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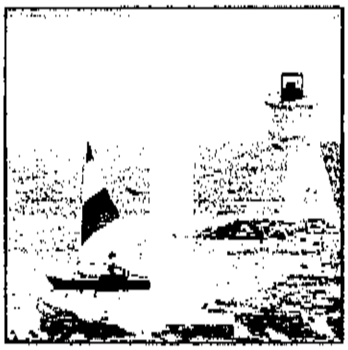

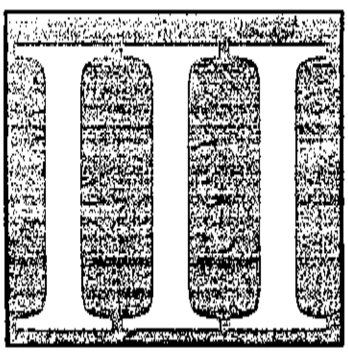

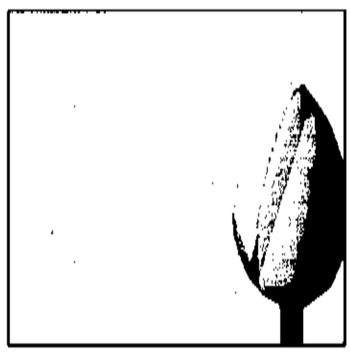

- *Daubert* Principles (Part II of III)
- *Daubert* — A Neuropsychologist's Perspective (Part II of II)
- Uncertainty in Accident Reconstruction
- Insurance Law Update
- Public Relations — Protecting a Client's Reputation
- Third Annual Law Student Writing Competition
- Young Lawyers Section: The Trial (Part 1)
- Court Rules Update
- Guest Column: Child Welfare and Parental Rights

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DAUBERT AND *FRYE*: A NEUROPSYCHOLOGIST'S PERSPECTIVE

[PART 2 OF 2]

By: Sue E. Antell, PhD ABPN ABPP

Executive Summary

Neuropsychology presents its own set of issues under the *Frye* and *Daubert* analysis of expert testimony. Part One of this article, in the October 2006 issue of the *Quarterly*, presented a discussion of the place of neuropsychology in the broader field of psychology, and the qualifications and credentials of neuropsychologists.

In this article, the author provides an explanation of the scientific methods employed in scientific studies, and the difference between experimental studies, where controls can be used, and observational studies, which are commonly used with human populations, and require different techniques. Observational studies may be longitudinal, based upon observation over time, or cross-sectional, based on observation of a group with variations of the characteristic of interest (such as age). In these areas, the attorney should be sensitive to the techniques and limits of statistical analysis, because those limits relate to the strength of the evidence as proof of causation in a particular case. Working with a neuropsychologist, the attorney can be prepared to prevent the use of testimony that may appear convincing but lack the scientific basis required under *Daubert* and *Frye*.

Introduction

Although neuropsychology is a recognized specialty within the field of psychology, any licensed psychologist can practice as a neuropsychologist. There are organizations that certify persons as qualified in the specialty of neuropsychology, but there are also "vanity boards" whose credentialing is not accepted within the profession. The attorney must be alert to the qualifications of a person retained by the attorney or the opposing counsel as a neuropsychologist. It is also important to examine the precise methodology that the expert has followed in gathering the data and interpreting it. Neuropsychology requires that regular methods be followed, including the way the testing is conducted, the way the report is prepared and the personnel who may participate in the process.

Experimental vs. Observational Research

It is in the area of applicability of research to individual cases that *Daubert/Frye* and associated rules may have their most important utility. Failure to understand scientific methodology has resulted in much speculative research offered as established fact, and broad findings offered as proofs in individual cases. In order to understand how scientific evidence should be used, it is first necessary to understand the distinction between *experimental* and *observational* research.

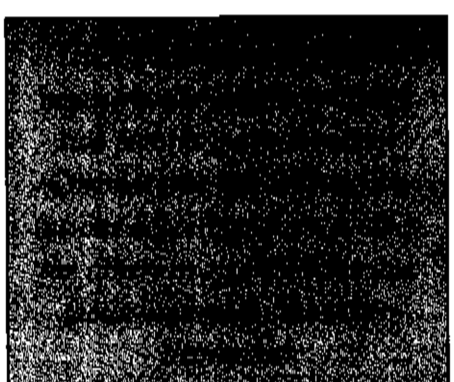
Experimental Research — Controlled Studies

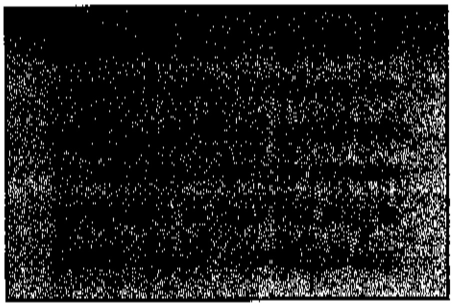
Experimental research is research conducted under highly controlled conditions in which all factors remain constant, except the single factor under investigation. For example, in a study to determine whether a particular chemical is carcinogenic, a scientist might initiate an experiment to see if the chemical had any carcinogenic potential in mammals. To do this, the scientist would expose a sample of mice to the chemical and compare tumor development to a control group of mice with no such exposure. Prior to and following exposure, all the mice would be maintained in identical conditions, so that the only factor that varied was exposure. If, at the end of the experiment, the mice in the exposure group demonstrated significantly greater rate of tumor development, this would be considered substantial evidence of the carcinogenicity of the agent in mice. If following this, the experiment was repeated with more mice, and perhaps other mammals, one could conclude that there was strong evidence of carcinogenicity in the animal groups upon which the experiment was done. This controlled experiment might **suggest** that the chemical has the potential to cause cancer in humans, although it could not be offered as **evidence** that it is carcinogenic in humans because the experiment did not include human subjects. The experimental design is, in science considered to provide the greatest level of proof since it is possible in such a design to tightly control for any other factors which might affect the outcome. These other factors that can affect the outcome are typically referred to as "confounds" or "covariates".

Observational Research — Longitudinal Studies

When we attempt to look at potentially toxic or harmful effects in a human population, the classical experimental design is not available as a method. Instead, we have to rely upon *observational* or *epidemiological* research. Broadly, such research consists of the identification of representative samples from a population of interest. In a *longitudinal* study, the sample is followed over a period of time and sorted by exposure to the hypothesized insult. The outcome of interest is measured at various points and yields a *correlation coefficient* or "*r*."

Simply described, a correlation merely measures the degree to which two factors move together. Correlations can be positive (as one score increases so does the other) or negative (as one factor increases, the other decreases). The correlation coefficient can range from 0.0 to 1.0 with 0.0 describing the absence of a relationship, and a 1.0 demonstrating a perfect relationship. Correlations between factors, even when quite high, may not reflect a *causal* relationship. Sometimes, correlations are *spurious* (due to factors other than the one under consideration), or due to some other shared influence ("covariates").





Statistical Significance

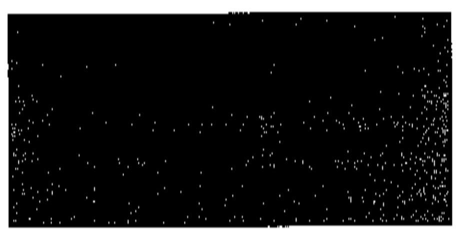
Once a "correlation coefficient" has been assigned, it is tested for *statistical significance,* a term of art that means that the obtained results are unlikely to have been derived by chance (*i.e.*, that the results are valid). A finding of significance is based upon scientific convention which says that there is either a 5% or a 1% chance (depending on which level is chosen) that the results are due to error.

A difficult principle for non-scientists to appreciate is that the findings of a study are not **more** or **less statistically significant**. They either **are** or **are not** significant. Studies that fail to meet the more generous .05 confidence level are simply not significant, and therefore cannot be used to support a hypothesis. Such studies do not "trend" towards significance or "suggest" or "imply" significance. They are simply not significant, period. In longitudinal studies, additional statistical techniques are typically used to control for the effects of known confounds and covariates, although by definition, such statistical control is never perfect.

Once we have established a correlation coefficient (through the use of techniques such as multiple regression), we can use it to estimate the amount of the variance accounted for by our factor of interest. This is represented by the "R-squared," which is simply the correlation squared. "Variance," as a term of art, simply refers to the difference between scores on an outcome. Thus, if we say a factor accounts for 1% of the variance, it means that 1% of the differences on our outcome measure are explained by the factor of interest. The remaining 99% is explained by other factors, some of which may have been entered into the regression as potential covariates and the contributions of which can thus be measured, but also including other factors of which we might be unaware.

Observational Research — Cross-Sectional Studies

A second observational method of conducting research is *cross sectional*. Here instead of following a group of people over time, the sample consists of people selected at various points along a continuum of interest (e.g., age), and the measurements completed on a single occasion. It is often possible with cross sectional research or similar designs to retrospectively compare populations. For example, if we wanted to look at smoking and lung cancer, it would be possible to study a group of lung cancer patients and compare their smoking habits



with non-patients. In these types of designs, there is always the responsibility to *match* or *randomize* samples to reduce the impact of covariates or other errors.

Epidemiology

Epidemiology is a separate science, which is closely related to observational research, and the terms are often used interchangeably. The principal difference between epidemiological research and more experimental observational research is that it is

Continued on page 16

Continued from page 15

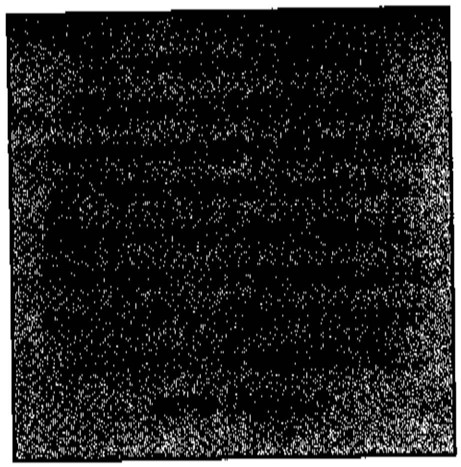
more often prospective and/or retrospective, and uses slightly different statistical models to measure the same things. Thus, instead of talking about correlations, we talk about "strength of association," and instead of statistical significance, we are more concerned with concepts of specificity (how likely is it that we measure an actual effect and not something else) and sensitivity (how likely is it that we will be able to find an effect which is out there). Typically, sensitivity and specificity exist in an inverse relationship.

Because such studies are acknowledged to be imperfect, scientists who seek general causal connections are, out of necessity, required to consider a **body of research** rather than merely the results of a few studies. This can be done by exploring the body of representative research and analyzing it with respect to a set of criteria known as "Bradford-Hill," and/or by applying a statistical technique known as "meta analysis."

General vs. Specific Causation

Before discussing these techniques in more detail, a word about **general** versus **specific causation**. Scientific research is rarely conducted with the intention of identifying a cause for a disease, dysfunction, or other outcome in an individual. Rather, science is intended to develop broad principles by which natural and social phenomena can be explained, and especially in medicine and the social sciences, the improvement of the human condition by identifying the causes and cures for diseases and dysfunctions.

By contrast, **specific causation** is of interest to the attorney and the litigant because, in a cause of action, it is necessary to demonstrate (to a reasonable degree of certainty), that the alleged insult caused an injury in a specific individual. In the *Reference Manual on Scientific Evidence* (Federal Judicial Center 2000), the authors very clearly set out both the manner

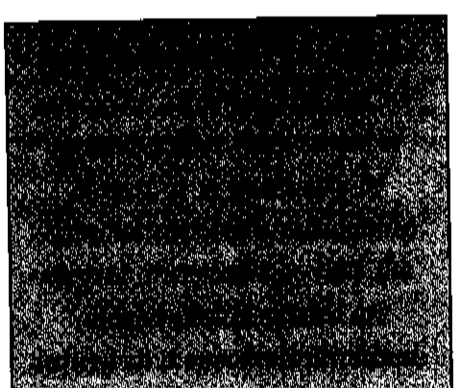


in which the Bradford Hill criteria can be used in developing theories of general causation, and the correct manner by which such theories may be applied in individual cases.

General Causation — Bradford Hill Criteria

Bradford Hill sets out 9 principles that must be satisfied before a group of studies can be construed as making a case for general causation. These include:

1. **Temporality.** The alleged cause must occur prior to the effect.
2. **Strength of the association.** In epidemiology, this refers to something called the relative risk ratio. Often, however, the results are not couched in these terms and instead apply to the size of the **correlation coefficient.** This is different from "effect size," which is a



term of art that literally describes the size of the change due to the factor of interest. It is possible to have a very large effect size and a very small correlation coefficient and vice versa. Similarly, it is possible to have a large correlation coefficient or effect size in the absence of statistical significant, and possible to have a tiny effect size or correlation coefficient which is statistically significant.
3. **Dose-response relationship.** There must be some predictable relationship between the cause and the effect, although this is not always linear.
4. **Replication of the findings.** Repeated studies have resulted in the same or similar findings in the same and other populations.
5. **Biological plausibility.** The findings must demonstrate some coherence with what is biologically possible based upon existing knowledge.
6. **Consideration of alternative explanations.** Have confounds been identified and accounted for either statistically or using other techniques?
7. **Cessation of exposure.** Does removal of the offending agent result in an appropriate reduction of the outcome across populations?
8. **Specificity.** The degree to which the relationship between cause and effect is specific to that set of factors.
9. **Consistency with other knowledge.** Are the findings consistent with other information which is relevant to the alleged relationship?

These criteria, while providing a broad set of standards upon which to base a causal inference, do not provide a **formula** for so doing. All factors are not equal (for example, that the cause precedes the effect would be an absolute, but specificity may be less important because a particular effect may have multiple independent causes). Similarly, not all of the criteria may be relevant within a given area of study.

General Causation — Meta Analysis

As noted, meta analysis makes use of a statistical methodology to pool or combine the results of multiple studies. When properly done meta analysis also accounts for the "file drawer effect" (the tendency of scientists and journals to not publish the results of studies in which a hypothesis is not supported). While meta analysis is a useful complement to the thoughtful analysis implied by the Bradford Hill criteria, the results of such meta analyses require careful scrutiny in terms of the studies included in the analysis. Still, when a meta analysis or series of meta analyses enable one to draw the same causal inferences as would result from a Bradford Hill analysis, then it would appear that both *Daubert* and *Frye* Criteria would be met. Conversely, failure to satisfy would violate standards based upon general acceptability, testability, and error.

Specific Causation

In litigation, once criteria for general causation have been met, it still remains for the trier of fact to determine whether the general cause can be inferred in the specific cause of action. The determination of whether the specific causation requirement has been met is more of a legal than a scientific question, but science does offer some assistance.

1. In neuropsychology, the first question to be answered in establishing causation is whether the individual is **different** after the alleged injury. In adults, we have many techniques to establish premorbid functioning (e.g. prior test scores, academic and employment history, medical history, etc). In children, especially those whose injury allegedly occurred prior to any formal testing or entry into the school system, the techniques are less certain, and most authors would agree that early medical/developmental history (including information regarding pregnancy, birth, and early childhood), when combined with social and genetic factors, provides the best method for **estimating** what function would have been prior to an insult.
2. The general methodology for establishing causation is to obtain measurements or estimates of premorbid function, assess current function, and record the difference. It is this difference, and only this difference, which reflects the damages potentially caused by this insult.
3. Alternative theories of causation must be fully and completely reviewed. To argue, for example, that a given child's cognitive dysfunction was caused by some toxic exposure at two without considering that the child had birth asphyxia is a violation of accepted methodology in neuropsychology.
4. Finally, the potential cause must be carefully evaluated in terms of the scientific literature to determine whether it has been recognized **generally** as a potential cause of the dysfunction identified.

In the Alabama case discussed in the first part of this article,[1] the medical and neuropsychological experts, after the test data collected by the unqualified and unsupervised individual was withdrawn, presented affidavits to the court in which they declared that they required no test data to formulate their opinions. Instead, they argued that the "literature" posited a very specific relationship between the alleged toxin and the alleged damages, and based upon this "formula," they could precisely calculate the degree of damage suffered by the plaintiffs. The admissibility of this purported formula itself was never actually tested, because the trial court ruled that the mere existence of general causation did not allow these experts to opine that damage of any kind was done in these specific plaintiffs. The case was dismissed with prejudice, and as a result, a number of additional cases in the same area of litigation in Alabama will not be pursued. Because of some additional issues in this case, it is unlikely that the decision of the trial court will be appealed, but the decision is, in this author's estimation, important in principle if only because it illustrates how *Daubert*, *Frye* and other rules of evidence can be applied more broadly

Continued on page 18

Continued from page 17

than has been typical, and that when arguments are presented in a very clear and cogent manner, it is possible to get a favorable decision.

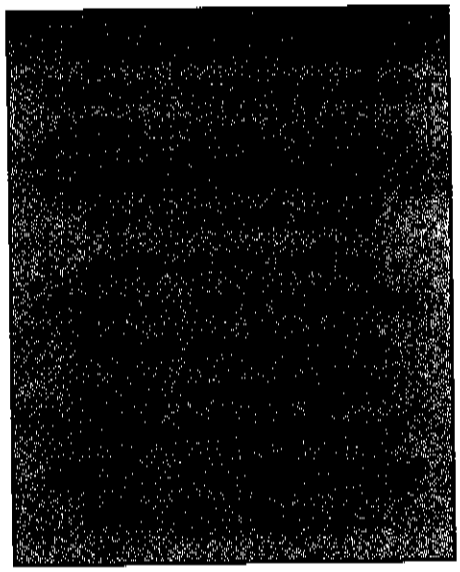
Conclusion

Daubert (and *Frye*) criteria have typically been applied only to analysis of the scientific opinions offered by expert witnesses. Properly construed, the *Daubert-Frye* criteria can be applied in neuropsychology much more broadly to such matters as expert qualifications, testing techniques, use of technicians, methods for establishing individual causation and damages, interpretation of findings, and understanding scientific literature. The "general acceptance" feature, which has often felt to be so inadequate when used to criticize the opinion testimony of a particular expert, may actually be a very powerful tool when applied to other aspects of the expert process. In *Daubert* states, the use of the additional *Daubert* criteria can likewise be applied beyond opinion testimony. In individual cases, such issues are best addressed by an attorney working in concert with a neuropsychological expert or consultant.

Other Sources

These articles are intended only to provide an introduction to the area, and identify some of the potential ways in which these scientific principles can be applied to limit or exclude the testimony of witnesses who may represent themselves as experts. This is a very complex topic, and the author's hope is that these articles have provided at least some new ways of thinking about *Daubert, Frye* and evidentiary rules in general which might prove helpful.

The *Reference Manual on Scientific Evidence 2nd Edition*, especially the chapters on epidemiology, statistics, and medical evidence, provides a cogent explanation of these subjects, and also provides a more complete



introduction to statistics, its language and principles.

Neuropsychological Assessment, Fourth Edition, by Muriel Lezak, provides additional information on the conduct of the neuropsychological evaluation.

Credentials for use of the title "neuropsychologist" can be found on the website of the National Academy of Neuropsychology.

Criteria for board eligibility in neuropsychology appear on the websites of the American Board of Professional Neuropsychology and the American Board of Clinical Neuropsychology.

The website of the American Psychological Association provides more complete information regarding standards for the administration and interpretation of psychological tests, ethical guidelines for psychologists, and additional useful publications.

Additional information/documentary history regarding the cited cases in Alabama and Maryland can be obtained by contacting the author directly at seantell@forensicneuroscience.net

Dr. Antell is a Clinical and Forensic Neuropsychologist with more than 20 years experience in the diagnosis and evaluation of children and adults with known or suspected brain dysfunction. She is board certified (Diplomate Status) in Clinical Neuropsychology by the American Board of Professional Neuropsychology (ABPN) and in Child and Adolescent Psychology by the American Board of Professional Psychology (ABPP).

In her forensic practice Dr. Antell has focused on personal injury with specialties in lead litigation, mold litigation, obstetrical malpractice, anoxic brain injury and mild closed head injury. Dr. Antell has also been interested in issues regarding the application of rules of evidence to scientific testimony, and has consulted with a number of attorneys in such matters. She has given invited presentations on multiple occasions to Mealey's seminars, and has also been invited to provide commentaries in Mealey's publications.

Dr. Antell received her PhD from the University of Maryland Baltimore County and completed a postdoctoral fellowship un Neuropsychology in the Department of Psychiatry and Behavioral Science at Johns Hopkins University School of Medicine with a Clinical Appointment at the Kennedy-Krieger Institute. Following this, she was on faculty at Johns Hopkins/Kennedy for five years, before leaving to establish her practice.

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Endnotes

1. *Patterson V Housing Authority*, Jefferson County Alabama Case No. CV01-2425 2006