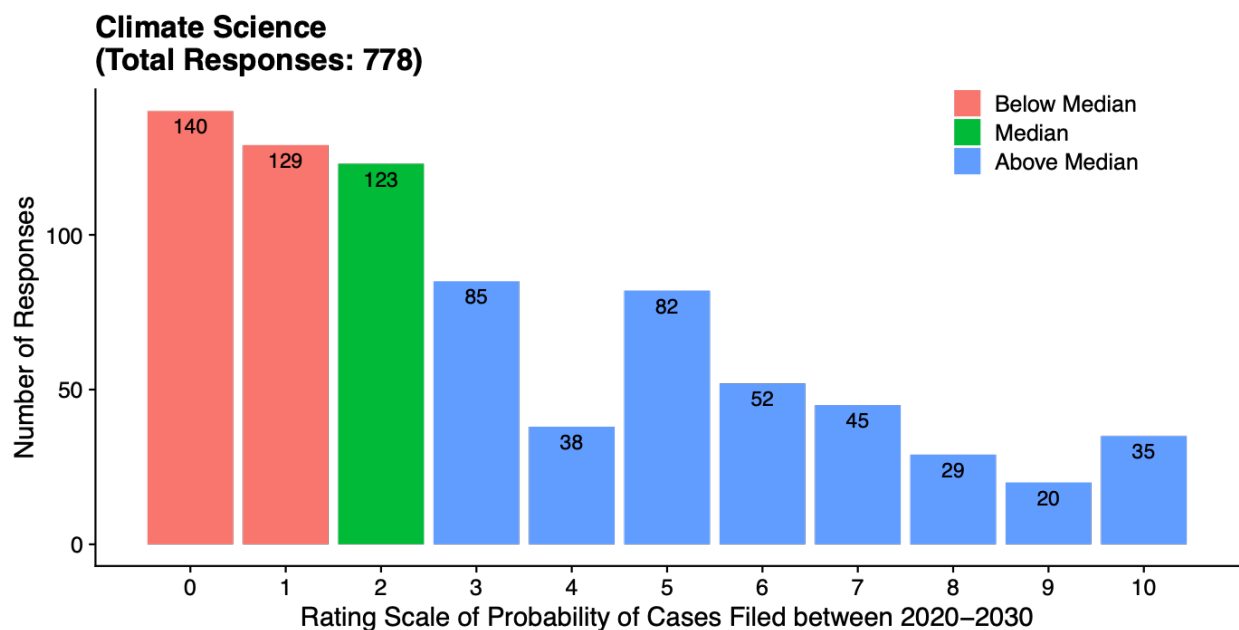
Separating Out Evidence Domains' Bar Charts for Closer Examination

It is obvious that the box-plot permits refinements to interpretation, but it is still group data. Figure 7.2 breaks the group data down into the evidence domain rated most highly probable of inclusion as a key feature of cases forecast to be filed this decade. And we can compare forensics forecast against that for the evidence rated least high probable of inclusion in cases this decade, research from climate science.

Figure 7.3. Bar Chart of Rankings for Molecular and Comparative Forensics Case Filing Probabilities, 2020-2030.



What stands out is the median score for each evidence domain - forensics at a rating of six, climate science at a rating of 2. We don't need additional statistical tests to conclude there is a big difference between the two. That difference is reinforced by the large numbers of higher ratings beyond the median for forensics and below the median for climate science.



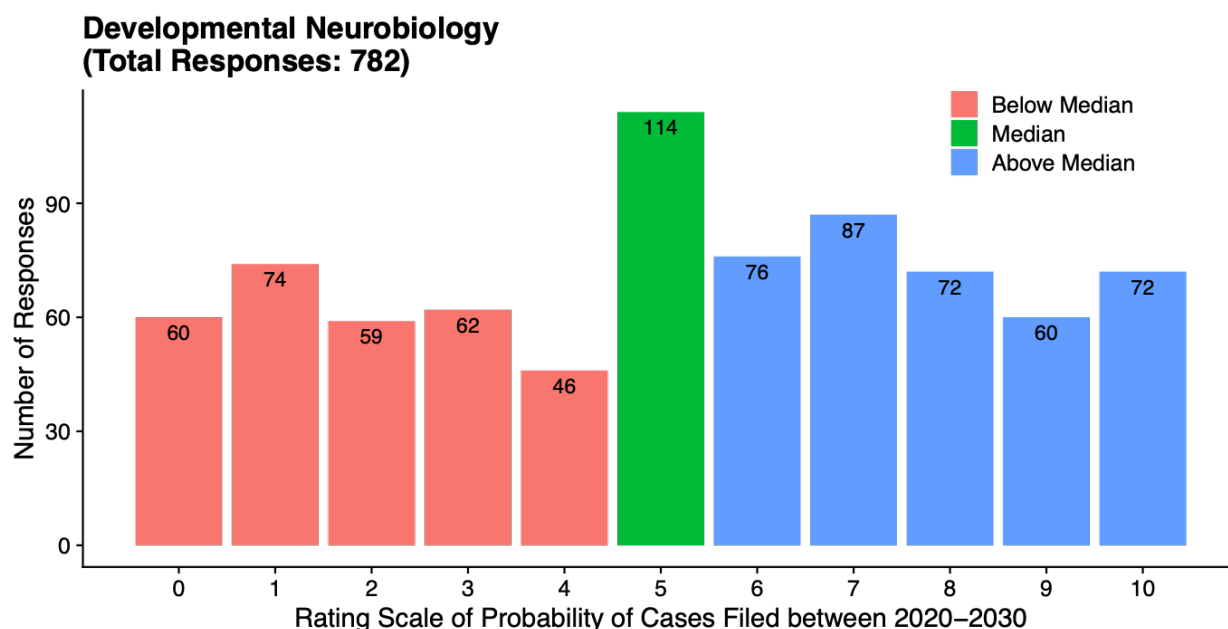
While we earlier described some of the factors that may be compelling the forensics evidence forecast, we are less informed about climate science. Perhaps judges believe climate-related litigation to be solely or largely in the province of the federal courts. Perhaps some judges expect cases to be class actions that may be difficult to qualify for state court filings, and much more likely cross state lines, thus candidates for federal multi-district litigation panel resolution. Only a followup inquiry can provide more reliable insight.

Why Is Developmental Neurobiology Rated as Relatively High Probability?

We were puzzled about judges' relatively high forecast for developmental neurobiology evidence. Third in the forecast hierarchy, its data can be seen in Table 7.1, above, and Figure 7.3, below. We added a definition of the term in a footnote to the rating scale so as to make this forecast more accessible to replying judges.* The result is that judges generally view this evidence area likely to be filed in their court

*Developmental neurobiology may be described as fuller understanding of behavior by means of analysis of brain function from pre-natal development through childhood and adult years via brain scans, chemical analyses of brain fluids, cells and tissues, and demonstrated understanding of the brain's complex circuitry."

Figure 7.3: Bar Chart for the Developmental Neurobiology Evidence Domain



We can also gain some insight from the 27 observations and comments judges offered in relation to developmental neurobiology. Listed, below, they link substantially to better understanding of addictive disorders, mental illnesses, impact of child abuse, and cases involving juveniles.

(2) Especially relating to interplay with substance use and abuse as well as medications and medically assisted treatment

2

This information can be helpful or prejudicial in the justice system

This science figures prominently in abused and neglected children cases.

Perhaps, in the sexually violent predator cases that I have.

Our court is located in a major technology/engineering region of our state.
If a case like this was to arise in our state, there is a strong likelihood that it
would come to our court.

This has already occurred in two of my cases involving juveniles
charged with violent crimes

(3) The current trend in our jurisdiction is training on becoming a trauma informed courthouse
which includes the impact of trauma on early childhood development

This may apply more commonly here with juvenile criminal cases

May hear within the mental health context currently

Could see this in mitigation evidence in criminal case and expect to in next ten years

We are rural and the lawyers will look for large verdict areas

Probably will see more of this in criminal cases we see on appeal

I can see criminal defense lawyers trying to use this as a defense but as of
this point I don't know that the research is generally accepted in the relevant scientific community

I could see this being raised by defense counsel in criminal sentencing proceedings

(2) The paradoxical interplay of nurture with nature (metaphorically approaching the q-bit dance of quantum physics)
will make this a final frontier of truth-seeking.

Defects in brain function might bear some relation to mitigation in sentencing
(i.e., if a defendant has a mental disorder it may bear on his/her ability to form intent
or to adapt to retraining and medications to prevent subsequent bad behavior.
Low serotonin levels may cause a lack of impulse control and violent behavior, etc.)

Possible through business disputes involving companies engaged in these matters

These comments and the relatively high expectations for neurobiology evidence provide a hypothesis for future research: the judiciary is struggling to look beyond the rim for evidence likely to roil or resolve on-coming cases. At the same time, it is not clear that even future-oriented jurists are ready for the neuro-technologies comprised of fMRI-guided brain implants that receive and send signals or the magnetic pulse therapies now being marketed—without scientific or medical approvals—as life changing.

Covid-19 Test-related and Health Care Outcomes Research Evidence This Decade

We highlight above the finding in Table 7.1 that developmental neurobiology evidence was rated within a group of the top four evidence domains. That group — in order of ranked case introduction probability — included Molecular and Comparative Forensics, Evidence, Covid-19 Test-related Evidence, trailed by Developmental Neurobiology Evidence, and Health Care Outcomes Research Evidence in a virtue tie. We present in Figures 7.4, and 7.5, below the bar charts for twins occupying the lower two positions of the group of four evidence domains

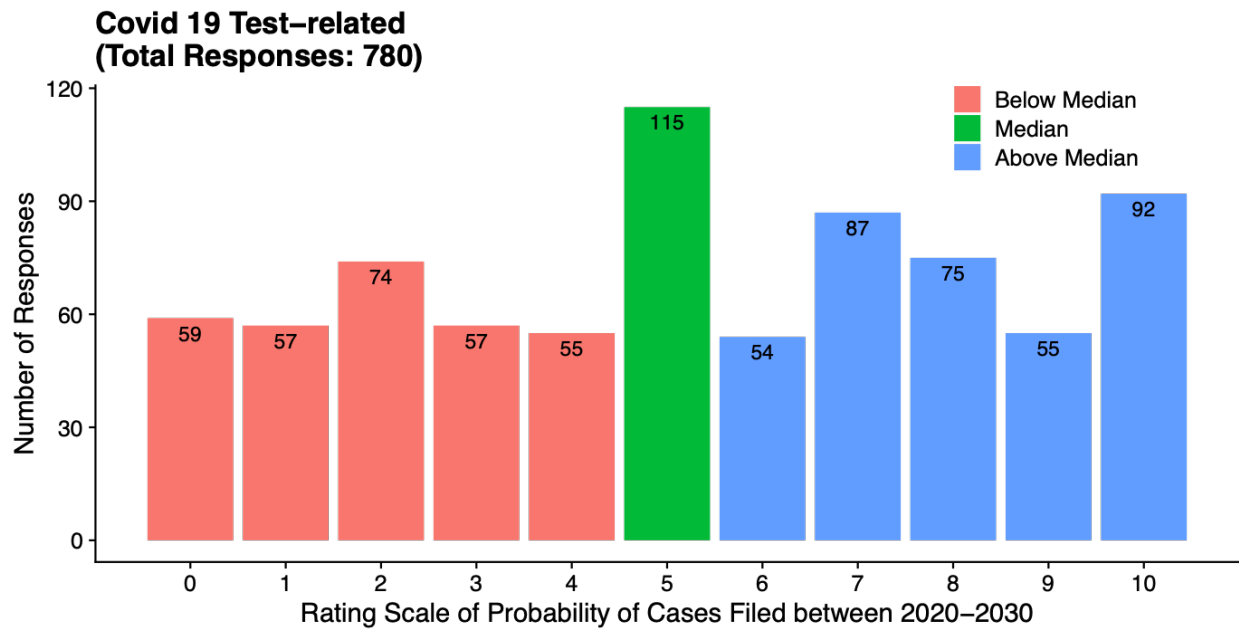


Figure 7.4 Bar Chart for Covid-19 Test-related Evidence

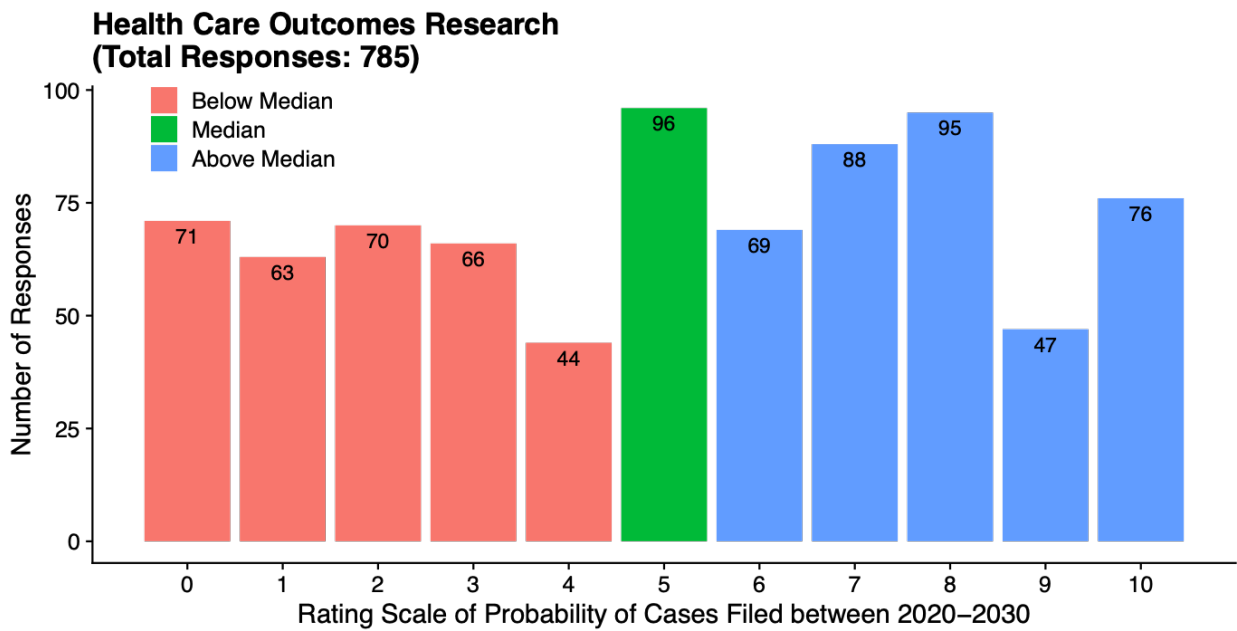


Figure 7.5 Bar Chart for Health Care Outcomes Research Evidence

Casual observation comparing Figures 7.4 and 7.5 will indicate what the T-test data also shows: there is no significant difference in the rating score structure of the two evidence domains.

NCSI's HCore concentration is active, having certified 9 judges mid-2020, but planned and initiated a year earlier, before the Covid-19 pandemic's onset. We have a hunch that the responding judges linked these two evidence domains, following the definitions embedded in the rate scale portion of the survey instrument. They were sequentially posed in the instrument. It is possible that a halo effect occurred.

On the other hand, it also seems reasonable that HCore's ratings closely follow those case for Covid-19 Test-related Research as a matter of unrelated public discourse. The professional and popular media have for months prior to and during the survey been filled with infection, recovery and death statistics, and a huge number of public interest stories about Covid-19's incidence, prevalence, and impact on families, economies and organizations. We now regard Covid-19 related findings to be closely related to health care outcomes research - particularly the rapid mobilization of tests, vaccines, and treatments. The courts have been organizationally impacted in profound ways. We conclude with a judgment that judicial science education could reasonably combine Covid-19 evidence with HCore techniques and procedures in a fashion that could result in practical and enduring benefits for case adjudication.

We underscore here an observation clearly seen in Table 7.1. The four highest filing probability forecasts - forensics, Covid-19, Developmental Neurobiology, and Health Care Outcomes Research evidence - differ minimally — all are above a five rating point mean and are separated only by hundredths of a point. No statistical difference occurs among them.

No statistical difference occurs by the top group of four and the next lower group of two — environmental research evidence and data science and artificial intelligence evidence. But, as indicated by the direction of scores in Table 7.1 column 3 — they are far stronger than the lowest group of two evidence categories.

It is not possible from this survey's data to separate judges *future* case filing probability estimates from their past three years' case management experiences. A glaring fact of this study, however, is that respondents forecast low probabilities for genetic engineering and climate research cases is paralleled by the meager number of cases — 8 and 7, respectively — reported in Figure 6.3 as having been adjudicated in the past three years.*

In science, however, the past may not be prologue to the future. And genetic engineering and big data flanked by artificial intelligence in cases labeled as something else may not be recognized. Let's expand this exploration by illustrating the evolving roles of both as critical evidentiary components of Covid-19 related evidence, a strongly forecast category for this decade.

Covid-19's causation became possible earlier this year when the virus's genome had been discovered, published, massively reviewed, and scientifically accepted, sometimes with minor reservations. With that discovery's utilization in vaccine development, treatment inventions, and transmissibility characteristics, it has been possible to derive technologies from the underlying genomic science at an unprecedentedly rapid rate. There is much still to be learned about the virus. But there is no doubt by serious and informed observers that genomics underlies management of the Covid-19 pandemic. And that engineering the virus's genome - removal and replacement of its central RNA core - is an essential approach to immunity and disease treatment.

A similar observation can be made with respect to data science and artificial intelligence evidence. Large population studies are needed to determine infection rates, role of underlying patients' conditions, and perhaps patients' susceptible and resistant genomes. If a minor human genome variation is determined to confer resistance, for example, artificial intelligence algorithms will be needed to sort out populations in need of concerted testing and contact tracing. And different algorithms will be needed to provide medical personnel and institutions with differential treatment pathways.

We believe that the impulse to speculate possibly detected with developmental neurobiology evidence and its huge mental health and addiction disorders caseloads implications can be adopted across the novel evidence spectrum adopted for this study. The costs for educating judges in data and genomics will be modest. And would result in much more highly confident case management applied to the anticipated surge in forensics and Covid-19 related cases.

*As for case evidence types drawing lower filing probability national forecasts —genetic engineering, and research climate science see Table 7.1—we have little help from judges' open-ended comments to explain those expectations. Out of a comment list from over 30 judges relating to each evidence category, half opted out as assigned to criminal court dockets and the others posed their comments around lawsuits to be brought against business entities conducting commercial research with respect to both case types.

Does a Jurisdiction's Evidence Law or Trial / Appellate Assignments Influence Judges' 2020-2030 Forecasts?

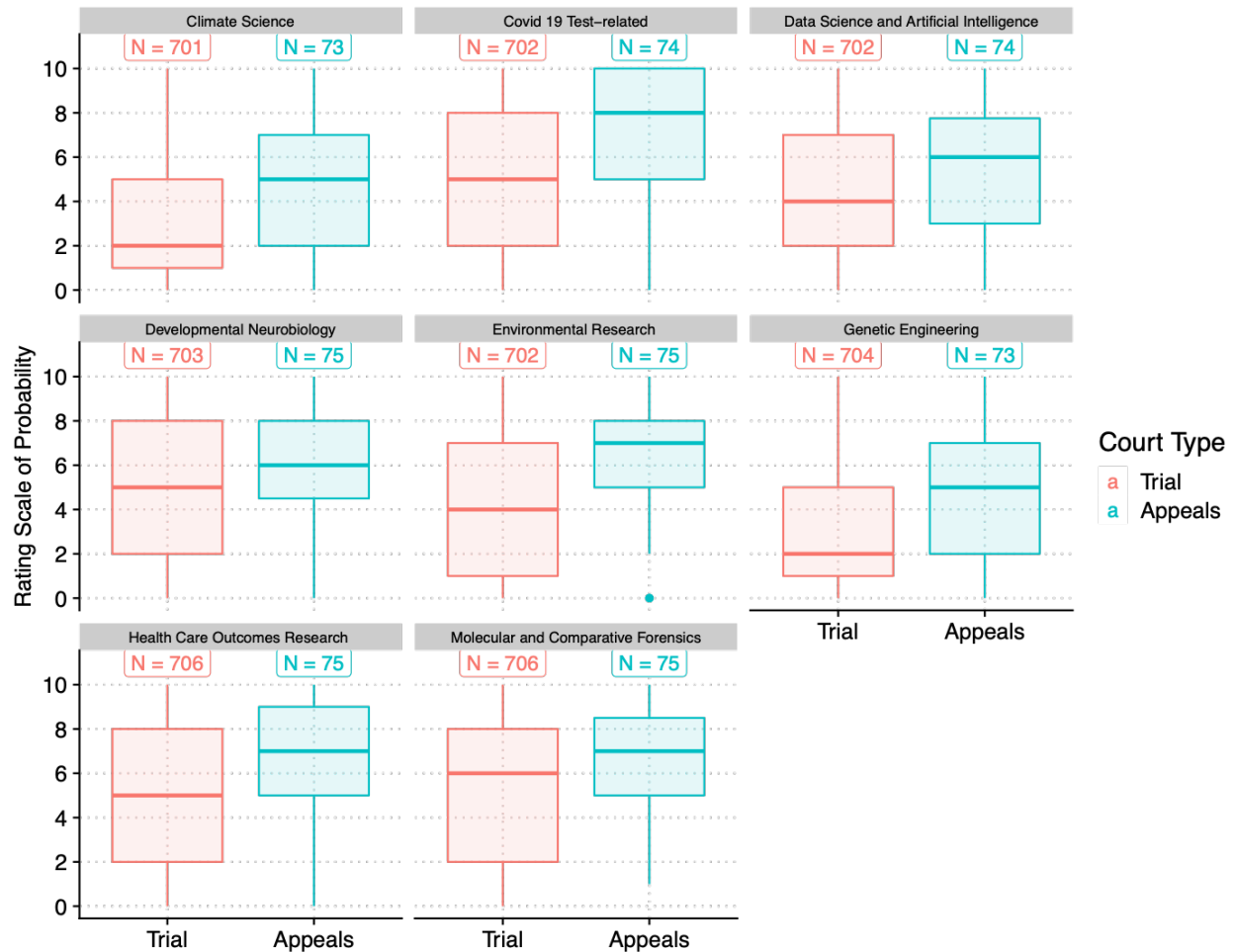
From extensive comparisons, we can confirm that Frye or Daubert evidence law doctrines did not in this survey exert an influence on the case-related evidence issues that judges rate as high or low probability for this decade. Figure 7.7 presents the data.



While there is some variation in median values and the interquartile ranges - that is the middle 50% of responses contained in the boxes, above - no statistically significant differences was found to exist when Daubert and Frye jurisdictions were compared.

What about comparisons of trial and appellate judges' forecasts?

Comparison of trial and appeals serving judges' probability expectations of novel evidence for cases filed between 2020–2030

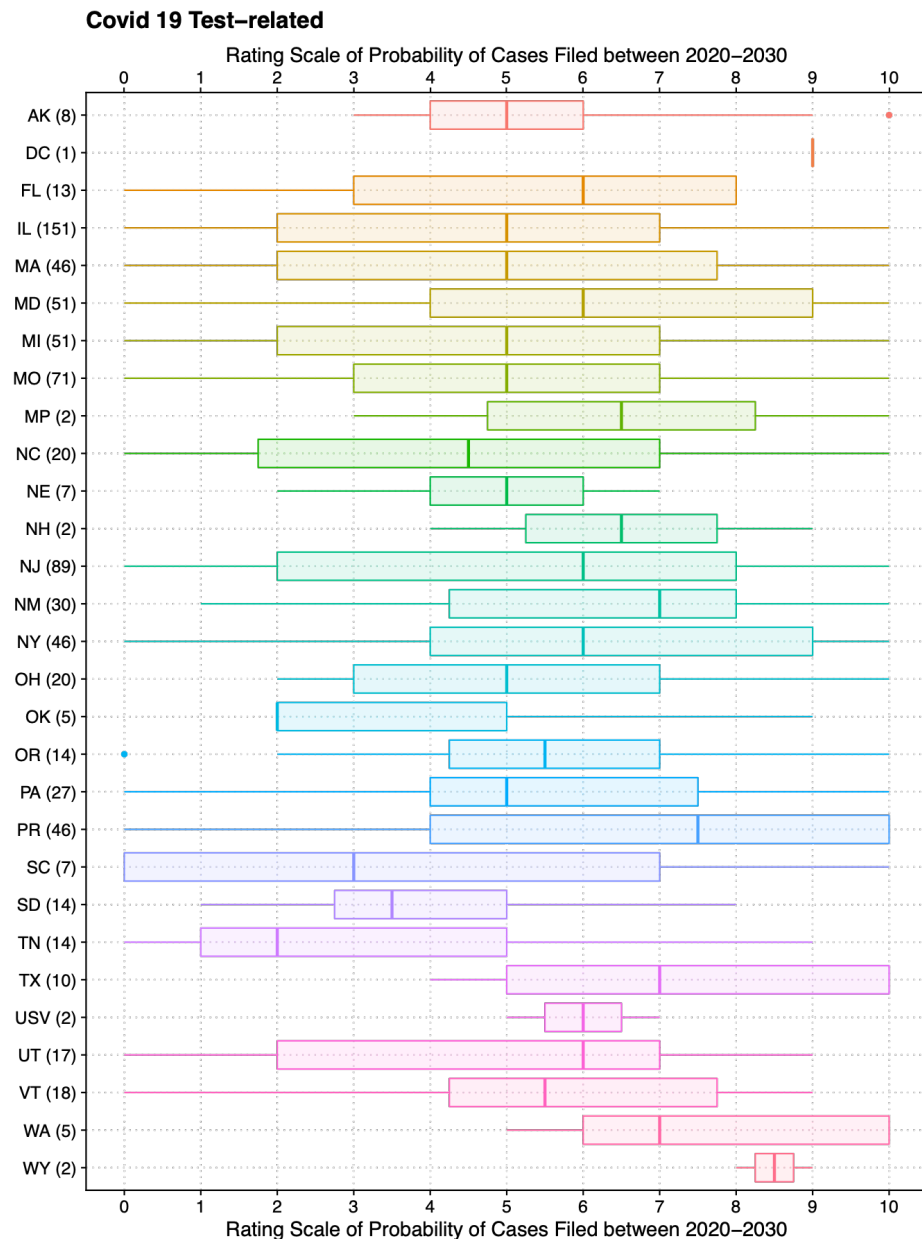


Trial and Appellate Assignments, Figure 7.8, immediately below, dichotomizes these assignments evidence and compares them with a box-plot. These results are not statistically significant. Still there is a qualitative difference of opinion of trial judges' and appellate justices' ratings for each novel evidence category posed in this study. Whether jurisdictions will find these differences a cause for varying continuing judicial education events is a question that only their education services divisions can answer.

Perhaps additional State / Territorial level data can help. How do jurisdictions compare with respect to relatively high and relatively low forecasts for cases predicated upon novel evidence? We add only three evidence categories in the following comparisons.

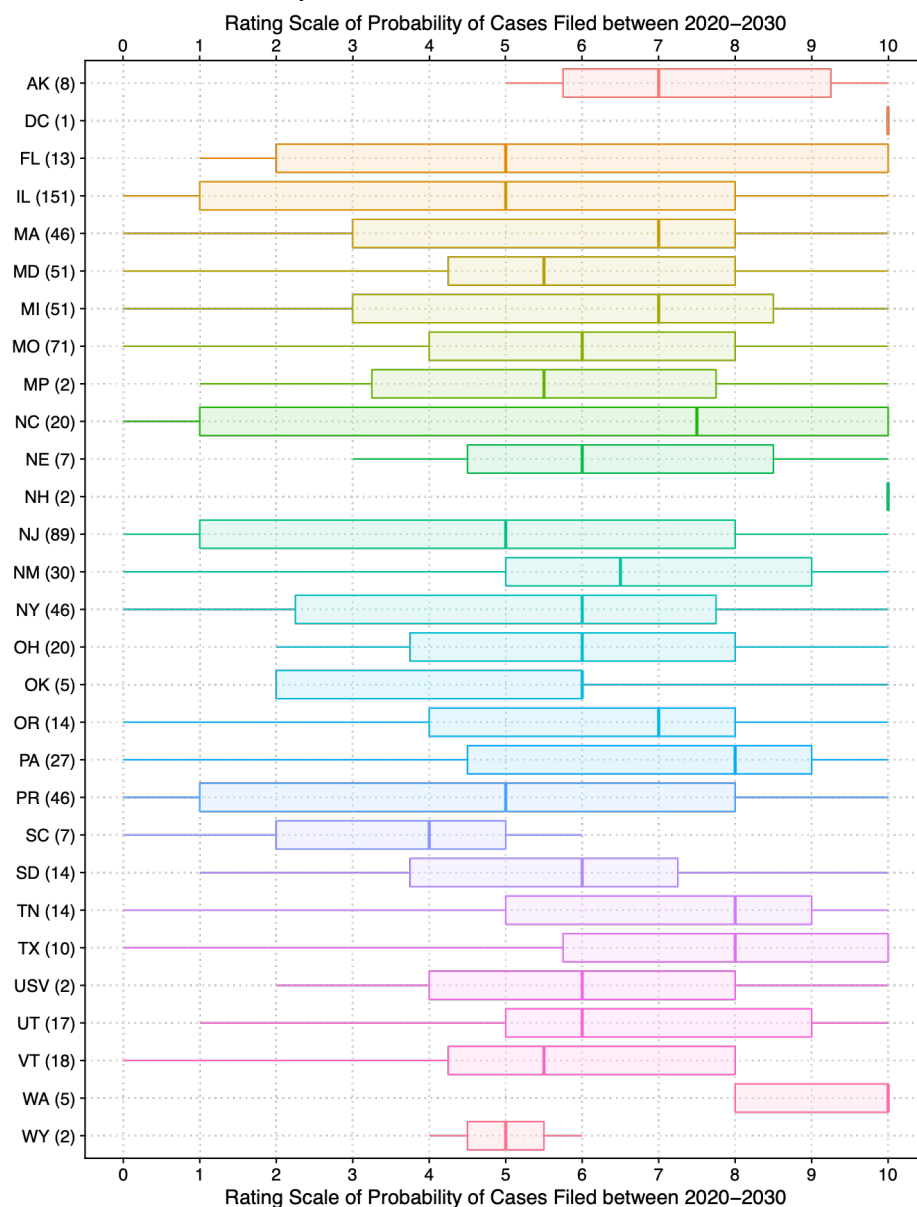
Jurisdictions' Comparative Forecasts for Three Novel Evidence Domains

Covid-19 Test Related Evidence. Garnering relatively robust forecasts from all judges, a wide variety of forecasts are evident in the Box-plots comparing jurisdictions in Figure 7.9, immediately below.



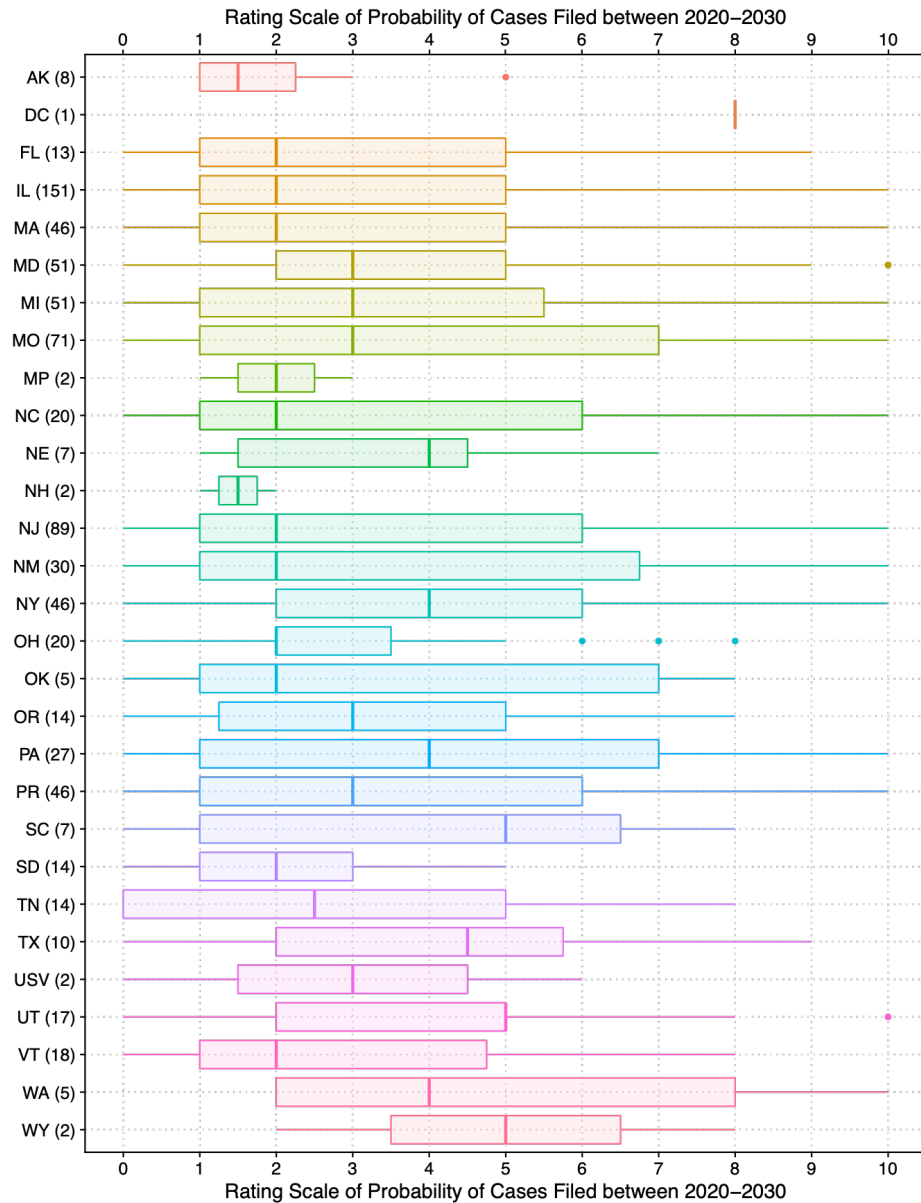
Molecular and Comparative Forensics Evidence. The survey's judicial sample rated likely filing in cases with this evidentiary domain the highest. Nevertheless, jurisdictional variations can be viewed in Figure 7.10, immediately below.

Molecular and Comparative Forensics



Genetic Engineering Evidence. Rated second least likely to be filed in court this decade, the genetic engineering evidence domain, Figure 7.11, provides another look at jurisdiction comparisons.

Genetic Engineering



U. S. Regions' Comparative Forecasts for Novel Evidence Domains

We wondered whether grouping jurisdictions in U.S. regions could provide additional insights into how evidentiary forecasts feature similarities and differences. Perhaps additional data can help. Figures 7.12 - 7.16 present box plots of judges ratings by regional jurisdiction clusters.

We grouped state and territorial court jurisdictions into regions. The regional distribution was comprised as follows: Northeast-Mid Atlantic Region (228 survey responding judges); Southern Region (169 survey responding judges); Mid West Region (314 survey responding judges); and Mountain West / West Region (78 survey responding judges). We can compare regions on all variables included in the survey. However, we regard the most important dimension as the way that regional clusters show similarities and differences with respect to novel evidence forecasts for cases rated for probability of filing in their courts. For this report, then, we will concentrate on those comparisons, taking each one of the eight evidence domains separately. While the regions' statistics are not significantly different from the national forecasts, and comparative jurisdictional forecasts, they demonstrate variations that may be of interest.

Figure 7.12. Regions Compared with Respect to Probability Ratings with Respect to Molecular and Comparative Forensics

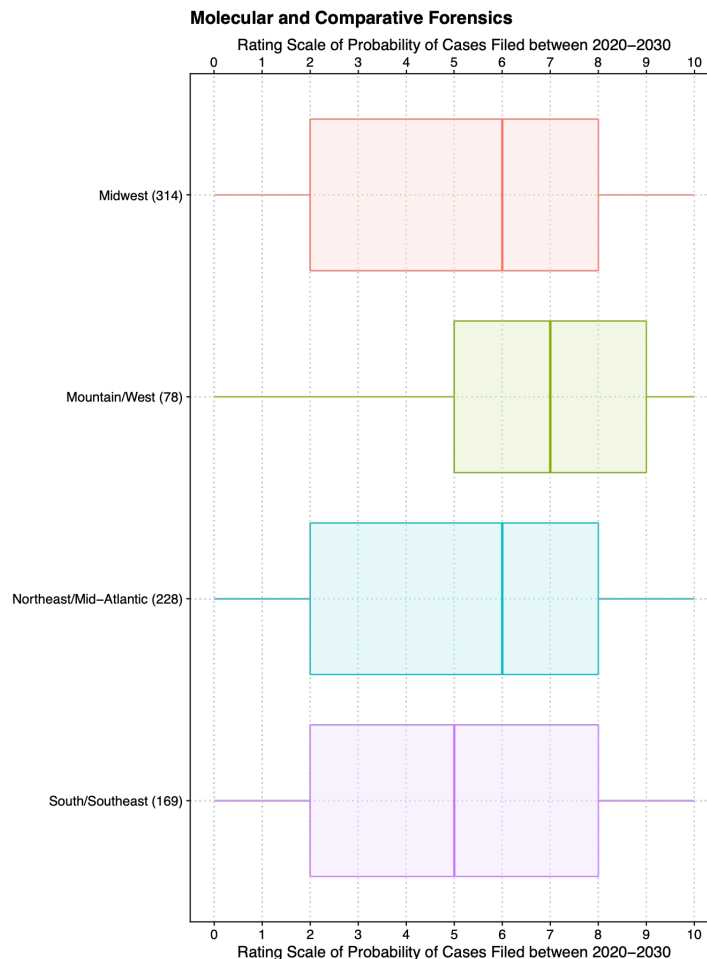
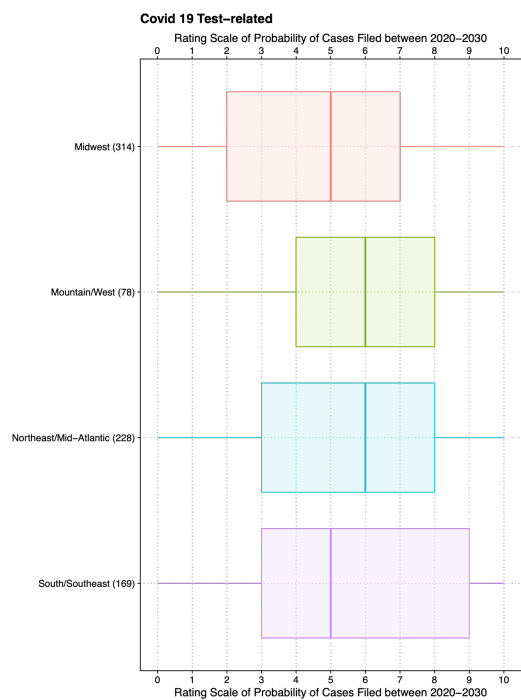
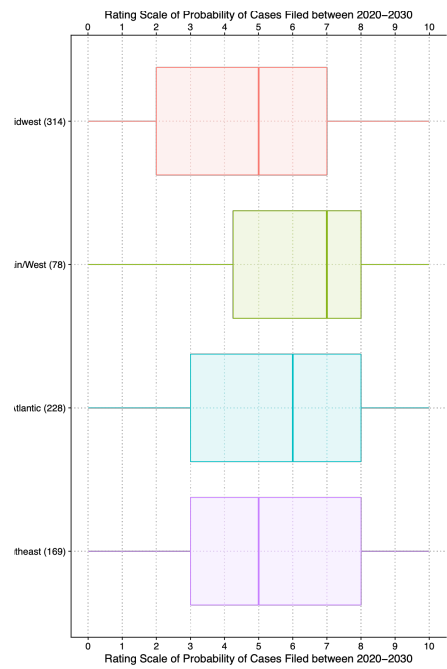
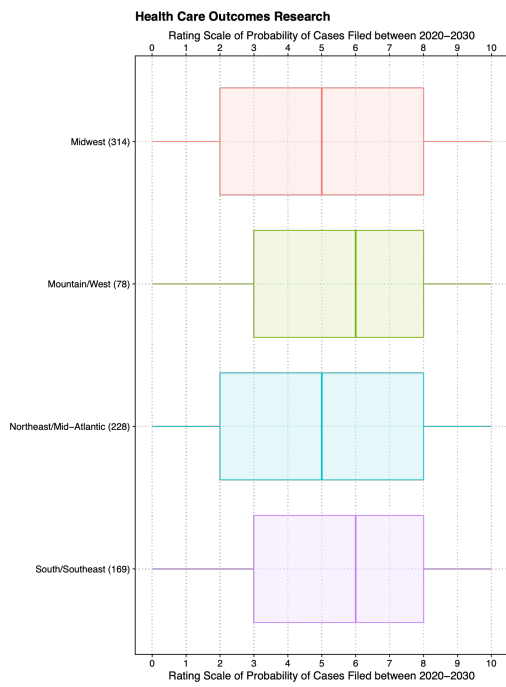


Figure 7.13. Regions Compared with Respect to Probability Ratings with Respect to Covid-19 Test-



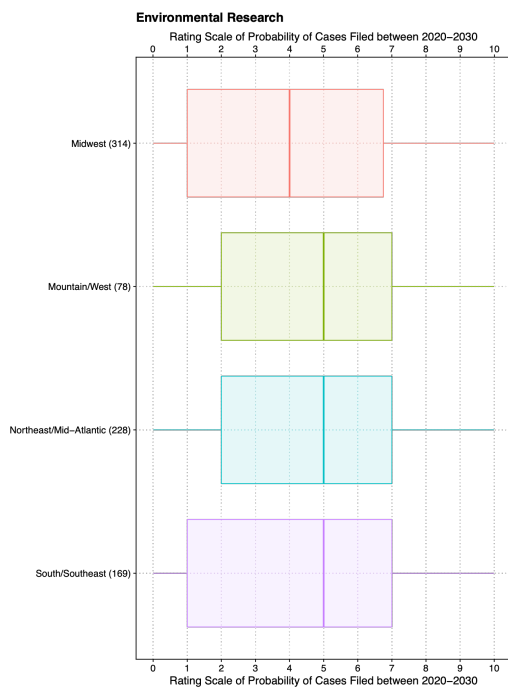
Figures 7.14 & 7.15 - Regions Compared with Respect to Probability Ratings with Respect to

Health Care Outcomes Research Evidence and

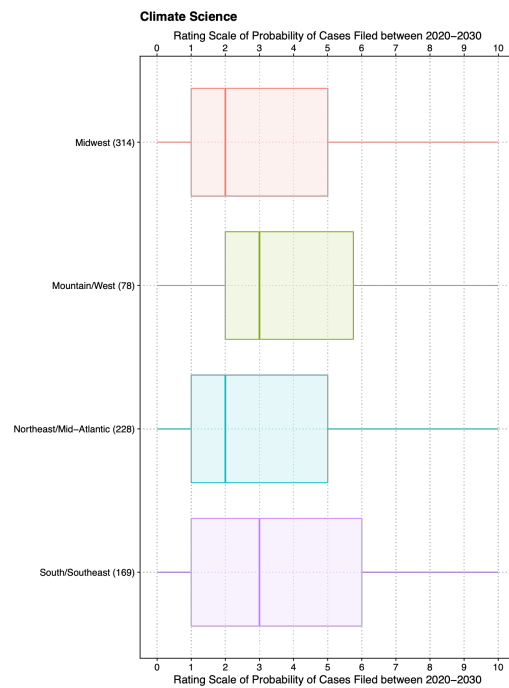


Developmental Neurobiology Evidence

Figure 7.16 & 7.17. Regions Compared with Respect to Probability Ratings with Respect to

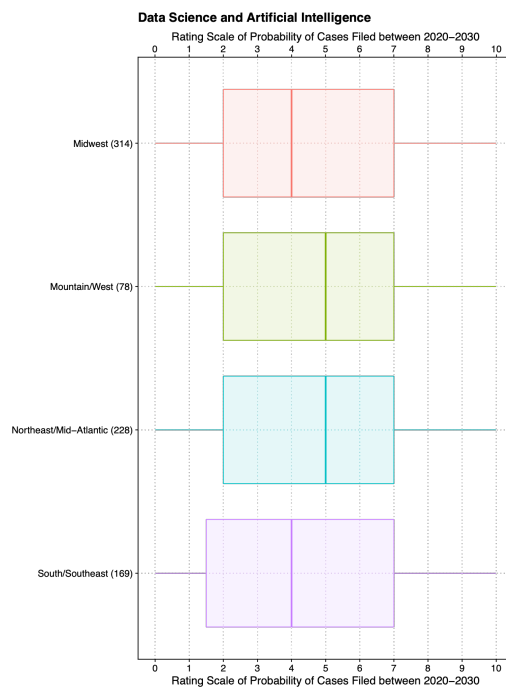
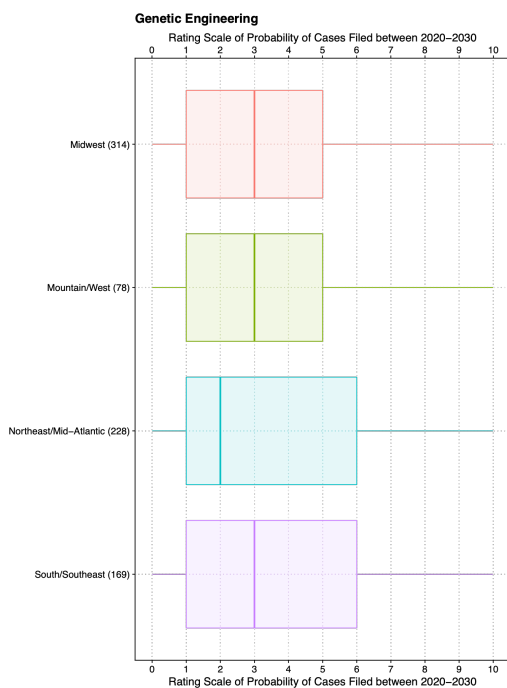


Environmental Research Evidence and Research from Climate Science Evidence



Figure

Figure 7.18 & 7.19 - Regions Compared with Respect to Probability Ratings with Respect to Genetic Engineering Evidence and Data Science / Artificial

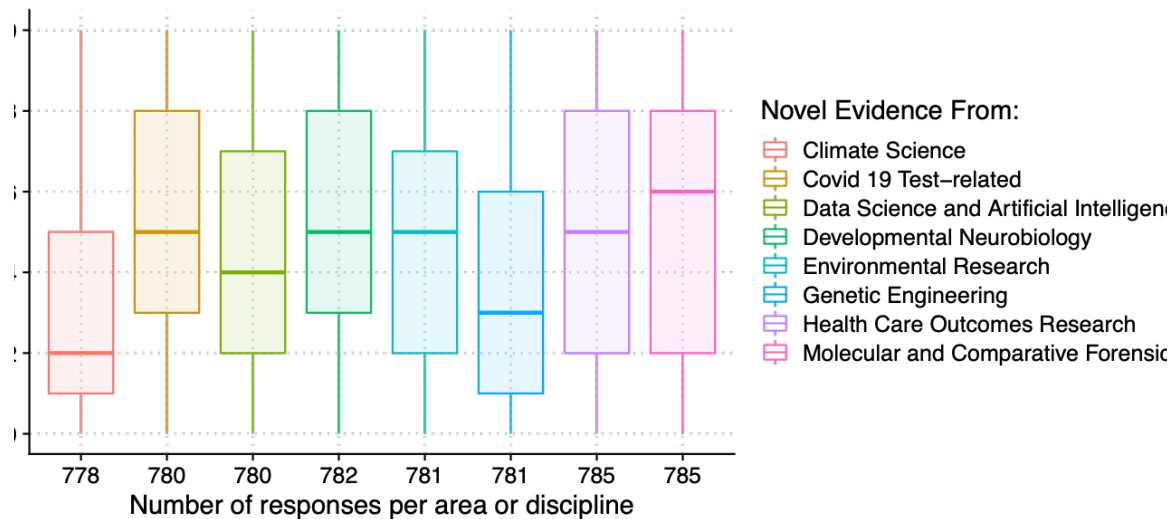


Intelligence Evidence

Referencing national data, immediately below, as a comparison tool, several comparisons appear to be noteworthy

1.
The
high

**Rating Scale of Probability of Cases Filed
between 2020–2030 involving novel scientific evidence
from eight subject areas or disciplines.**



predictions that judges have made nationally for molecular and forensics evidence are replicated by regional comparisons. This places pressure upon jurisdictions' education services to find the human resources capable of quantifying reliable underlying scientific methodology, as we noted in this report's executive summary scenarios. So far as opinions go, forensics is the "go-to" on-the-job content.

2. Covid-19 Test-related cases gained high probability forecasts from three of our four regions; the South / Southwest region trailed the others substantially. The same pattern hold true for Health Care Outcomes Research Evidence. This data warrants followup and may be related to the policy contexts that have harnessed attitudes about Covid-19 safeguards, or a general disinclination to credit science more generally.

3. Environmental research-related cases, on the other hand, received higher probability scores in the South / Southwest region with a much higher upper quartile rating when compared with the other three regions. With judicial education funds not likely to increase in the next few years, forecasts might point to a way to efficiently target case management education.

4. NCSI's resource judge training programs might benefit from inter-regional comparisons. Probability forecasts could well hide a proxy variable: the salience of cases for the justice administration workforce. Choice of jurisdictions for training and deployment of science and technology resource judges might well be gauged in part by discussions about case salience over the five and ten year periods ahead.

5. RESERVED FOR DISCUSSION

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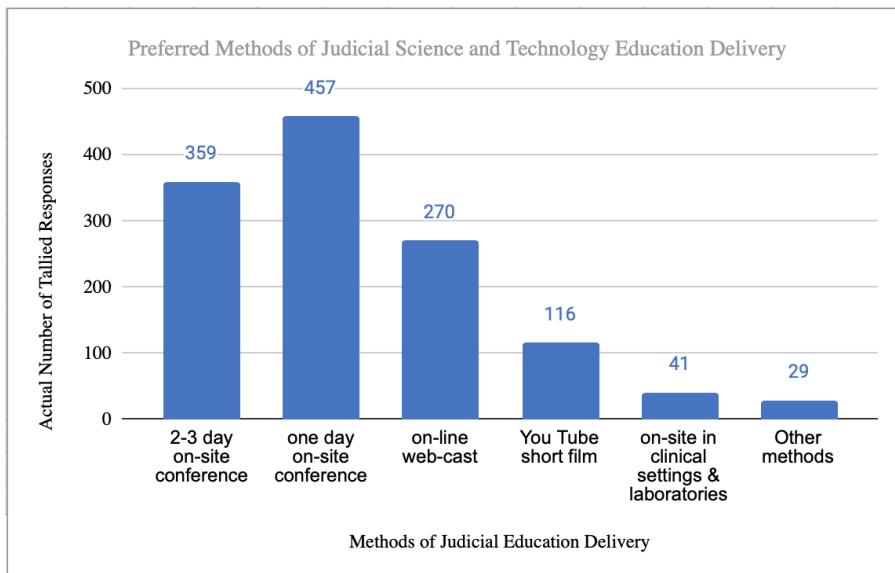
Section 8. SCIENCE AND TECHNOLOGY EDUCATION DELIVERY PREFERENCES

Judges were asked to select their two most preferred methods of judicial science and technology education delivery from six (6) options, as presented in Table 8.1.

Table 8.1. Judicial Science and Technology Education Preferences, N=729, 1272 total responses

Preferred Education Delivery Method	Mean Response
One Day Onsite Conference sponsored by respondent's jurisdiction education services	16.32
2-3 Day Onsite Conference at an institution of higher or professional education	12.82
One hour long on-line webcast on a subject of your interest	9.64
You Tube short film or film series	4.14
Health care outcomes research evidence on-site in clinical settings and laboratories	1.46
Other methods for expanding knowledge tools re civil and criminal case evidence (discussed below)	Listed Below

Figure 8.1 A Bar Chart Depiction of Judges Preferred Education Methods with Nomination



Judges rank-ordered references appear to favor shorter and compacted course designs. Online webcasts were less favored, and clinical and laboratory experiences with respect to health care outcomes research evidence attracted least favor.

It is important to note that the jurists responding to the survey emanate from a wide ambit of the State and Territorial Court Systems. They often refer to themselves as generalists. Were they limited to assume the roles of an NCSI science and technology resource judge, education delivery preferences may well change. In our experience, and based upon direct evaluations of several science evidence areas, laboratory experiences were highly valued. Planning such integrated knowledge tools educational segments, however, is laborious and time-consuming. It also requires collaborating institutional networks that also are demanding to initiate and maintain.

Judges offered 26 additional comments about science educational delivery methods. Eight judges indicated they would prefer on-site educational programs but elected other methods due to the health risks and obstacles created by the Covid-19 pandemic. Several highlighted the importance of written materials' availability in advance or coterminously with on-line programs. Several respondents underscored difficulties posed by multiple time zones and others highlighted the online webcasts' need for good production values and interesting presenters.

Section 9. JUDGES' OPINIONS RE: STRUCTURAL ASSISTANCE FOR CASE MANAGEMENT

In the survey instrument's final section, Part C, judges were asked to rate on a ten-point fixed interval rating scale the degree of helpfulness of three proposed institutional innovations intended to assist adjudication procedures at trial and on appeal. The ten-point scale ranged at the high end, 10, 9, or 8 as Greatly helpful, middle ratings of moderately helpful, and low ratings of 3 to 0 as little or not helpful.

We posed this rating task because evidentiary proffers this decade can be expected to contain increasingly complex science and technical information that could be information solely possessed — or falsely represented to be possessed—by expert witnesses. By asking about institutional enhancements and additions that judges might find helpful, we assumed no change in adjudication's adversarial nature and fundamental principles and features. We were aware that some jurisdictions had governing statutes that permitted court-appointed expert witnesses with safeguards for the parties in court. We were aware that others had determined such appointments to be permitted by inherent powers of the courts.

We were not aware, however, how a wide array of trial and appellate judges might regard three assistive techniques —(1) an institutional science officer installed as part of a jurisdiction's professional staff and available for both advice and case-related testimony under standard rules for parties' objections and full use of direct and cross examination; (2) background briefings for juries, with the parties operational stipulations and opportunity to dissent at such briefings or in later stages of a trial; (3) specially reserved funds for judges to engage, with parties' consents, court's witnesses or masters who would report findings in open court, again subject to parties' cross examination.

From the entire national sample of 790 respondents' ratings, Figure 9.1 presents the following opinions about the helpfulness of an institutional science officer for a single jurisdiction.

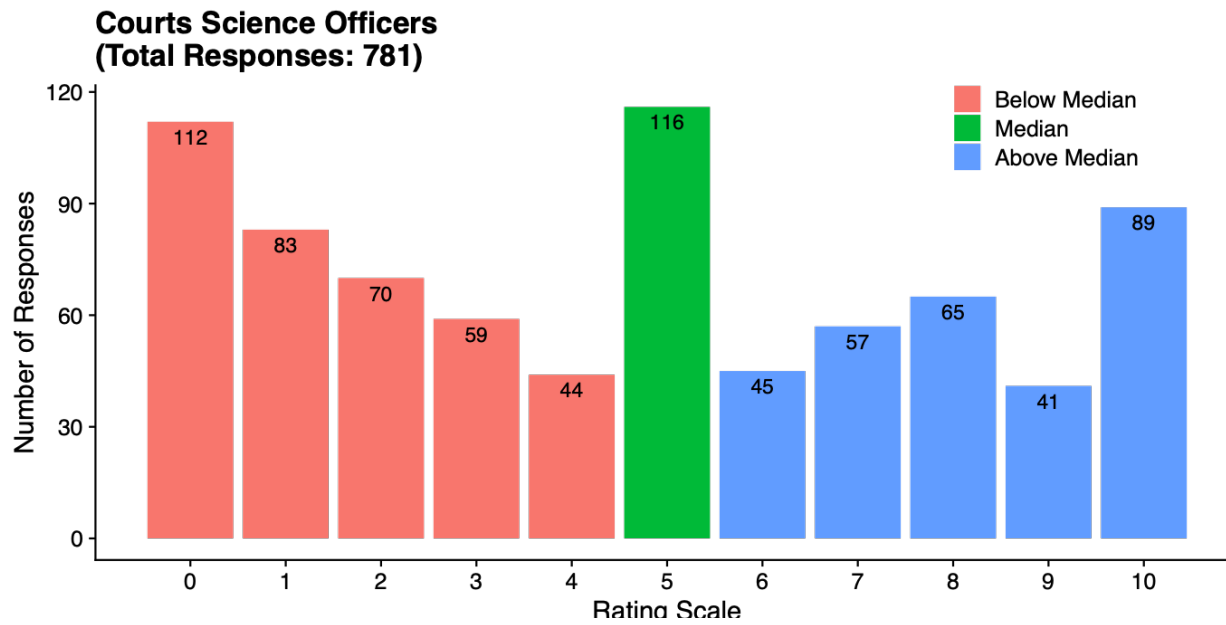
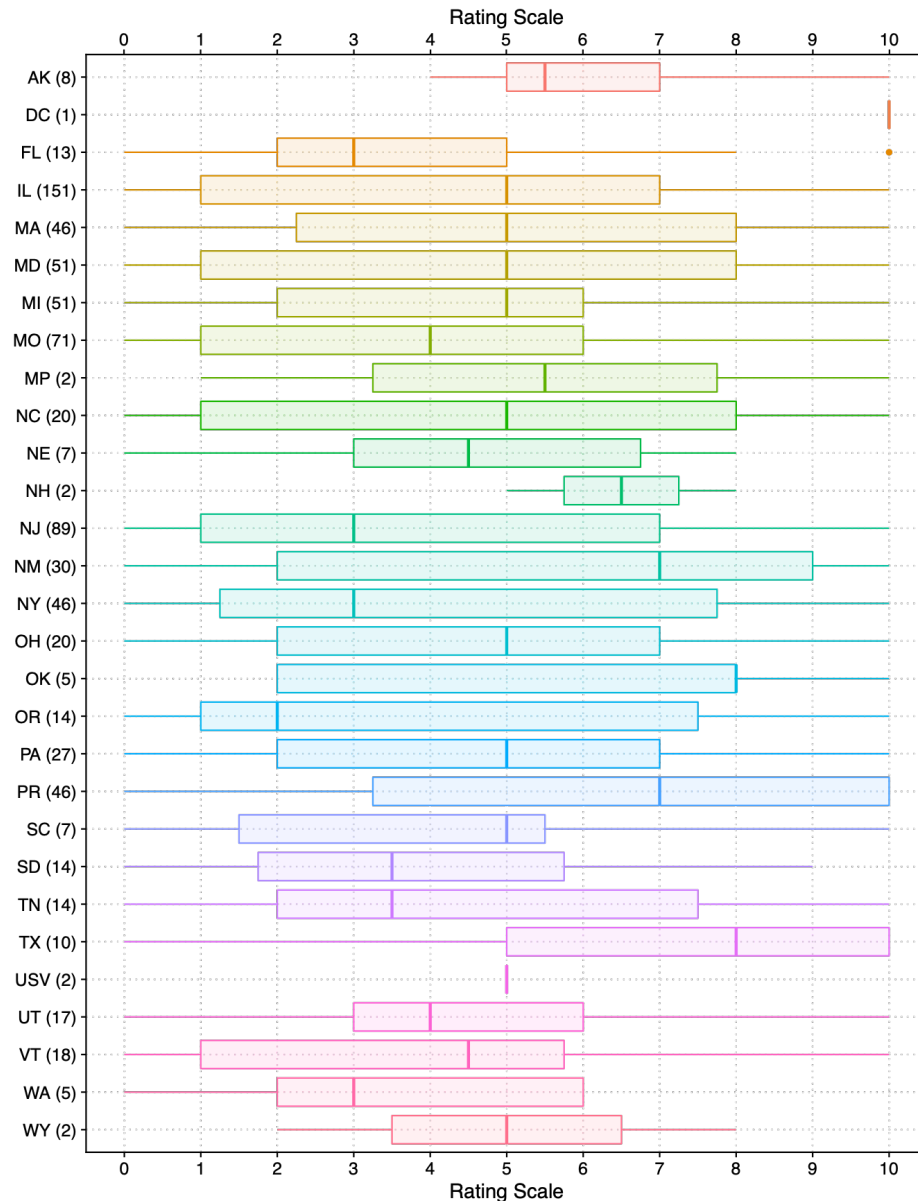


Figure 9.1 Judges Ratings: Courts Science Officers' Helpfulness 2020-2030

Figure 9.2 State by State Box-plot Ratings for Courts' Science Officers

Courts Science Officers



A quick review of Figure 9.1 and 9.2, immediately above, shows that judges from many states do not believe that a staff scientist would be helpful to the adjudication of cases infused with novel evidence during this decade. Median ratings, the thick bar in the boxes, were low for the states contributing the most numerous completed surveys, but the lower interquartile range for Illinois, Maryland, Maryland, Missouri, North Carolina and New Jersey point to rejection of this proposed structural innovation.

As with other survey features, we invited judges to express observations or comments following the questions rating the helpfulness of a court system's science officer. We were rewarded with 62 comments, some lengthy, all summarized immediately below.

Ten comments expressed concern about the appearance of bias that relying on assistance of a jurisdiction staff scientists might cast upon the judiciary. This concern came in several flavors: usurpation of a court staffer of the constitutional delegation of judicial authority; the gap between the (good) principle of a judicial science officers' helpfulness and the (bad) practical difficulties of doing so that diminish the principle; the implied assertion that judges are unable to acquire new knowledge tools as science and technical evidence evolve; and statutory and case law prohibitions on courts' conduct of research, which could draw an otherwise helpful idea into spiraling disagreements.

15 comments opined that the idea would be helpful, especially in the right cases; some comments joined that opinion with a condition: that the trial judges' good sense would call upon a courts' science officer at the right time and upon the right occasion. While some comments decried the dissolution of parties' responsibility for putting on a case, others noted that the advocates had the responsibility to provide effective assistance of counsel as a matter of law, including proper evidentiary proffers.

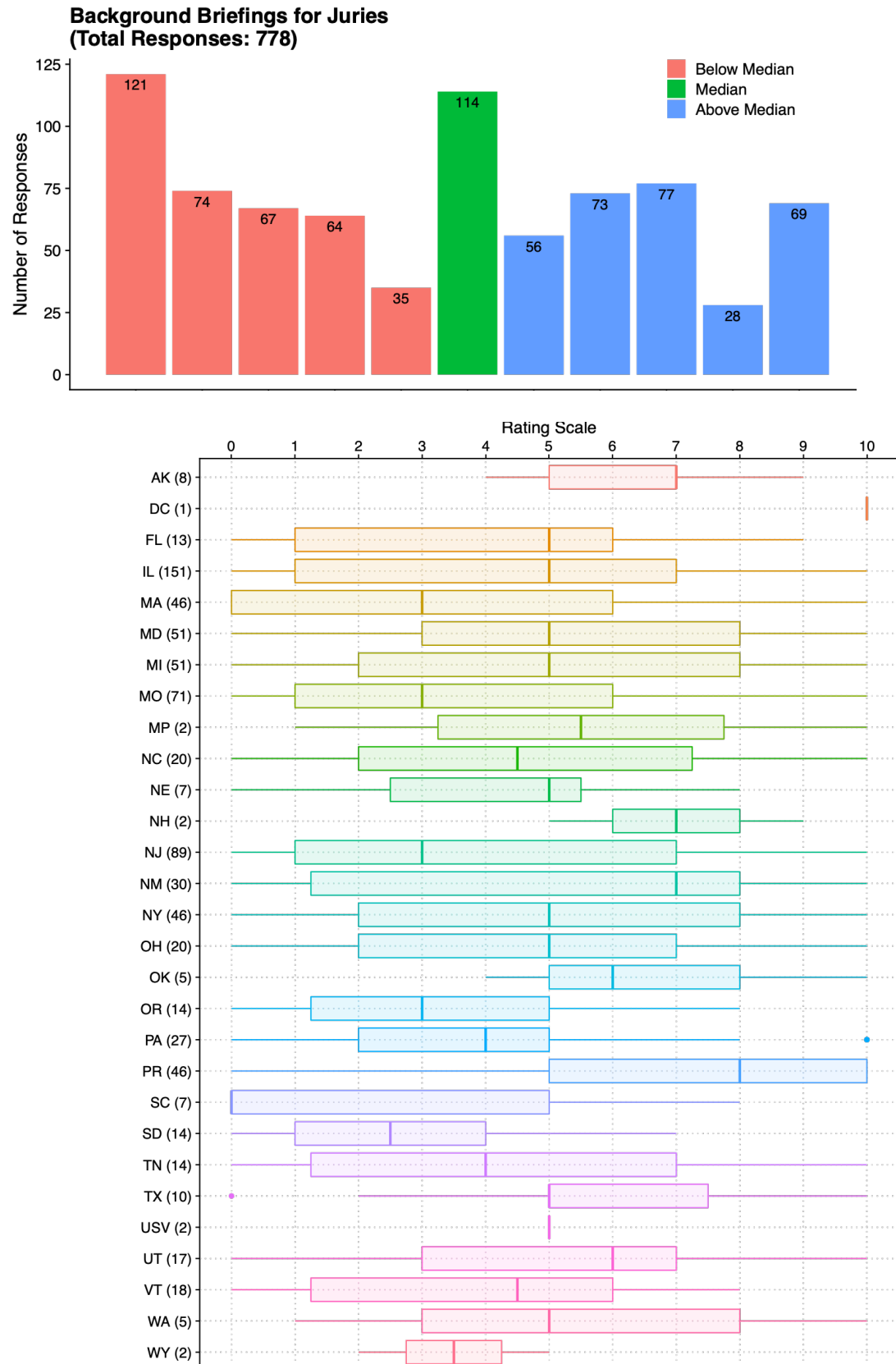
Problems of *ex parte* communication and the danger of too much weight accorded to a court science officer's opinion rounded out the judges' observations and comments with respect to a court science officer.

The second institutional assistance proposal we tested with judges concerns background briefings for juries. The problem facing juries is two-fold. First, many expert witnesses try to confuse the jury with the expert's own credentials and knowledge. Second, jurors are asked to understand decades of scientific notions and notations in an immensely short time. So how helpful to judges might be expert background briefings stipulated by the parties and subject to examination or objection from an expert or an expert panel not connected with the case?

Figures 9.3 and 9.4 set forth the data. Treating the fifth rating space as the middle, 341 judges rated juries' scientific background briefing 314 times as low to moderately helpful, 46.7% of the question's sample of 737 judges. 113 judges rated the assistance technique as being of no help.

279 judges rate jury background briefings as moderately to greatly helpful, with 64 judges nominating a scale high of ten favoring the procedure (37.9%). And right in the middle, at a rating space of 5, 108 judges cast their nominations in favor of moderately helpful. Added to the response sample, 387 judges favored the procedure as being of at least moderate help, and tilted the entire sample in jury briefings' favor to 52.5%

Figure 9.3 Judges Ratings: Jury Background Briefings' Helpfulness 2020-2030 and
Figure 9.4 Jury Background Briefings All States Box-plot

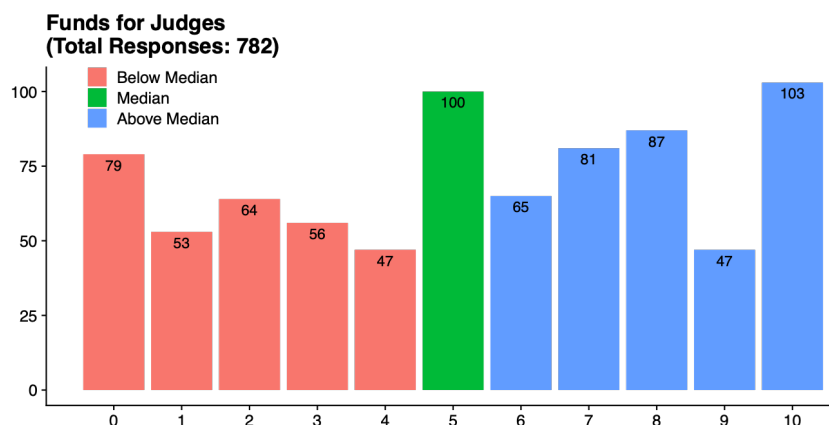


So: did judges offer in the way of observations and comments about this adjudication assistive technique? 60 judges offered comments, 12 of which explained that they did not conduct jury trials. Another 12 judges observed that they did not know how the briefings would operate and remain out of the trial record. And a final block of 12 asserted that it is the lawyers' responsibility to educate the jury by way of expert witnesses. The other comments argued about the briefing technique's legality and constitutional status. But almost no judge observed that the technique would not be helpful in every trial circumstance.

Funds for judges to hire scientifically-prepared, case-related masters is the final dimension of adjudication assistance explored by the survey. For some answers, we present survey data in Figure 9.4, Judges Helpfulness Rating of Funds for Acquisition of Case-related Scientific Masters (N=734) , immediately above.

Figure 9.5 Judges Ratings: Funds for Judges to Acquire Science Master

Helpfulness
2020-2030



Opinions of not helpful to moderately help comprised 38.7% of survey respondents. 12.8% opted for a five-point rating, right in the fixed interval rating scale. And 356 judge chose ratings in the 6-10 range, 48.5%.

While arguably less oppositional to this proposed structural assistance than was found with respect to judicial science officers and jury background briefings, a similar pattern emerged. So we turned to 39 judges' comments and observations for illumination.

Approximately half of the comments supported the technique, but worried about jurisdictions' resource limitations. The oppositional comments divided between objections based on jurisprudential factors and questions about the litigants' responsibility for funding such an adjudicating assistive technique. Most jurisprudentially-based comments expressed the concern that scientific masters biased the trial proceedings, placing the court's thumb on the scale of justice. Funding-related comments highlighted litigants' past resistance to paying for a master's services. But jurisdictions differ, as Figure 9.4, below shows.

Figure 9.6. Funds for Judges to Acquire Science Masters - All States

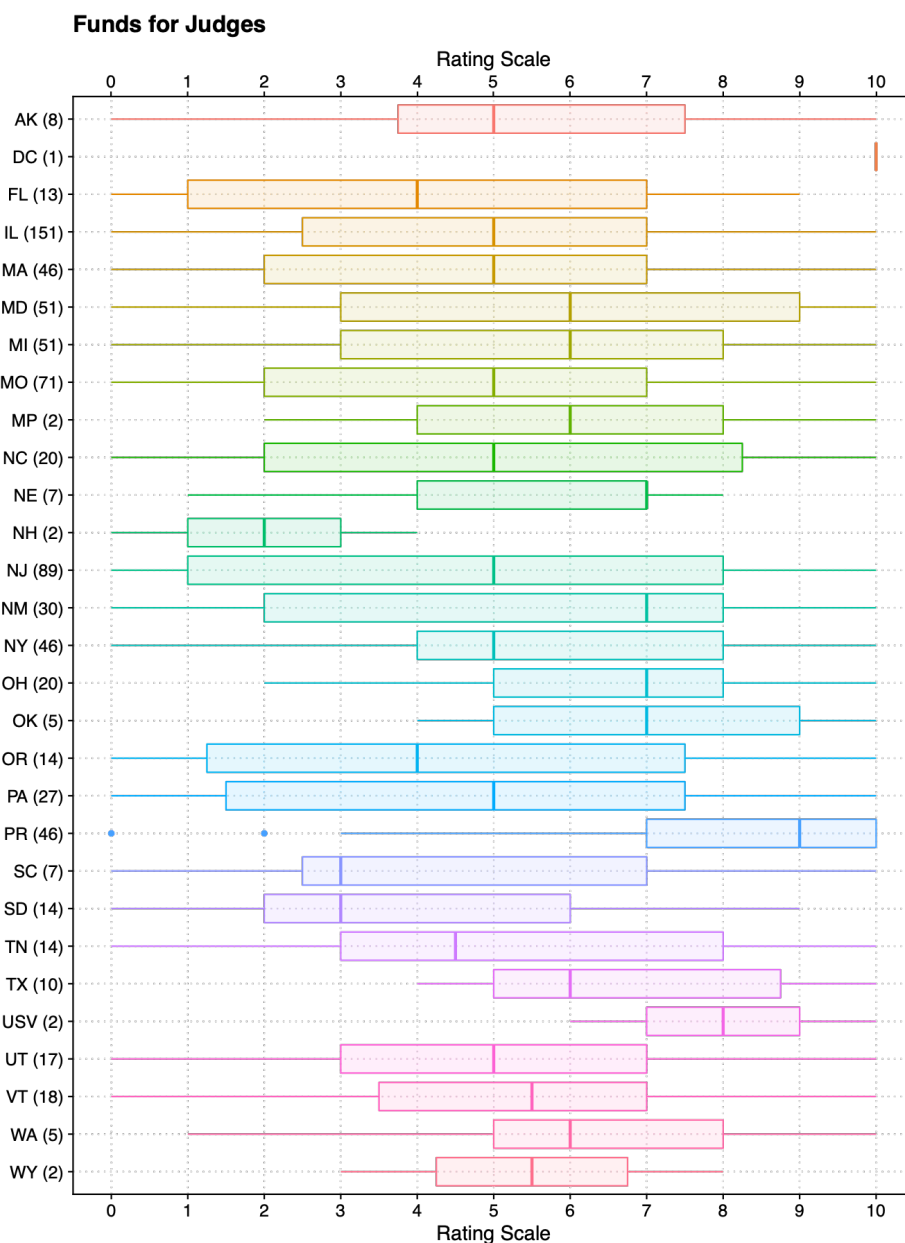


Figure 9.6 immediately above does indeed show higher medians and more robust upper interquartile ranges for the proposed adjudication assistance, with Puerto Rico leading all states' perception that this device would prove helpful in the decade ahead. But negatives also can be seen in New Jersey, Oregon and Pennsylvania, where this technique appears to be viewed with suspicion.

Conclusion

We thus conclude judges' opinions about adjudication assistive solutions to ever-expanding novel evidence with a hypothesis for future studies: a majority of judges feel that they

can only rely on their colleagues to assist adjudication of novel evidence as this decade moves forward. While differing among states and territories, a sizable minority appear willing to innovate, albeit with safeguards.

Section 10: ADJUDICATION IMPACT OF RETRACTED PEER REVIEWED JOURNAL ARTICLES

As the survey instrument was under development, several highly prominent, peer-reviewed scientific journals announced article retractions following publication. In two instances, the retractions concerned reported research about the Covid-19 pandemic. The journals' action became a subject widely disseminated in news outlets and by social media.

As this survey project became operational, we sensed an opportunity to determine whether our sample identified article retractions as an influential factor in upcoming science and technically-infused cases.* Here is how judges rated the expected impact upon adjudication in the ensuing decade:

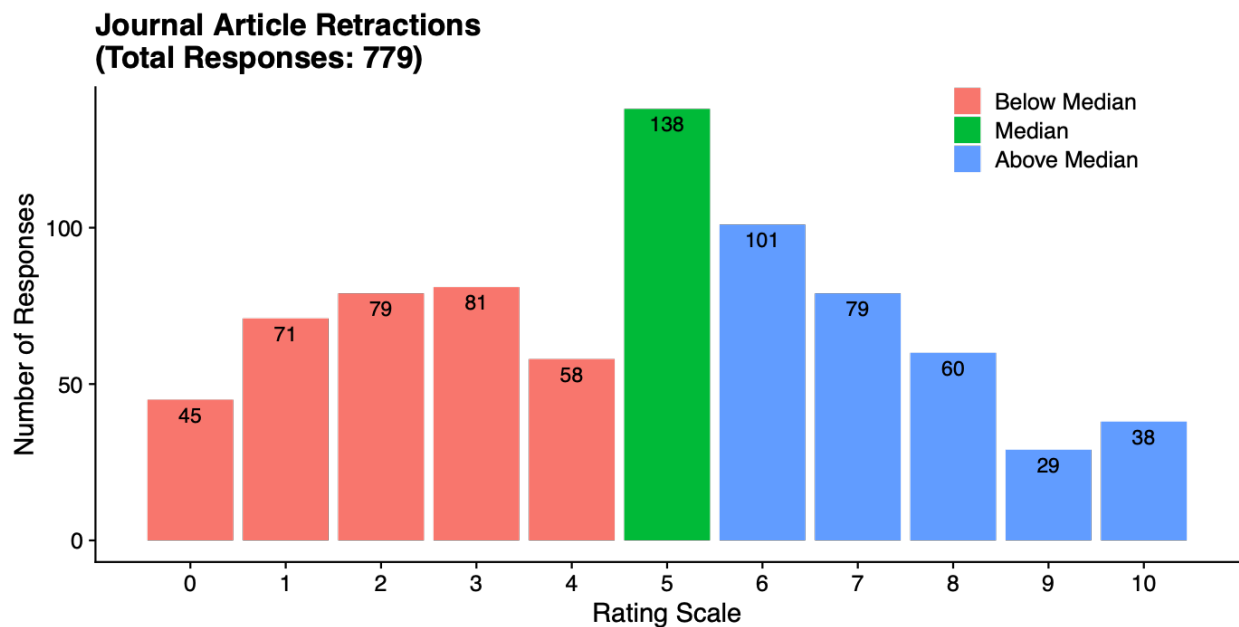


Figure 10.1 Judges Ratings: Impact of Journal Retractions 2020-2030

Figure 10.1 exhibits a nearly normal distribution of impact rating opinions about journal article retractions. Low to moderate impact ratings (red bars) comprise 42.9 % of judges estimates. Moderate to high ratings comprised 39.4% of judges' estimates. The two arms of the distribution were nearly equal. 138 judges fell on the median, rating journal retraction impacts as "5" on a ten-point scale, 17.7% of the respondents.

* The survey question reads: To what extent, if at all, over the emerging decade might you expect complications impacting adjudication of criminal and/or civil cases as the result of retraction of scientific and technical articles from peer-reviewed journals?

With only 195 judges, 25%, rating journal article retraction as low impact (0-3 on the rating scale), the survey discovered substantial concern about this scientific phenomenon during

this decade. This discovery warrants secondary exploration and analysis. In Figure 10.2 we noted prior to Michigan's 51 added surveys, for example, that service time as a judge seemed to be equally characterized by journal retraction impact ratings. (See, figure 10.2, below).

Figure 10.2 Mean of Judges' Opinions of Peer-Reviewed Journal Article Retractions by Length of Time on the Bench. N=738

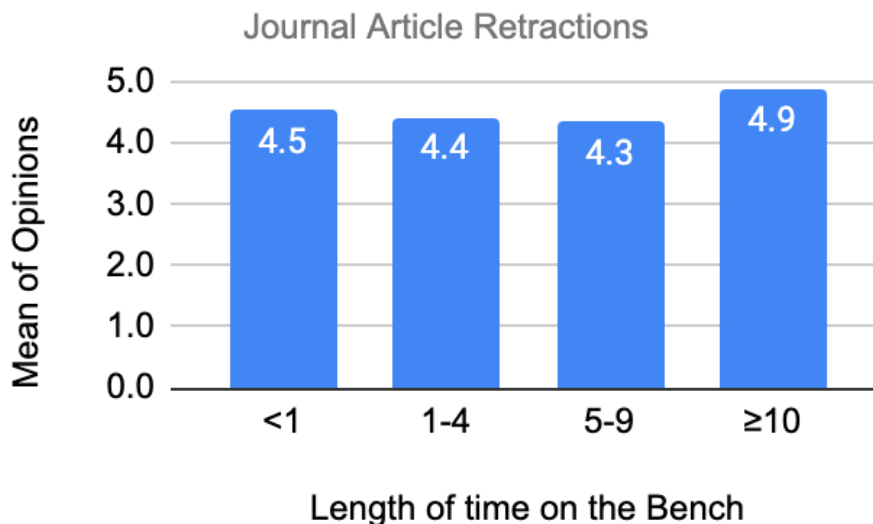
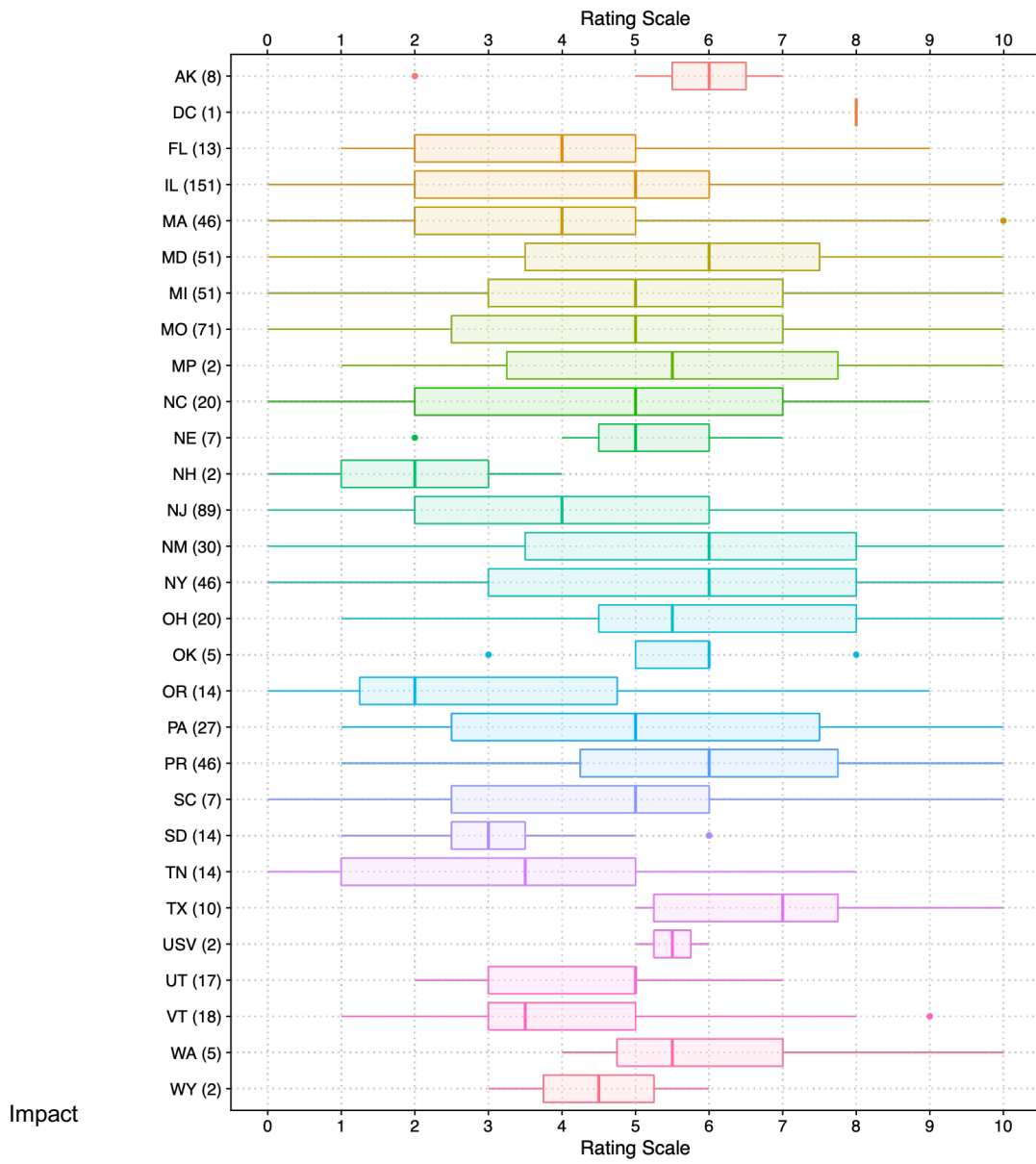


Figure 10.3. State by State Ratings of the Adjudication Impact of Journal Article Retractions 2020-2030

Journal Article Retractions



Conclusion

Journal article retraction impacts rated in all participating states, Figure 10.3, above, generally discloses substantial uncertainty about the impact of journal article retractions. Judges from Florida, Massachusetts, New Jersey and Tennessee appear to be skeptical of impacts. Judges from Alaska, Maryland, Puerto Rico and Texas appear to indicate concern about those impacts. With a robust mixture of forecasts among a non-representative sample of judges, it is recommended that this issue be tracked in a dedicated effort for the next half of this decade to determine its trend lines and courts' management responses.

A point elaborated in this report's Section 12, this survey implies that a healthy majority of judges are both conscious of the newly publicized journal article retraction meta-trend and the need to be alert to it. Jurisdictions' education divisions could monitor this trend and produce background papers for their judges. And followup surveys can highlight actual experience with managing this factor in adjudication proceedings.

Is too much emphasis given to journal article retractions in this report? We perceive it to be a quiet, powerful factor because peer reviewed journal publications lie at the heart of Daubert and Frye evidentiary domains. And advising scientists believe it lies at the heart of scientific integrity.

Section 11. IMPLICATIONS FOR STATE AND TERRITORIAL COURTS' EDUCATION SERVICE

1. With respect to the scenarios charted in this report's executive summary, pages 16-17:

Scenario	Implications
1. Forensics Domination	Consider a self-renewing, court-based consensus report utility. Perhaps vested in a court or state librarian, a consensus review conducted periodically with briefs circulated widely to a jurisdiction's judges and educational divisions following the review. This could alleviate demand for specialized forensics seminars, workshops or conferences.
2. Covid-19 Test Related Evidence	Equip National Commission with a scientific evidence authority and periodic summaries supply. While NCSI proposes a network of science and technology resource judges as a primary solution to the confusing research-based blast furnace occurring with respect to this evidentiary domain, adoption of consensus report techniques and supply of period reviews nationally could aid jurisdictions as well.
3. Covid-19 Vaccine and Treatment Related Evidence	Establish Blue-Ribbon Advisory Panels in each State / Territorial Jurisdictions with a Bi-annual mandate to report on developments, especially new conclusions and interpretations found to success earlier inaccurate one.
4. Environmental Modifications using GMO Interventions	Create regional, inter-jurisdictional review entities to monitor proposals and policy initiatives with period summaries supply. This labor-intensive effort might be a collaboration between jurisdictions and respective academic institutions and their specialized research center. The data will be forthcoming; the challenge is how to package it for justice system utilization.

Scenario	Implications
<p>5. Class action’s favorable verdict based on expert witness testimony collapses when a prominent journal retracts the key article upon which the expert depends, citing fraudulent inclusion of an artificial intelligence algorithm as the basis for the journal article’s findings, conclusions and interpretations.</p>	<p>Create a central, continuing journal review entity that adopts standards for adjudication admissibility and exclusion, and issue periodic findings obtained by sequentially random surveys of trial and appellate courts. The modality for this initiative would likely vary jurisdiction-to-jurisdiction. Tapping the data specialized academic research centers may be useful. A host of additional approaches exists; perhaps a national conference to consider these perspectives could be helpful.</p>

2. With respect to other issues surfacing from report findings:

NCSI hopes that this survey report will prompt responses from the Judiciary. Ideas and collaborations will be welcomed by the NCSI Board of Directors.

Section 12. IMPLICATIONS FOR NCSI RESOURCEJUDGE TRAINING CONCENTRATIONS

(PARTIAL, OPEN FOR DIRECTORS' DISCUSSION)

1. With respect to the scenarios charted in this report's executive summary:

Scenario	Implications
1. Forensics Domination	Create a National Forum of resource judges with specialized training in a combination of digital, molecular and comparative forensics, with jurisdictional deployment agreements, and mandate continuing hands-on education.
2. Covid-19 Test Related Evidence	Create a self-sustaining and spiral expanding resource judge corps, initially 12 three-judge jurisdictional teams with jurisdictional deployment agreements, and mandate continuing hands-on education.
3. Covid-19 Vaccine and Treatment Related Evidence	Mandate the 12 three-judge jurisdictional teams to formulate adjudication-related scientific and technical background programs for their jurisdictions and all other jurisdictions.
4. Environmental Modifications using GMO Interventions	Initiate a court-related environmental health and disease evidence periodical publication to be supplied to all jurisdictions. Create regional, inter-jurisdictional review entities to monitor case developments, proposals and policy initiatives with period summaries supply.
5. Class action's favorable verdict based on expert witness testimony collapses when a prominent journal retracts the key article upon which the expert depends, citing fraudulent inclusion of an artificial intelligence algorithm as the basis for the journal article's findings, conclusions and interpretations.	Establish an inter jurisdiction journal review network and publish advisory findings on an established schedule. Train network members along the lines of the novel scientific and technical evidence domains studied in this science in the courtroom survey, with other domains added as necessary.

2. With respect to other issues surfacing from report findings, NCSI expects to import findings into resource judge training project, using conclusions to guide those projects' design.

Appendix A: THE SURVEY INSTRUMENT: ONLINE FILLABLE FORMAT

THE NATIONAL COURTS AND SCIENCES INSTITUTE ANONYMOUS SCIENCE IN THE COURTROOM DECADEAL SURVEY 2020 -2030

8/5/20, 11:02 AM

THE NATIONAL COURTS AND SCIENCES INSTITUTE ANONYMOUS SCIENCE IN THE COURTROOM DECADEAL SURVEY 2020 -2030

About This Survey: An Introduction for Judges

Dear Judge:

This survey is being conducted for NCSI by the Chambers of Hon. John M. Leventhal, Associate Justice, Appellate Division, Second Judicial Department of the New York State Supreme Court. It will be sent to all State court jurisdictions. This questionnaire requires no identification, and is treated as a judge-to-judge privileged communication. Justice Leventhal has assembled a team of second-year law students to implement the survey. Each law student is bound by New York rules of confidential court communications. The law student assigned to your jurisdiction is Mr. Ryan Baal, 2L, Cardozo School of Law. Mr. Baal's email is baal@law.cardozo.yu.edu. His telephone number is 914-980-5354.

Justice Leventhal's Chambers number is: 718-722-6350, jleventh@nycourts.gov.
NCSI's liaison for this project is Dr. Franklin M. Zweig, vice president, email zweigtech@gmail.com.

The survey's purpose is to classify and quantify sitting judges' expectations for complex cases involving novel scientific and technical evidence in the decade bookended by calendar years 2020 and 2030. The survey includes a full sample of general jurisdiction, appellate and policy court judges nationwide and court systems operating in all states.

The survey's results will be available to you, to your chief judicial officers, and to your court administrators in a report that tabulates and statistically forecasts complex caseloads with novel scientific evidence, as well as judicial science education preferences and issues for the years ahead.

The survey will take about 20 minutes to complete. If you are unable to participate, please so inform Mr. Baal. Otherwise, please accept our thanks for helping scale up and plan on-the-bench science and technology education. And contact me at any time.

Sincerely,
Hon. John M. Leventhal

PART A: RESPONDENT'S BACKGROUND CORRELATION INFORMATION

This section documents a few vital statistics relating to the judges who generously complete this Questionnaire. All questions relate to professional tasks, none are personal in nature, and no identifying names or courts are required.

1. Please indicate the state wherein you preside.

2. Court type in which your permanent appointed / elective position is located.

Please designate by clicking the appropriate bubble.

- ☐ Limited jurisdiction court
- ☐ General jurisdiction court
- ☐ Appellate court
- ☐ Court of last resort / policy court
- ☐ None of the foregoing

3. If you selected "None of the foregoing," please indicate the kind of court on which you customarily serve in the space provided immediately below.

4. Length of time on the Bench

Please designate by clicking the appropriate bubble, indicating the length of time you have served as a judge from your initial appointment or election as a judge mid-year 2020.

- ☐ Less than one year
- ☐ One to Four Years
- ☐ Five to Nine Years
- ☐ Ten Years or Longer

5. Principal legal practice prior to Bench appointment or election

Please designate by selecting the appropriate box(es) in the list of pre-bench professional positions that indicate your professional practice immediately prior to your initial judicial appointment.

- ☐ Public prosecutor or staff in the office of a District, Municipal or State's Attorney
- ☐ Public defender or staff in the office of a public defender or indigent defense agency
- ☐ Private criminal defense attorney in solo practice, small law firm or large law firm
- ☐ Corporation counsel in-house or external for for-profit entities
- ☐ Non-profit corporation counsel practicing within a non-profit entity
- ☐ Attorney for a municipality, county agency, state agency or federal agency
- ☐ Plaintiff's counsel for civil litigation
- ☐ Defense counsel for civil litigation
- ☐ None of the above.

6. If you selected "None of the above," please briefly indicate in the space provided immediately below a description of your principal legal practice immediately prior to your Bench appointment or election as a judge.

7. Case Types with evidence based in science and/or technology you were assigned during the past three years, whether the case resulted in a settlement, plea or verdict from trial on the merits.

Please designate by selecting the box(es) from the list provided below as many as apply that were assigned to you during the past three years:

- ☐ Case(s) involving DNA forensic technology
- ☐ Case(s) involving In Vitro Fertilization
- ☐ Case(s) involving mental illnesses or behavioral science claims and defenses
- ☐ Case(s) involving forensic analysis related to arson or homicide
- ☐ Case(s) involving testimony of a forensic psychologist
- ☐ Case(s) involving claims of illness emanating from environmental sources
- ☐ Case(s) involving artificial intelligence related to risk of dangerousness
- ☐ Case(s) involving fronto-temporal or senile dementias (e.g. Alzheimers Disease)
- ☐ Case(s) involving autism
- ☐ Case(s) involving inherited disabilities (e.g., sickle cell disease)
- ☐ Case(s) involving alleged injury from use of a commercial product
- ☐ Case(s) involving proofs from large databases reflecting upon a plaintiff's claims made and burdens assumed in a civil action
- ☐ Case(s) involving contaminated drinking water
- ☐ Case(s) involving alleged cancer-causing agents, such as, asbestos
- ☐ Case(s) involving the physical or sexual abuse of children
- ☐ Case(s) involving addictive disorders or illegal use of controlled substances
- ☐ Case(s) related to the current Covid-19 Pandemic
- ☐ Case(s) related to violations of State or Federal laws to protect the environment
- ☐ Case(s) related to climate change
- ☐ Case(s) related to genetically modified organisms, including plants, animals and microbes
- ☐ Case(s) involving a defendant's competence to stand trial
- ☐ Other case(s) featuring novel scientific or technical evidence

8. If you selected "Other," please briefly indicate in the space provided immediately below a description or descriptions that involved scientific or technical evidence requiring the testimony of an expert witness.

9. Your formal academic training in science, technology and engineering

Please describe briefly in the space provided immediately below your college-based or graduate school academic training in science, technology or engineering.

10. Your Continuing Judicial Education courses, if any, in science, technology and engineering over the past three years including any structured instruction provided through the auspices of your jurisdiction's educational division or services.

11. Your priorities, if any, for seminars, workshops or conferences presenting the current state of science, technology or engineering during the next five years (e.g., to mid-decade 2025).

Please describe your preferred subject matter by selecting as many of the box(es) as apply in the list provided below:

- ☐ Principles of forensic science
- ☐ Case(s) involving forensic technologies, including arson materials, ammunition identification, weapons usage, hair analysis, bite mark analysis, blood splatter analysis
- ☐ Techniques that could result in "designer babies"
- ☐ Research techniques used to sample environmental conditions (e.g., water quality, air quality, soil viability)
- ☐ Artificial intelligence and big data science techniques claimed to be best or reliable collateral evidence in court cases
- ☐ Health care outcomes research evidence - principal techniques, report limitations, and sources for misleading and fraudulent interpretations
- ☐ Laboratory techniques used in "best practices" trace evidence analyses
- ☐ Advances in brain science evidence bearing upon "state of mind" and predisposition for violence
- ☐ Genetic engineering technologies, including use of CRISPR-Cas9, to change the genetic makeup of plants, animals, and humans
- ☐ New brain modification technologies to treat mental disorders (such as Parkinson's Disease and Post-Traumatic Stress Disorder)
- ☐ Other and Additional Science, Technology and Engineering Perspectives

12. If you selected "Other and Additional," please briefly indicate in the space provided immediately below a description of a seminar, workshop, or conference you would favor attending on-site or via interactive video on-line.

13. Your Preferred Methods of Judicial Science and Technology Education Delivery.

Please describe your preferred receipt of subject matter by selecting the box(es) preceding your two most favored methods for receiving judicial science and technology education background descriptions and state of the science landscapes.

- ☐ Attendance at an institution of higher or professional education for a 2-3 day on-site conference involving lectures, laboratory experiences, and criminal, civil and equity case applications including moot courts.
- ☐ A one day on-site conference sponsored by your jurisdiction's educational services
- ☐ One hour long on-line web-cast on a subject of your interest
- ☐ You Tube short film or film series
- ☐ Health care outcomes research evidence on-site in clinical settings & laboratories
- ☐ Other methods for expanding knowledge tools regarding civil & criminal case evidence

14. If you selected "Other," please briefly indicate in the spaces provided immediately below a description of the best means to become familiar with emerging, case-related, science and technology evidence validity, reliability, and fraud.

**PART B. Ranking Opinions for
Novel Evidence in Complex Cases
between 2020 and 2030, on 1 - 10
point scales with open-ended
answer invitations.**

The following several questions request your opinion with respect to the likelihood that complex cases will be assigned to your court that involve novel scientific and technical evidence over this decade. For each evidence category enumerated below, please select the number on each scale that most closely reflects your opinion about the likelihood, if any, that the case described will be introduced in your court system.

15. GENETIC ENGINEERING EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving genetic engineering evidence. Please select the number on the following scale that most closely approximates your expectations over the ten years. (*Genetic engineering may be described as changing biological inheritance by the application of technologies to modify DNA, genes and development of humans, animals, plants, and microbes - virtually all life forms.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

16. Comment or Observation

17. DATA SCIENCE AND ARTIFICIAL INTELLIGENCE EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving data science, artificial intelligence and machine-learned evidence. Please select the number on the following scale that most closely approximates your expectations over the ten years. (*Data science may be described as evidence obtained from the analysis of large databases constructed for the purpose of understanding statistically the features and behaviors of large human populations; an example is risk of disease or comparative longevity of subpopulations. Artificial intelligence is a general term referring to statistical models derived from big data and contains algorithms claiming to be capable of answering inquiries posed by users: an example is determination of the risk of re-offending among individuals apprehended by law enforcement.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

18. Comment or Observation

19. DEVELOPMENTAL NEUROBIOLOGY EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving developmental neurobiology evidence. Please select the number on the following scale that most closely approximates your expectations over the ten years. (*Developmental neurobiology may be described as a fuller understanding of behavior by means of analysis of brain function from prenatal development through childhood and adult years via brain scans, chemical analyses of brain fluid cells and tissues, and demonstrated understanding of the brain's complex circuitry.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

20. Comment or Observation

21. COVID-19 TEST - RELATED EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving Covid-19 test data. Please select the number on the following scale that most closely approximates your expectations over the ten years. (Expectations for criminal, civil and equity case incidence and prevalence involving Covid-19 test data. Please select the number on the following scale that most closely approximates your expectations over the ten years.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

22. Comment or Observation

23. HEALTH CARE OUTCOMES RESEARCH EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving re-reported research on the outcomes of medical or surgical treatments. Please select the number on the following scale that most closely approximates your expectations over the ten years. (*Health care outcomes research evidence may be described as procedures, often in phased clinical trials, to determine the safety and efficacy of treatments for human diseases and disorders.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

24. Comment or Observation

25. ENVIRONMENTAL RESEARCH EVIDENCE*

Expectations for criminal, civil and equity case incidence and prevalence involving ecosystem research methods reporting water, air and soil quality and contamination. Please select the number on the following scale that most closely approximates your expectations over the ten years. (*Environmental research frequently expressed in reports about environmental conditions, including impact statements produced under law to assess efforts to change land, water or so use.)

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

26. Comment or Observation

27. EVIDENCE FROM CLIMATE SCIENCE PROPONENTS AND OPPONENTS

Expectations for criminal, civil and equity case incidence and prevalence involving climate science research reports on climate quality, degradation and change over time. Please select the number on the following scale that most closely approximates your expectations over the ten years.

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

28. Comment or Observation

29. MOLECULAR AND COMPARATIVE FORENSICS

Expectations for criminal, civil and equity case incidence and prevalence involving forensic evidence on trace substances not ordinarily visible to the eye but asserted to be detected by laboratory methods. Please select the number on the following scale that most closely approximates your expectations over the ten years.

	0	1	2	3	4	5	6	7	8	9	10	
Little or No Probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High probability

30. Comment or Observation

Part C: COMPLEX SCIENCE-RELATED ADJUDICATION TECHNIQUES**31. Courts Science Officers**

To what extent, if at all, would you find helpful the advice of a permanently appointed science officer commissioned by your highest court to assist assessment of the underlying scientific reliability of expert witness proffers? Please select the number on the following scale that most closely approximates your expectation over the ten years.

	0	1	2	3	4	5	6	7	8	9	10	
Of Little or No Help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Greatly Helpful

32. Comment or Observation

33. Science and Technology Background Briefings for Juries.

To what extent, if at all, would you find helpful authorization of trial judges to order background briefings for juries sitting in complex cases with novel evidence. Please select the number on the following scale that most closely approximates your expectations over the ten years

	0	1	2	3	4	5	6	7	8	9	10	
Of Little or No Help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Greatly Helpful

34. Comment or Observation

35. Funds for Judges to Acquire Science / Technology Masters

A Jurisdiction Fund to Employ Scientific and/or Technical Masters in high profile cases involving novel science and technology evidence, with the right of the parties to examine and cross-examine the master on her / his findings and report. Please select the number on the following scale that most closely approximates your expectations over the ten years.

	0	1	2	3	4	5	6	7	8	9	10	
Of Little or No Help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Greatly Helpful

36. Comment or Observation

37. Estimating the Impact of Peer-Reviewed Journal Article Retractions*

To what extent, if at all, over the emerging decade might you expect complications impacting adjudication of criminal and/or civil cases as the result of retraction of scientific and technical articles from peer-reviewed journals. Please select the number on the following scale that most closely approximates your expectation over the ten years. (*A retraction is the extraordinary act of a journal editor or editorial board to withdraw post-publication a peer-reviewed research-based article in which case it becomes a nullity in the scientific arena.)

	0	1	2	3	4	5	6	7	8	9	10	
Little / No Retraction Impact	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	High Retraction Impact

38. Comment or Observation

**Part D. THANK YOU AND
GENERAL
RECOMMENDATIONS, IF
ANY.**

The National Courts and Sciences Institute is most grateful for your participation in this survey about the future of science and technology evidence in cases typically adjudicated by general jurisdiction trial courts, appellate courts and courts of last resort.

39. We will appreciate any general recommendations you may have for improving management or background training related to scientific and technological evidence over the present decade - from 2020 to 2030.

The report drawn from this survey will be provided as a comment draft on or about August 15, 2020.

This content is neither created nor endorsed by Google.

Google

APPENDIX B.

STATISTICAL SIGNIFICANCE CALCULATIONS

By

DR. JOSHUA STARMER

Significance of Type of Court (trial v appellate) in differences between the two highest filing probability evidence domains - Forensics and Covid-19) and the two lowest probability evidence domains - Genetic Engineering and Climate Science.

For each category (where a category is something like "Climate Science" or "Covid 19 Test-related" etc), I used t-tests to compare Trial vs Appellate courts.

t-tests are justifiable with this data because the sample sizes are large (> 30) for each category.

For example, for Climate Science, I compared Trial vs Appellate and got a p-value (adjusted for multiple testing) = 0.0004. This means that there is a statistically significant difference between Trial and Appellate courts when it comes to expectations related to Climate Science.

Now, like I said, I repeated that for every category and for every single category, I detected a statistically significant difference between Trial and Appellate courts after adjusting for multiple testing.

If you want the numbers:

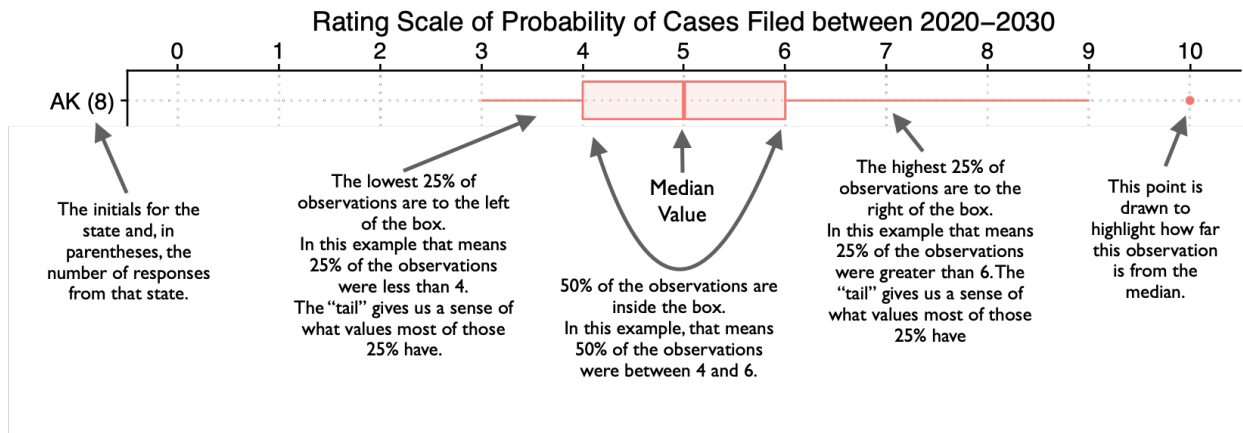
category	p.value	p.adj
Climate Science	2.73E-04	4.37E-04
Covid 19 Test-related	6.71E-08	2.68E-07
Data Science and Artificial Intelligence	4.87E-04	6.49E-04
Developmental Neurobiology	1.34E-02	1.34E-02
Environmental Research	1.87E-08	1.49E-07
Genetic Engineering	3.81E-03	4.35E-03
Health Care Outcomes Research	1.06E-06	2.83E-06
Molecular and Comparative Forensics	5.69E-05	1.14E-04

NOTE: If you are wondering what I mean by "adjusted for multiple testing", see: <https://youtu.be/HDCOUXE3HMM>

Significance of Type of Court (trial v appellate) in differences between Covid 19 and Health Care Outcomes Research Evidence.

APPENDIX C

THREE MINUTE BOX-PLOT READING TUTORIAL



APPENDIX D.

ENDNOTES BY REPORT SECTION

(Available Upon Request)

APPENDIX D.

JURISDICTIONS' APPLICATION LAW OF EVIDENCE / CONTROLLING CASES

(Available Upon Request)

APPENDIX E.

TABLES AND FIGURES BY PAGE NUMBERS

(Available Upon Request)