Evidentiary Incommensurability:

A Preliminary Exploration of the Problem of Reasoning from General Scientific Data to Individualized Legal Decision-Making

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Scientists typically study variables at the population level, and most of their methodological and statistical tools are designed for this kind of work. The trial process, in contrast, ordinarily concerns whether a particular case is an instance of the general phenomenon. As I have previously observed, "[w]hile science attempts to discover the universals hiding among the particulars, trial courts attempt to discover the particulars hiding among the universals."[1] This essential difference in perspective between what scientists normally do and what the trial process is ordinarily about has yet to be studied with any degree of rigor—by scientists or lawyers.[2] Yet this phenomenon is endemic to virtually every context in which law and science meet. Indeed, it might be said to be the single greatest obstacle to the law's rational use of science.[3]

The challenges associated with individualizing science, however, are not unique to the law. In fact, in a wide variety of social contexts, empirical research exploring general phenomena are sought to be applied reliably to individual cases. In medicine, for example, research on the effectiveness of various cancer therapies will inform a particular patient's decision regarding which therapy to choose. In meteorology, research on hurricanes will inform a governor's decision regarding whether to evacuate a particular city. Indeed, all applied science, ranging from aerodynamics to zoology, potentially presents the problem of making decisions about discrete cases based on group data. Different fields have adapted strategies to respond to the evidentiary-incommensurability challenge with differing degrees of success. In medical decision-making, for example, evidence-based medicine is one way that doctors have sought to bring data to bear on individual diagnostic and therapeutic judgments.[4] Meteorologists generate computer models that describe the likelihoods associated with a storm's path and strength.[5] At least from an outsider's perspective, these efforts have not been so successful that courts would want to borrow them wholesale.[6]

How and whether general data can be usefully employed to inform decisions about individual events is a problem that is central to the law's function. In fact, courts are generally acquainted with the difficulties inherent in employing general scientific data to reach conclusions about specific cases. The primary area in which courts have considered this matter is in medical causation cases where they distinguish routinely between "general causation" and "specific causation."[7] Courts and legal scholars have not, however, engaged in a careful

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Footnotes

1. DAVID L. FAIGMAN, LEGAL ALCHEMY: THE USE AND MISUSE OF SCIENCE IN THE LAW 69 (1999).
2. One exception to this yawning silence is the work of Joseph Sanders. *See generally* Joseph Sanders, *Applying Daubert Inconsistently? Proof of Individual Causation in Toxic Tort and Forensic Cases*, 75 BROOK. L. REV. 1367 (2010). In addition, the statistical challenges associated with individualizing group data have been examined with considerable sophistication in the context of predictions of violence. *See, e.g.*, Stephen D. Hart et al., *Precision of Actuarial Risk Assessment Instruments: Evaluating the 'Margins of Error' of Group v. Individual Predictions of Violence*, 190 BRIT. J. PSYCHIATRY s60 (2007); Douglas Mossman, *Analyzing the Performance of Risk Assessment Instruments: A Response to Vrieze and Grove*, 32 LAW & HUM. BEHAV. 279, 280 (2008); Scott I. Vrieze & William M. Grove, *Predicting Sex Offender Recidivism*, 32 LAW & HUM. BEHAV. 266, 267 (2008). The problems of individualizing group data have also caught the attention of neuroscientists. *See, e.g.*, Michael B. Miller et al., *Extensive Individual Differences in Brain Activations Associated with Episodic Retrieval Are Reliable over Time*, 14 J. COGNITIVE NEUROSCIENCE 1200 (2002). On the issue more generally, *see* John A. Swets, Robyn M. Dawes & John Monahan, *Better Decisions Through Science*, 283 SCI. AM. 82 (2000). Ultimately, however, the question of individualizing group data for courtroom use is not simply a problem of inferential statistics. *See* David L. Faigman, *The Limits of Science in the Courtroom*, *in* BEYOND COMMON SENSE: PSYCHOLOGICAL SCIENCE IN THE COURTROOM 303 (Eugene Borgida & Susan T. Fiske eds., 2008).
3. *See, e.g.*, Margaret A. Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2129–30 (1997); Margaret A. Berger & Lawrence M. Solan, *The Uneasy Relationship Between Science and Law: An Essay and Introduction*, 73 BROOK. L. REV. 847, 852–53 (2008).
4. Daniel B. Mark, *Decision-Making in Clinical Medicine*, *in* 1 HARRISON'S PRINCIPLES OF INTERNAL MEDICINE 6, 6 (Dennis L. Kaspar et al. eds., 16th ed. 2005).
5. *See, e.g.*, DAVID J. STENSRUD, PARAMETERIZATION SCHEMES: KEYS TO UNDERSTANDING NUMERICAL WEATHER PREDICTION MODELS (2007).
6. For example, Dr. Jerome Groopman cautions against over-reliance on evidence-based medicine, fearing that it "risks having the physician choose [a treatment course] passively, solely by the numbers," rather than rely on the individual circumstances of each patient. JEROME GROOPMAN, HOW DOCTORS THINK 5–6 (2007).
7. *See* DAVID L. FAIGMAN ET AL., 3 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY § 21:6-7, at 27–45 (2008–2009 ed.) (listing cases). Not all science is engaged in describing cause-and-effect relationships, so "general causation" and "specific causation" are subcategories of what might more properly be labeled "general propositions" and "specific application." Sometimes general propositions in science will be stated in causative terms, but very often they will be associational, technical, or descriptive. Specific application refers to the determination whether a particular case is an instance, use, or example of general propositions that are supported by research.

study of the details and intricacies associated with this matter across the wide spectrum of cases in which it presents itself. In addition, although the courts are passingly familiar with the problem of evidentiary incommensurability, they naturally approach the subject from their own need for information, with little appreciation for how and whether scientists can produce this information. Courts frequently demand empirical answers despite scientists' inability to provide them.[8] At the same time, scientists involved in the legal process naturally approach the problem of incommensurability from the perspective of their own desire to produce information, with little appreciation for how and whether the courts can effectively use this information.[9] It is hardly surprising that scientists should study the questions that they are most curious about and able to answer rather than those the law deems most relevant. In short, therefore, the two sides, law and science, perceive incommensurability from their separate vantage points, which largely perpetuates the problem.

This essay jumps into the center of this conundrum. My objective, however, is somewhat unusual. It is a call to arms. I do not aim to resolve the incommensurability paradox but rather to ring the fire bell. Indeed, given the scope and depth of the obstacles presented by evidentiary incommensurability, it is a subject well beyond resolution in the pages provided to me here. My purpose, then, is to explore the paradox in the hope that it will help lay a common framework through which both lawyers and scientists might understand the challenges presented at the intersection of these two great professions. This essay, therefore, contemplates many of the sundry issues that would have to be reckoned with in any subsequent comprehensive effort to bring systematic rationality to the problem of employing group data to decide individual cases. It is divided into two parts. Part I, Hypothesis Testing in Science, considers scientific hypothesis testing and the inherent population focus of most of that work. While most scientific research focuses on a general population-level analysis, results of that work can have very different levels of probative value in regard to informing decision-making at the individual level. Part II, Framing Empirical Questions in the Courtroom, examines evidentiary demands in the courtroom and the inherent individualized focus of that process. This part also considers some of the challenges inherent in any attempt to close the evidentiary-incommensurability gap between what most science says and what most legal proceedings need to know.

HYPOTHESIS TESTING IN SCIENCE

Scientific research is most often conducted from a general and population-based perspective. This is a defining characteristic of the field. However, scientific methods, and the phenomena that scientists study, range widely. Inevitably, the demands of the empirical context dictate which set of research designs are, or might be, available. While studying the effects of depleted biodiversity in the Amazon rainforest and investigating the interaction between neuron and glial cells in a rat's brain are both scientific endeavors, the methods involved are obviously disparate. Yet, from the law's perspective, there may be certain insights that persist across scientific domains in regard to individualizing group data. This section provides a preliminary sketch of the scientific landscape and examines whether certain common denominators might be identified within the process of bringing group data to bear on individual decisions.

"The essential question . . . is whether a particular case is an instance of the general phenomenon."

The essential question posed in the context of reasoning from the group to the individual is whether a particular case is an instance of the general phenomenon. If smoking causes lung cancer, the individualized query is whether a particular person's lung cancer was caused by smoking. The degree to which scientific research might be relevant to resolving an individualized question varies from completely to not-at-all relevant. In some areas, science might provide a definitive answer to the question of whether an individual case is an instance of a general phenomenon. If tobacco smoke is the only cause of lung cancer, we logically know that someone with lung cancer got sick from tobacco smoke. In other areas, science might help increase the accuracy of individual decision-making along a range of helpfulness, from nearly determinative to just above random chance. If tobacco smoke causes lung cancer, but many other things, known and unknown, do so as well, we cannot say with certainty that the person's lung cancer was caused by tobacco smoke. The degree of certainty that the science provides, of course, is the operative question. Indeed, sometimes even very good science will not demonstrably improve the accuracy of individual decision-making, though it might nonetheless be relevant and admissible in court because it provides the triers of fact with contextual information that will help them understand other evidence in the case.

WHEN GENERAL SCIENCE IS DETERMINATIVE IN PARTICULAR CASES

In practice, the law is interested not simply in whether a particular variable causes a particular effect, but, ultimately, in

8. Among many possible examples that could be cited, possibly the most obvious is that of predicting violence. Courts call upon experts in myriad contexts to predict future behavior, from probation decisions to capital sentencing, though the best empirical research indicates that such expert opinions remain highly fallible. *See* John Monahan, *A Jurisprudence of Risk Assessment: Forecasting Harm Among Prisoners, Predators, and Patients*, 92 VA. L. REV. 391, 405–07 (2006).

9. Scientists do not generally study how to "individualize" their findings in ways that would make their findings more helpful for legal usage. This is not meant as a criticism, only an observation. Especially in the social sciences, it is ordinarily sufficient to find a statistically significant effect among college sophomores. Little attention has been paid to how the variables studied might operate in a particular case.

> **"In some situations, the science will be nearly definitive regarding a specific cause-and-effect relation. . . ."**

whether a particular variable did cause the effect.[10] Scientific research will sometimes identify a single unidirectional relationship between two variables. In medicine, the term *pathognomonic* refers to a diagnostic version of this insight. A symptom is pathognomonic when it is "decisively characteristic of a disease."[11] For example, "Koplik's spots are pathognomonic of measles."[12] The strongest version of a path-specific relationship would be the unusual situation where a cause and an effect are uniquely associated, such that the cause always produces the effect and the effect is always attributable to the cause. Outside of basic physics and chemistry, however, the strongest version of path-specificity will be quite rare. Nonetheless, such relationships are possible. This strong version could be termed cause/effect path-specificity because the cause and the effect are uniquely tied to one another.

The law is also interested in weaker versions of path-specificity. For instance, a particular cause might always produce a particular effect, but other causes might produce similar effects. This could be termed causal path-specificity because the cause always produces a single effect, but other causes might produce the same effect. An example of this might be a lesion in a specific part of the brain that produces auditory hallucinations. Anyone with such a lesion would suffer from auditory hallucinations, but not all people with auditory hallucinations have a lesion in that region of the brain. Conversely, a particular effect might always be produced by a particular cause, but the cause does not invariably produce the effect. This could be termed effect path-specificity because the effect has a single cause, but the cause does not have a single effect. An example of this is the relationship between asbestos exposure and mesothelioma. The unique cause of mesothelioma is exposure to asbestos, but not everyone exposed to asbestos develops mesothelioma.[13]

In legal proceedings, the strength and nature of path-specificity is likely to be important. In general, cause/effect path-specificity will be the most probative kind of scientific evidence available. In contrast, the probative power of causal path-specificity or effect path-specificity will depend on the substantive law of the case. For example, in many criminal cases, the issue will be whether the defendant suffered the relevant effect, and it will not matter greatly that a variety of causes can produce it. In such cases, scientific evidence of causal path-specificity would strongly support the defendant's case. This would be so in an insanity case in which evidence that the defendant has a brain lesion that invariably produces auditory hallucinations would be highly probative, despite the fact that other factors might cause the same symptoms. Conversely, in many civil cases, effect path-specificity will be the more probative kind of evidence. In the example of mesothelioma, a civil plaintiff who has this disease will be able to trace it back to asbestos exposure. In many civil cases, a substantial obstacle to a plaintiff's recovery is showing that the effect he or she suffers from is attributable to a cause associated with the defendant. Effect path-specificity solves this difficulty. If the defendant was responsible for the plaintiff's asbestos exposure, then the plaintiff's mesothelioma is attributable to the defendant.

WHEN GENERAL SCIENCE IS PROBATIVE, BUT NOT DETERMINATIVE, IN PARTICULAR CASES

In most applied-science contexts, path-specificity is not possible, either because it does not exist in actuality or because scientists' methods are unable to identify it in those cases in which it does exist. In most areas of interest to the law, scientific research provides knowledge about cause-and-effect relationships generally, but will be only more or less determinate on the question of whether a specific instance of an effect is attributable to a specific cause, or that a specific cause contributed to a particular effect. In this vast domain, applied scientific research comes in myriad forms, and its value for deciding individual cases varies greatly. In some situations, the science will be nearly definitive regarding a specific cause-and-effect relation, and in others it will do little more than increase the likelihood slightly above chance that a relevant relationship exists.

As is true with the concept of path-specificity discussed in the previous section, indeterminate scientific research might be relevant in legal proceedings in three separately identifiable ways, regarding (1) effect only, because the cause is known (or can be assumed); (2) cause only, because the effect is known (or can be assumed); or (3) both cause and effect. As will become clear in the discussion that follows, the intended purpose for which the science is to be used is associated with the demands that courts place on the science itself.

In many legal contexts, only the effect is relevant because the causal variable is fairly known or is assumed. Indeed, one of the best-known subjects in law and psychology fits this category: eyewitness identification. In eyewitness-identification research, researchers have found that certain factors interfere with accuracy, such as presence of a weapon, cross-race identifications, and use of leading questions by interviewers.[14] In

10. This analysis simplifies matters considerably, since both the existence and extent of the cause, as well as the existence and extent of the effect, may be disputed in a particular case.
11. Mondofacto Online Medical Dictionary, Pathognomonic, http://www.mondofacto.com/facts/dictionary?pathognomonic (last visited Nov. 5, 2013).
12. MedicineNet, Definition of Pathognomonic, http://www.medterms.com/script/main/art.asp?articlekey=6386 (last visited Nov. 5, 2013).
13. Asbestos also causes other ailments, including lung cancer. *See* Piero Mustacchi, *Lung Cancer Latency and Asbestos Liability*, 17 J. Legal Med. 277, 280 (1996). But, as mentioned, some people who are exposed to asbestos never get sick from it.
14. *See* Gary L. Wells, *Eyewitness Identification: Scientific Status*, *in* 2 Modern Scientific Evidence: The Law and Science of Expert Testimony, *supra* note 7, at 520, 534–47.

this example, the causal side of the equation is the independent variable, which is more or less known or assumed to be present in the case. The focus, therefore, is principally on what effect this causal variable has had. Hence, if the witness is white and the perpetrator is black, the empirical crux of the matter concerns what effect this causal variable has on the accuracy of the identification. Other examples in which the effects are relevant and the cause is known or assumed include the effects of hypnosis on memory,[15] the impact of putatively prejudicial photographs or images on fact-finders' judgments,[16] and the effect of violent television on viewers.[17]

In effect-relevant cases—that is, where the cause is known or assumed and the effects have been the subject of research—the science is rarely employed to do more than provide general insights about those who have experienced the causal variable of interest. It may very well be, for instance, that when a gun is present, eyewitness identifications are on average less accurate than when one is not; but this finding provides very little information regarding whether any particular identification is accurate. In the law, general research findings might very well be relevant and admissible to inform the jury of factors that might interfere with a witness's accurate recall, which the jury could use or ignore as it deemed fit. The science in this case, however, says very little about eyewitness identification.

The second category, and one that arises often in court, is when the effect is fairly known (or can be assumed), and the science is offered to demonstrate the cause of that effect. Whole areas of medical and psychological causation fit this category, as do some areas of forensic science. In medical causation, a plaintiff might be known to have leukemia (*i.e.*, the effect) and the scientifically controverted issue will be whether one variable (*e.g.*, trichloroethylene) or another caused the illness. In psychological causation, the same analysis applies. For example, a witness who suffers from post-traumatic stress disorder (PTSD) might claim that it was caused by a sexual assault rather than other causes, such as a failed marriage and a lost job. Finally, some areas of forensic science fit this cause-relevant category. The best example is arson investigation. In the ordinary arson case, the effect is known (*i.e.*, a burned or exploded structure), but the science is offered to demonstrate the cause (*e.g.*, purposely set using some incendiary device or material).

When the proffered science is relevant to determining the cause of some known effect, it is ultimately meant to operate diagnostically in regard to the individual case at hand. This category presents the most classic manifestation of the challenges associated with applying reasoning from group data to decisions in individual cases. In many areas, the research provides substantial evidence of a general connection between variables, but the science does not pave a direct path for extrapolating general data to apply to the individual case. Ordinarily, some additional method is used to bring the general science to the individual case, usually labeled vaguely as "differential diagnosis" or "differential etiology."[18] This issue is considered in Part II, *infra*.

"[T]he methods of science do not correspond neatly to the needs of the law."

The third and final category of scientific relevance is something of a catch-all and involves those cases in which the science informs both the cause and the effect sides of the equation. In other words, in this category the situation or context is argued to have legal significance, but the science is necessary to show how or why this is so. Many psychological claims fall into this category, as do most forensic identification technologies. A good example of the former is research on predictions of violence. The matter of predicting violence has wide significance in the law, and scientists have sought to provide guidance on this issue by relating one set of variables (*i.e.*, predictors) to another variable (*i.e.*, future violence). Neither the "cause" nor the "effect" is known outside of the applicable research. Most forensic-identification technologies operate similarly. Scientific research on DNA profiling, for instance, describes both the existence of the phenomenon as well as the significance of that phenomenon for legal decision-making. Significantly, both actuarial predictions of violence and DNA profiling are framed generally, and, to the extent that they are applied to individual cases, the proffered opinions ordinarily remain in their general population-based form.[19]

In the end, law and science are separate disciplines and, though they often share goals or objectives, neither is nor should be expected to be the other's handmaiden. It is hardly surprising, therefore, that the methods of science do not correspond neatly to the needs of the law. Yet, at least in a preliminary way, it is possible to identify general pathways of scientific investigation and consider how they sometimes might, but oftentimes do not, provide the answers to the questions the law poses. Understanding the parameters of the scientific enterprise, however, is only the first step in improving the law's use of research data. Much of the information the law needs from science does not fit neatly into conventional modes of empirical inquiry. Whereas scientists ordinarily study causes

15. *See* Michael Nash & Robert Nadon, *Hypnosis: Scientific Status, in* 2 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY, *supra* note 7, at 733.
16. David A. Bright & Jane Goodman-Delahunty, *Gruesome Evidence and Emotion: Anger, Blame, and Jury Decision-Making*, 30 LAW & HUM. BEHAV. 183 (2006).
17. Kevin D. Browne & Catherine Hamilton-Giachritsis, *The Influence of Violent Media on Children and Adolescents: A Public-Health Approach*, 365 LANCET 702, 702 (2005).
18. *See generally* FAIGMAN ET AL., *supra* note 7, at 27–49.
19. *See* Helena Kraemer et al., *Coming to Terms With the Terms of Risk*, 54 ARCHIVE GEN. PSYCHIATRY 337, 340 (1997). It should be noted that, very often, an expert witness's predictions of violence are not based on scientific research at all. Many, if not most, opinions offered in court on this subject are based on clinical judgment, and they are presented accordingly as conclusions about a particular person. On the value of clinical versus actuarial predictions of violence, see Stefania Aegisdottir, *The Meta-Analysis of Clinical Judgment Project: Fifty-Six Years of Accumulated Research on Clinical Versus Actuarial Predictions of Violence*, 34 COUNSELING PSYCHOLOGIST 400 (2006).

> **"Professor Kenneth Culp Davis. . . distinguished between. . . legislative facts and adjudicative facts."**

and effects in populations, courts ordinarily need to determine causes and effects in particular individuals. The next section examines the difficulties endemic to developing a rigorous individual-based empiricism.

FRAMING EMPIRICAL QUESTIONS IN THE COURTROOM

The basic perspective of most courtroom proceedings is individual and specific. Courts look to answer such questions as whether the defendant killed the victim, the plaintiff's leukemia was caused by a chemical produced by the defendant, the juvenile defendant is competent to be tried as an adult, the capital defendant is likely to be violent if not executed, and so forth. While the ultimate issue in most legal proceedings involves the determination of a particular fact (or facts), courts well understand that underlying these specific questions is knowledge about the general world. Hence, a defendant's guilt might depend on the general match probabilities of DNA evidence, and a plaintiff's civil claim against a chemical manufacturer might depend partly on epidemiological studies showing an association between the alleged offending chemical and leukemia. Tackling the complex challenge of integrating scientific research into legal decision-making would be helped considerably if there were a vocabulary that permitted categorization of the different ways science might be relevant to legal decision-making. There has been no shortage of attempts at providing such a taxonomy.[20]

TAXONOMIES OF FACT-FINDING

The first, and still most influential, taxonomy of fact-finding in law was offered by Professor Kenneth Culp Davis.[21] Davis distinguished between what he termed legislative facts and adjudicative facts. Legislative facts are those facts that transcend the particular dispute and are relevant to legal reasoning and the fashioning of legal rules.[22] Adjudicative facts, in contrast, are those facts particular to the dispute.[23]

In a series of influential articles in the 1980s, Professors John Monahan and Laurens Walker refined Davis's dichotomy in a manner that more fully captures the ways that science is used in the courtroom.[24] Their primary focus was on the law's use of social science. They identified three levels of convergence between social science and law: social authority, social facts, and social frameworks. Social authority refers to social science research relevant to the determination of legislative facts and thus the formulation of legal rules.[25] According to their proposal, social authority is analogous to legal authority and should be consulted similarly. Hence, judges would consider social science "precedent" (*i.e.*, past research) as presented through briefs, arguments, and sua sponte.[26] The information found to be relevant and valid would then be incorporated into the judge's conclusions of law. Alternatively, in the Monahan-Walker model, social science research might be relevant to adjudicative facts (what they call "social facts"), in which case, after being deemed admissible, it would be presented to the trier of fact through expert testimony.[27] Finally, social science research might have relevance as a combination of social authority and adjudicative fact. Professors Monahan and Walker label this use "social frameworks," where some issue in the particular dispute is claimed to be an instance of a social scientific finding or theory of general import.[28]

The Monahan-Walker model, though framed to deal exclusively with social science, nicely captures the three basic divisions of fact-finding that courts must process. Most importantly, their social framework category is a significant leap forward in clarifying the challenges associated with integrating empirical research into legal decision-making. Indeed, arguably the social authority (*i.e.*, legislative facts) and social facts (*i.e.*, adjudicative facts) are merely components of social frameworks, with the latter two being defined as a function of the legal use for evidence, not its scientific nature. In other words, all empirical research is conceivable in terms of frameworks, because it invariably has both a general component and a specific component. Whether the general component is legally relevant at all and, if so, what it is relevant to prove, dictates in the Monahan-Walker model whether it is a "social authority" or "social framework."

For example, consider the empirical question of the developmental competence of 16- and 17-year-olds. In the context of capital punishment, this general fact was used in *Roper v. Simmons*[29] to support the conclusion that applying the death

20. I too have participated in this endeavor, though my efforts were restricted to constitutional cases. *See* DAVID L. FAIGMAN, CONSTITUTIONAL FICTIONS: A UNIFIED THEORY OF CONSTITUTIONAL FACTS 43–62 (2008).
21. Kenneth Culp Davis, *An Approach to Problems of Evidence in the Administrative Process*, 55 HARV. L. REV. 364, 402–03 (1942).
22. *Id.* at 402; *see also* FED. R. EVID. 201(a), Advisory Committee's Note ("Legislative facts are those which have relevance to legal reasoning and the lawmaking process, whether in the formulation of a legal principle or ruling by a judge or court or in the enactment of a legislative body.").
23. Davis, *supra* note 21, at 402.
24. John Monahan & Laurens Walker, *Social Authority: Obtaining, Evaluating and Establishing Social Science in Law*, 134 U. PA. L. REV. 477 (1986) [hereinafter Monahan & Walker (1986)]; Laurens Walker & John Monahan, *Social Facts: Scientific Methodology as Legal Precedent*, 76 CAL. L. REV. 877 (1988) [hereinafter Walker & Monahan (1988)]; Laurens Walker & John Monahan, *Social Frameworks: A New Use of Social Science in Law*, 73 VA. L. REV. 559 (1987) [hereinafter Walker & Monahan (1987)].
25. Walker & Monahan (1987), *supra* note 24, at 562.
26. Monahan & Walker (1986), *supra* note 24, at 490–91.
27. Walker & Monahan (1988), *supra* note 24, at 887.
28. Walker & Monahan (1987), *supra* note 24, at 563–67. According to Monahan and Walker's social-framework model, the judge would consider and instruct the jury on the accuracy of the general claim, but the jury would also hear expert testimony on how the research applies to the case before it. *Id.* at 592. In traditional practice, however, the jury is the fact-finder for both components of social-framework evidence. For present purposes, I need not choose which procedural approach is the better one.
29. 543 U.S. 551, 569 (2005).

penalty to those who killed before reaching the age of majority was unconstitutional. As such, this legislative fact was informed by "social authority." On the other hand, if the question was whether a particular 16- or 17-year-old had competently waived his *Miranda* rights, the research used in *Roper* would be employed to inform a "social framework."[30] In the case involving the waiving of *Miranda* rights, the court would have to apply the framework to the individual case, thus paradigmatically using both components of Monahan and Walker's social-framework category.

EMPIRICAL FRAMEWORKS

For the purpose of examining evidentiary incommensurability between law and science, the Monahan and Walker concept of social frameworks is all that is specifically needed. It fully captures the juxtaposition of the inordinate empirical difficulties surrounding the use of group data to make individual decisions and the law's frequent need to do just that. Since the phenomenon of interest extends well beyond social science, and includes all applied science with policy implications, the term "empirical framework" is more accurate and will be used here. The following sections, therefore, consider the legal demands on empirical research, from both the more conciliatory use of general research data to answer general legal propositions, to the more demanding use of general data to reach individualized judgments.

DEFINING THE "FRAME"

Because ordinary science operates at the general level of descriptive and inferential statistics, it can be readily employed to determine general propositions. Consider, for example, a hypothesis that has been the subject of several legal cases: violent video games cause minors who play them to be violent and asocial. This hypothesis has been studied in a multitude of ways, including observational case studies, correlational studies, laboratory experiments, brain imaging, and so forth.[31] If these differing methods point in the same direction, then some general conclusions might be made regarding the relationship between violent video games and violence among children. If they point in different directions, of course, the task is complicated greatly, if not made impossible, until more research is done. But even when the body of research is robust, conclusions are likely to be tentative and, at best, described in probabilistic terms.

The legal relevance of the science, however uncertainly known, depends on the substantive law of the case. In regard to the violent video game example, then, this hypothesis might be relevant as a general proposition (*e.g.*, do violent video games lead to increased violence among children?) or as that research might apply in a particular case (*e.g.*, was the minor defendant's violent action attributable to having played violent video games?).

"[There are] inordinate empirical difficulties surrounding the use of group data to make individual decisions."

In the law, most litigation tends to involve the application of general principles to a specific case. Frequently, however, a general proposition of science is itself at issue. A good example of this, coming from the violence-in-media example, is the case *Entertainment Software Association v. Blagojevich*.[32] In *Entertainment Software*, several video-game-industry trade associations sued the State to enjoin the enforcement of two statutes that regulated the content of violent and sexually explicit video games. The plaintiffs argued that the State's laws violated the Free Speech Clause of the First Amendment. The district court agreed that the laws implicated First Amendment rights and held that the legislation could survive only if the State had a compelling interest that would be substantially achieved by the laws. The court found that "[t]he Illinois General Assembly's main justifications were three legislative findings about the effect of playing video games on minors' physiological and neurological development."[33] According to the court, the legislature believed that playing violent video games makes children (1) "exhibit violent, asocial, or aggressive behavior"; (2) "[e]xperience feelings of aggression"; and (3) "[e]xperience a reduction of activity in the frontal lobes of the brain which is responsible for controlling behavior."[34] In concluding that Illinois had not met its considerable burden, the court extensively reviewed psychological and neurological research that had been advanced by the State. The court explained that the State "failed to present substantial evidence showing that playing violent video games causes minors to have aggressive feelings or engage in aggressive behavior."[35] Moreover, the court stated that "there is barely any evidence at all, let alone substantial evidence, showing that playing violent video games causes minors to 'experience a reduction of activity in the frontal lobes of the brain which is responsible for controlling behavior.'"[36] The court permanently enjoined the Illinois law.

The second hypothesis, that a particular minor's violent action is attributable to having played violent video games, is the more typical courtroom situation in regard to scientific evidence. In these cases, both the general hypothesis and the specific hypothesis are at issue. Although the defense is unusual, defendants have on occasion argued insanity on the basis of

30. *See*, *e.g.*, Thomas Grisso, *Juveniles' Capacities to Waive Miranda Rights: An Empirical Analysis*, 68 CAL. L. REV. 1134 (1980).
31. *See generally* Craig A. Anderson, *An Update on the Effects of Playing Violent Video Games*, 27 J. ADOLESCENCE 113 (2004) (reviewing the literature).
32. 404 F. Supp. 2d 1051, 1059 (N.D. Ill. 2005).
33. *Id.* at 1073.
34. *Id.*
35. *Id.* at 1074 (The court added that, "[a]t most, researchers have been able to show a correlation between playing violent video games and a slightly increased level of aggressive thoughts and behavior.").
36. *Id.*

> **"The principal tool used to move from general research findings to statements about individual cases is 'differential etiology'. . . ."**

video programming.[37] In *Zamora v. State*,[38] for example, "Zamora's insanity defense was based upon 'involuntary subliminal television intoxication."' In particular, defense counsel argued that violent television had a noxious influence on sociopathic children and that Zamora had killed as a consequence of this effect.[39] To support this theory, the defense offered two experts. The first, a psychologist, offered to testify to the effect of television on adolescents generally.[40] A second expert, a psychiatrist, testified that the defendant "did not know right from wrong" when he "fired the fatal shot," thus applying the general theory of the case to the particular defendant. The court excluded the psychologist on the ground that she could not speak to Zamora's individual case. The psychiatrist testified at trial, but apparently to little effect, since Zamora was convicted.

In the courtroom, research on general propositions, such as whether violent media causes an increase in violence among children, addresses a threshold question and one which scientists are trained to address. In an insanity defense to murder, however, the question is whether the particular person's violence was caused by exposure to violent media. This issue of specific application poses a complex and difficult cognitive exercise. Moreover, it is an exercise that varies in different empirical contexts. It is also a subject that has been substantially ignored by scientists interested in the courtroom use of their data.

REASONING TO THE SPECIFIC

Although the challenge of reasoning from general research data to individual cases has been considered in a fairly cursory manner by courts and legal scholars, the basic challenges are fairly easily summarized. This is especially so in the conventional toxic-tort-litigation context, the area in which courts have most often considered it. In a nutshell, the first task is to demonstrate that the substance could have caused the ailment (*i.e.*, the validity of the general proposition); the second task is to show both that it probably did, and that other substances probably did not, cause the plaintiff's condition.

The simplest case of this reasoning process might involve general research that indicates that some substance causes an ailment that is uniquely associated with that substance. For instance, as noted in Part I, asbestos has been shown to cause mesothelioma, and it is the only substance known to cause it.[41] Since mesothelioma is a "signature disease," the only question concerns the circumstances of the individual's exposure to asbestos (*i.e.*, was the defendant responsible?), not whether exposure caused the condition. The cause-and-effect path-specificity operates in this example to permit straightforward logical deductions from the general data to individual cases. This is rare in toxic tort litigation. For example, in contrast to asbestos, while second-hand smoke has been linked to lung cancer, many other substances are known to cause lung cancer. Hence, in regard to identifying the cause of a person's lung cancer, an expert must not only rule in smoking as a possible cause but also rule out other possible causes.[42]

The principal tool used to move from general research findings to statements about individual cases is "differential etiology," sometimes misleadingly referred to as "differential diagnosis." Properly understood, differential diagnosis refers to the identification of the illness or behavioral condition that a person is experiencing. Differential etiology refers to the cause or causes of that condition. Hence, the determination that a person suffers from "dissociative amnesia" and not "dissociative fugue" is a diagnostic issue.[43] The determination that a sexual assault at age ten caused the diagnosed dissociative amnesia, and that it did not result from a medical condition or physical trauma, is an etiological matter. Very different skill sets are usually involved in these two determinations. Indeed, the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (the DSM) explicitly eschews any claim of the etiological verity of its diagnostic categories.[44] It is worth emphasizing, as well, that the validity of the diagnosis of dissociative amnesia is a matter of general research. The entire process of differential diagnosis and differential etiology assumes that the designated category has adequate empirical support in the first place as a general proposition. Hence, although it is logically obvious, it should be stated plainly that an expert should never be permitted to testify about a specific application of a general proposition if research does not adequately support the general proposition.

In the professional practice of both clinical medicine and clinical psychology, the primary concern is diagnosis and not etiology. An oncologist might be curious about what caused his or her patient's leukemia, but the doctor's first task is to diagnose and treat the condition, not determine whether it was caused by trichloroethylene, benzene, electromagnetic fields, or something else. Similarly, a psychologist treating a person thought to suffer from either PTSD or adjustment disorder is primarily concerned with identifying and treating the condition, not determining the true causes of that condition. In the

37. *See generally* Jonathan Chananie, *Violent Videogames, Crime, and the Law: Looking for Proof of a Causal Connection*, 26 Dev. Mental Health L. 27, 43 (2007) (listing cases); Patricia J. Falk, *Novel Theories of Criminal Defense Based Upon the Toxicity of the Social Environment: Urban Psychosis, Television Intoxication, and Black Rage*, 74 N.C. L. Rev. 731 (1996) (same).
38. 361 So. 2d 776, 779 (Fla. Dist. Ct. App. 1978).
39. *Id.*
40. *Id.*
41. Victor Roggli, *Asbestos: Scientific Status*, *in* 3 Modern Scientific Evidence: The Law and Science of Expert Testimony, *supra* note 7, at § 26.
42. Faigman et al., *Tobacco: Legal Issues*, in 3 Modern Scientific Evidence: The Law and Science of Expert Testimony, *supra* note 7.
43. Am. Psychiatric Ass'n, Diagnostic and Statistical Manual of Mental Disorders §§ 300.12–.13 (4th ed., text revision 2000).
44. *Id.* at xxxvii.

ordinary practice of clinical medicine and clinical psychology, treatment and therapy are the principal objectives, not assessing cause. A person presenting symptoms associated with PTSD, therefore, may claim that the traumatic event was a sexual assault committed by her uncle. From the therapeutic standpoint, at least at the start, the important factor is that there was a traumatic event. Whether the patient's uncle was the cause need not be specifically resolved for diagnostic purposes. In the law, of course, who caused the traumatic event is the crux of the matter. Hence, the core nature of much clinical practice is at right angles to the crux of most legal inquiries.

In the courtroom, differential etiology is the operative issue. Moreover, the same basic principle is implicated, whether the expert opinion comes from research-based science or clinical practice (*i.e.*, "experience"). Indeed, at least superficially, the former suffers a comparative disadvantage, since the research tradition does not ordinarily purport to offer conclusive statements about individual cases. Research, for example, might identify factors highly associated with false confessions, but these general propositions are some distance from what is needed to allow experts to opine regarding the truth or falsity of any particular confession. Clinicians at least have a history of applying general knowledge to individual cases, though, as noted, while this practice might be well accepted for therapeutic purposes, its validity for forensic ends is somewhat doubtful. Whether researchers or clinicians have the wherewithal to help triers of fact in applying general research propositions to specific cases is a threshold legal matter that should depend on the reliability and validity of the differential etiology done in the respective case. It may be, that is, that in vast areas of clinical practice there is no general research foundation in the first instance. And, as stated above, if research does not support a general proposition—say, the phenomenon of repressed memories—then clinical expert testimony that a particular person has repressed certain memories of early sexual abuse cannot be sustained.

DIFFERENTIAL ETIOLOGY

Differential etiology is a reasoning process that involves a multitude of factors, few of which are easily quantified. An expert offering an opinion regarding a specific case must first consider the strength of the evidence for the general proposition being applied in the case. If the claim is that substance X caused plaintiff's condition Y, the initial inquiry must concern the strength of the relationship between X and Y as a general proposition. For example, both second-hand smoke and first-hand smoke are associated with lung cancer, but the strength of the relationship generally is much stronger for the latter than it is for the former. The inquiry regarding strength of relationship will depend on many factors, including, among other things, the statistical strength of any claims and the quality of the methods used in the research. Additionally, the general model must consider the strength of the evidence for alternative possible causes of Y and the strength of their respective relationships (and possibly interactions with other factors). Again, the quality of the research and the different methodologies employed will make comparisons difficult. Complicating matters further regarding identification of potential causes of condition Y are the myriad of possible causes that have not been studied, or have been studied inadequately.[45] Hence, determining the contours of the general model is a dicey affair in itself, since it requires combining disparate research results and discounting those results by an unknown factor associated with additional variables not yet studied. And this is just the first part of the necessary analysis if the expert wants to give an opinion about an individual case.

> **"Differential etiology is a reasoning process that involves a multitude of factors. . . ."**

The second part of the analysis—specific application of general propositions that are themselves supported by adequate research—requires two abilities, neither of which are clearly within most scientists' skill sets. The first, and perhaps less problematic, is that of forensic investigator. Almost no matter what the empirical relationship, whether medical or psychological, exposure or dosage levels will be relevant to the diagnosis. The first principle of toxicology is that "the dose makes the poison," since any substance in sufficient quantities could injure or kill someone.[46] Similarly, in a wide variety of psychological contexts, the exposure or dose will be the poison. For instance, degree of trauma affects diagnostic categorization between PTSD and adjustment disorder, level of anxiety affects eyewitness identifications, amount of lack of sleep affects false confession rates, and so on. The expert testifying to specific causation must determine exposure and dosage levels for the suspected cause (*i.e.*, the source suspected by the client) as well as for all other known or possible causes. This task is difficult enough alone but is enormously complicated by the significant potential for recall bias, given that the litigation will be profoundly affected by what is recalled.

The second skill set that is needed has not yet been invented or even described with precision. Somehow, the diagnostician must combine the surfeit of information concerning the multitude of factors that make up the general model, with the case history information known or suspected about the individual, and offer an opinion with some level of confidence that substance or experience X was the likely cause of condition Y. In practice, this opinion is usually stated as follows: "Within a reasonable degree of medical/psychological certainty, it is my opinion that X caused [a particular case of] Y." This expression

45. In *Henricksen v. Conocophilips Co.*, 605 F. Supp. 2d 1142 (E.D. Wash. 2009), the court observed that 80 to 90% of the causes of acute myelogenous leukemia (AML) were unknown ("ideopathic"). *Id.* at 1149. The court stated that "[i]f 90 percent of the causes of a disease are unknown, it is impossible to eliminate an unknown disease as the efficient cause of a patient's illness." *Id.* at 1162 (quoting Whiting v. Boston Edison Co., 891 F. Supp. 12, 21 n.41 (D. Mass. 1995)).

46. Bernbard D. Goldstein & Russellyn Carruth, *Toxicology: Scientific Status*, *in* 3 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY, *supra* note 7, at § 22.

has no empirical meaning and is simply a mantra repeated by experts for purposes of legal decision makers who similarly have no idea what it means. But even less extreme versions of this statement—such as, "It is more likely than not true that this case is an instance of some general phenomenon"—are objectionable. Just how, for instance, would an eyewitness researcher determine that a witness was more likely than not inaccurate when the witness made a cross-racial identification of the defendant after seeing the unarmed perpetrator for five minutes under a streetlight from an unobstructed view 20 feet away from the crime? There is no data that would support psychologists' ability to make such statements, however modest or innocuous such statements may appear. Experts' case-specific conclusions appear to be based largely on an admixture of an unknown combination of knowledge of the subject, experience over the years, commitment to the client or cause, intuition, and blind faith. Science it is not.

Whether, and in what way, particular scientific findings are relevant to legal decision-making depends on the substantive law of the case. Frequently, the relevant factual issue under applicable law involves general propositions, ones that population-based research corresponds to directly. Much more often, however, the empirical focus of the ultimate legal issue is on the particular case. But conventional scientific methods do not share this focus. Although research data might demonstrate with high confidence that a particular variable has an effect of interest, it typically cannot demonstrate with the same confidence that the particular variable had the effect of interest in a particular case. Reconciling this evidentiary incommensurability between what science ordinarily does and what the law ordinarily needs is, as yet, one of the great unmet challenges at the intersection of science and the law.

CONCLUSION

Most evidentiary codes require that expert testimony "assist the trier of fact" in order for it to be admissible.[47] Scientific expert testimony, however, must be legally relevant and have evidentiary reliability (*i.e.*, scientific validity).[48] Moreover, expert opinion must offer insights beyond what triers of fact could do on their own. Put another way, scientist-experts are limited to testifying about what their respective field's research can validly add to fact-finders' deliberations—and nothing more. This injunction, however, is not always followed. In particular, experts frequently seek to comment not simply on the import of general research findings, but on whether a particular case fits those findings. Scientific research that permits a valid description of a general phenomenon, however, does not invariably give experts the capacity to validly determine whether an individual case is an instance of that general phenomenon.

A basic difference in perspective between science and the law is that science studies individuals in order to make statements about populations, while the law studies populations in order to make statements about individuals. It does not necessarily follow that a scientist who can validly describe a general phenomenon also has the wherewithal to say whether an individual case is an instance of that general phenomenon. In many respects, the matter of translating scientific research findings into helpful information for fact-finders in court should be a subject of first concern for applied science. Yet this issue has been largely ignored by scientists. This essay calls for a broadly conceived collaborative effort to consider this basic issue, one that is endemic to the intersection of law and science.

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47. FED. R. EVID. 702.

48. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 591 (1993).