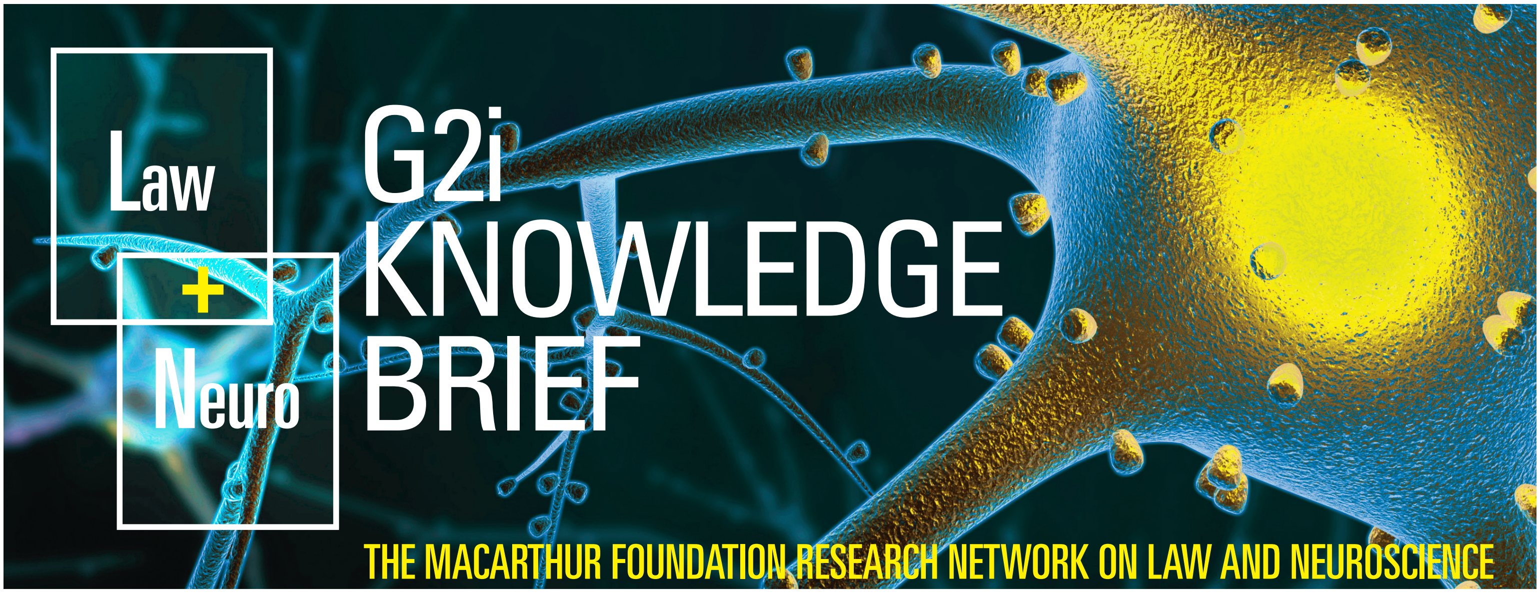


There's a good chance that if you take an aspirin, your headache will disappear. Then again, it might not.

Decades of clinical trials conducted with hundreds of thousands of ordinary headache sufferers confirm that the humble aspirin really works. So, why isn't your headache budging? The answer, or a version of it, is usually somewhere on the package insert: individual results may vary. The longer version of the marketing shorthand is this: Even the best science—science characterized by rich data collected from multiple experimental subjects or events and over multiple trials or experiments—frequently can tell us little, if anything at all, about the individual case.

Science seeks to understand general phenomena, not particular instances. Scientists typically don't attempt to infer from group or population-based data (or "G") to a particular individual (or "i"). Answering the individual question simply isn't part of the everyday scientific enterprise. That's why the applied science that is part of our everyday lives—whether in the form of drugs, diagnostic tests, or weather forecasts—doesn't come with a promise. It comes with a probability.

## G2i IN THE COURTS: MUDDLING THROUGH

The challenge of reasoning from group data to make decisions about individuals—a process we call "G2i"—is endemic in the modern courtroom. As in everyday life, that challenge is also frequently ignored, underestimated, or misunderstood.

Neuroscientists offer evidence that, on average, adolescents are less developmentally mature than adults. Cognitive psychologists testify to factors that contribute to eyewitness misidentification. Psychiatrists identify factors associated with "future dangerousness." In each case, experts offer general statements about the empirical world based on aggregate data across groups of individuals. The courts, however, are typically looking for answers specific to the case at hand: Is or was *this* defendant developmentally mature? Was *this* eyewitness's identification accurate? Will *this* defendant be violent in the future?

Courts are generally guided by one of two cases when it comes to admitting—or excluding—scientific evidence. Established in 1923, the *Frye* test asks whether the scientific methods supporting the expert opinions are generally accepted in the particular fields from which they come. Seventy years later, the Supreme Court ruled that the applicable federal rules of evidence replaced *Frye* test with a validity test. Under that approach, first established in the case of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, courts must determine whether the methods and principles underlying the expert opinion are reliable and valid. Today, *Daubert* is the rule in all federal cases. Most states have adopted it, as well, and many others have been influenced by its reasoning. Neither *Frye* nor *Daubert*, however, speak directly to G2i.

Courts are daily confronted with admissibility issues, some of which involve the existence of the general phenomenon (i.e., "G") and others the question of whether a particular case is an instance of that general phenomenon (i.e., "i"). For instance, research might indicate that a particular abnormality in a part of the brain called the amygdala is associated with psychopathy. But many psychopaths have normal amygdalae and many non-psychopaths have abnormal amygdalae. So although, on average, psychopaths might have more abnormal amygdalae than non-psychopaths, a particular person's amygdala is not diagnostic of psychopathy.

Unfortunately, courts have yet to carefully consider the implications of G2i for their admissibility decisions. In some areas, courts limit an expert's testimony to the general phenomenon. They insist that whether the case at hand is an instance of that phenomenon is exclusively a jury question, and thus not an appropriate subject of expert opinion. In other cases, in contrast, courts hold that expert evidence must be provided on *both* the group-data issue, i.e., that the phenomenon exists, and what is called the "diagnostic" issue, i.e., that this case is an instance of that phenomenon.

Courts' treatment of expert testimony on factors that might lower the accuracy of eyewitness identifications illustrates the "phenomenon only" approach. Courts generally permit eyewitness experts to testify about factors, such as cross-race identifications or stress, that might negatively affect accuracy. They do not permit testimony, however, on whether a particular identification was accurate or not. In *United States v. Smith*, for instance, the court explained that the value of this general testimony was educative: "Educating the jury about this research … is an important step along the road to using improved scientific knowledge to create more accurate and fair legal proceedings." The testimony was not, the *Smith* court emphasized, diagnostic: "Applying this research to the facts of the case is within the sole province of the jury."

Yet in a host of other cases, the courts either demand or permit experts to offer diagnostic opinions on whether the case at hand is an instance of some legally relevant phenomenon. In medical causation cases, for example, a plaintiff must introduce expert testimony on both "G" and "i". A plaintiff claiming that benzene exposure caused his or her leukemia, for instance, would have to introduce both general scientific evidence that benzene causes leukemia and scientific diagnostic evidence that exposure to benzene specifically caused his or her leukemia. In cases involving forensic identification—ranging from fingerprints to firearms—the courts generally allow experts to testify to both "G" and "i". Thus, a firearms expert typically testifies that certain marks on cartridge cases are associated with a group of firearms and, additionally, that the marks on the cartridge case found at the crime scene were made by a specific gun.

Unfortunately, the cases in which the courts insist on, or permit, diagnostic testimony do not necessarily align with scientists' ability to offer valid diagnostic opinions. It is exceedingly difficult to determine whether a particular case of leukemia is attributable to benzene exposure, and it's impossible to say that the marks on a cartridge case came from a particular gun. A key insight of G2i, then, is that courts should assess an expert's ability to provide empirical framework evidence separately from his or her ability to provide diagnostic evidence.

## KNOWLEDGE AND ITS LIMITS: THE ADOLESCENT BRAIN

Three decisions of the United States Supreme Court illustrate both how far we have come and how far we still have to go in understanding the limitations of scientific inference. All three cases involved group-level behavioral and neuroscience research that demonstrates that the brain, with its concomitant developmental capacities, does not fully mature until the early 20s.

In *Roper v. Simmons* (2005), the Court held that the Eighth Amendment did not permit imposing the death penalty on a defendant who had killed prior to his eighteenth birthday. Writing for the majority, Justice Kennedy implicitly acknowledged that justice must take into account both the validity of the "G"—the empirical evidence that on average the adolescent is not developmentally mature—and the difficulty of the "i," that is, of knowing whether a particular adolescent is mature or not.

"[T]he differences between juvenile and adult offenders," Kennedy wrote, "are too marked and well understood to risk allowing a youthful person to receive the death penalty despite insufficient culpability." Drawing a line at 18 years of age, the Court allowed, was arbitrary but necessary under the circumstances. "It is difficult even for expert psychologists to differentiate between the juvenile offender whose crime reflects unfortunate yet transient immaturity, and the rare juvenile offender whose crime reflects irreparable corruption," he wrote.

In *Graham v Florida* (2009), the Court extended this reasoning to another set of juvenile offenders, those facing life without parole for crimes other than homicide. The decision, like the one in *Roper*, was categorical, applying to all individuals below the age of 18 at the time the crime was committed. Again, the Court explained, "even if we were to assume that some juvenile nonhomicide offenders…merit a life without parole sentence, it does not follow that courts taking a case-by-case proportionality approach could with sufficient accuracy distinguish the few incorrigible juvenile offenders from the many that have the capacity for change."

Finally, in *Miller v. Alabama* (2013), the Court concluded that the Eighth Amendment also prohibits mandatory life without parole for juveniles convicted of homicide. Citing both *Roper* and *Graham*, once again the Court's decision referenced scientific findings that "both lessened a child's 'moral culpability' and enhanced the prospect that, as the years go by and neurological development occurs, his 'deficiencies will be reformed.'" It also reiterated the previously noted difficulty of distinguishing between "transient immaturity" and "irreparable corruption."

Yet in *Miller*, the Court declined to "foreclose a sentencer's ability" to make that distinction. That is, unlike *Roper* and *Graham*, *Miller* gave courts the option of sentencing youthful offenders to life without parole on a case-by-case basis, despite the fact that there is no available neuroscience research to aid such a determination. There is no neural signature for maturity, no single psychological test that directly reveals how well developed an individual person is. Justice Kagan, writing for the *Miller* Court, did note the incongruity between the earlier cases of *Roper* and *Graham* and the one before her. She believed that the scientific studies regarding the average maturity of adolescents might create something of a presumption against Life Without Parole sentences for youthful offenders. As she put it, "appropriate occasions for sentencing juveniles to this harshest possible penalty will be uncommon."

Do the inherent challenges of G2i, then, constitute an unbridgeable gulf between science and the law? We think not. Although G2i decsribes a fundamental divide between the two disciplines, and perhaps no single structure is available to bridge it—at least, not yet—it's a division that might be managed effectively.

Effective management will depend both on paying attention to the specific legal context and on the science that might be available at the time in each of those contexts. Consider, for example, the issue raised by the *Miller* case. The Court found that the state of the science indicated legally relevant differences in maturity between adolescents and adults, which supported its ruling that it was unconstitutional to sentence adolescent homicide offenders to mandatory life in prison. The science on adolescents as a group thus helped establish the constitutional rule. But, as a practical matter, courts must now sentence individual adolescents. Almost certainly, at sentencing the parties will seek to introduce "scientific" expert testimony that supports their side—for the defendant, that he was developmentally immature at the time of the crime and, for the prosecution, that the defendant was as developmentally mature as an average adult when he committed the crime.

Should courts admit this form of diagnostic expert evidence? The answer rests on a G2i evaluation and, specifically, whether the scientific foundation is sound enough to permit a valid opinion about the individual case. If the answer is no, other evidence, evidence from non-experts (i.e., family, friends, police, victims, etc.) can still be introduced to demonstrate the defendant's level of developmental maturity at the time of the crime. Just as in the case of eyewitness identification research, the general framework research on adolescent behavioral and brain development is valuable and admissible. Whether a particular individual is or is not mature continues to be a pivotal legal issue, but may not be one that science can answer with any certainty.

## MANAGING THE G2i DIVIDE

Managing G2i requires, foremost, the active involvement of both legal scholars and scientists.

For the courts, adopting just two key best practices will help reduce the complexity that contemporary science has added to the already complex adjudicative task. First, courts must begin their consideration of scientific evidence by focusing on both whether it is "good"—that is, meets certain evidentiary standards—and on what it's good *for*. Every case involving expert evidence involves a choice: admit testimony about the general phenomenon, or admit such general testimony *and* diagnostic testimony. The first decision is separate from the second. Furthermore, diagnostic testimony cannot be admissible unless the testimony on the general phenomenon is also admissible; evidence that something is an instance of a larger phenomenon presumes that the larger phenomenon itself exists.

Second, only after the court has decided whether the expert testimony concerns a general phenomenon, or concerns whether a particular case is an instance of that phenomenon, should it determine whether that testimony is admissible. While few courts realize it, the primary criteria derived from *Daubert*—i.e., relevance, qualifications, scientific validity, added value or helpfulness, and unfair prejudice—operate differently depending on how the evidence is to be used.

For scientists, and the experts who testify to the science, a host of issues should be paramount. The process of reasoning from group data to individual cases, of course, is principally a scientific one and, more particularly, a matter of statistical inference. The scientific community might begin by asking which methods or tools might be available or could be developed to facilitate the process. The issue of G2i reasoning is not unique to the courtroom. Meteorologists study storms, but we want to know whether a storm will hit during our commute tomorrow morning. Medical researchers study the effectiveness of drugs, but we want to know whether a particular drug will relieve our headache or, possibly, cause some side effects. Ordinarily, the G2i issue is translated into group statistical terms: "there's a 60 percent chance it will be raining at 8:30 a.m. tomorrow." In court, decision makers often need to translate those probabilities into more categorical terms, such as guilty/not guilty, liable/not liable, mature/not mature, and causation/no causation. Scientists could assist the process considerably by helping courts understand and translate the probabilities derived from group data to help legal decision makers decide individual cases.

Scientific advances in understanding the challenges of G2i, however, might not be far off. For instance, we may be on the cusp of an explosion of high-quality "precision" science in realms from neuroscience to genetics to nanotechnology. One tantalizing promise of science in the 21st century is knowledge at the level of the individual, and the challenge for courts in the 21st century is to distinguish between that promise and reality. Developing and refining a more sophisticated understanding of science, along with evidentiary guidelines that reflect that understanding, will enable the courts to meet that challenge now and in the decades to come.

### To learn more

For a full discussion of the material presented in this summary, including how evidentiary standards change depending whether an expert is offering framework or diagnostic testimony, see *Group to Individual (G2i) Inference in Scientific Expert Testimony*, David L. Faigman, John Monahan, & Christopher Slobogin, 81(2) U. Chi. L. Rev. 417 (2014).

For an example of how the best practices described in the above article might apply to a specific discipline, see *Toward a Jurisprudence of Psychiatric Evidence: Examining the Challenges of Reasoning from Group Data in Psychiatry to Individual Decisions in the Law*, Carl E. Fisher, David L. Faigman, & Paul S. Appelbaum, 69(3) U. Miami L. Rev. (2015).

*Law & Neuroscience: What, Why, and Where to Begin*, MacArthur Foundation Research Network on Law and Neuroscience (2016).

For more information about the work of the MacArthur Foundation Law and Neuroscience Network, visit **www.lawneuro.org**.