

## Legal Series

# Bias and Its Impact on Expert Testimony: How the Thoughts of the 17th Century Enlightenment Can Help the Forensic Scientist

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Part of a forensic scientist's role is to provide an unbiased and objective opinion, often in some type of dispute resolution process such as a trial. The purpose of this article is to look into the role of bias in an expert's opinion and how it can have a deleterious impact on one's testimony. The writings of the 17th-century philosophers Francis Bacon and René Descartes are discussed and their findings on the bias problem explored. Examples of where bias can appear within the testimony of an environmental expert are also explored and ways to alleviate this problem are provided.

Keywords: bias, environmental litigation, expert opinions, testimony

### Introduction

Forensic environmental scientists are often asked to give opinions on certain subjects, usually dealing with some type of conflict or dispute for which expertise in our field is needed. In one of my previous writings, I created a definition for our field—*environmental forensics: the use of expertise to resolve environmental disputes* (Oudijk, 2005a). Many may feel that this definition is too simplistic or overly broad and that there are probably numerous other definitions available for what we do.

Expert opinions are often given in the context of some type of litigation: either through a written report or testimony in a dispute resolution process such as a trial or adjudication. The key to successful expert testimony is often *objectivity*, or convincing the judge, jury, and not or the parties involved that the opinions given are the truth slanted in any direction. *Merriam-Webster's Collegiate Dictionary* defines *objectivity* as “expressing or dealing with facts or conditions as perceived without distortion by personal feelings, prejudices or interpretations” (Mish, 2003).

One of the roadblocks to an objective observer, an objective researcher, or an objective scientist, is a term known as *bias*. The term *bias* is defined as “an opinion, feeling or influence that strongly favors one side of an argument or one item in a group” (Ehrlich et al., 1980). The term *bias* is also defined as “an inclination of temperament or outlook” (Mish,

2003). Bias may be subconscious to the scientist—he or she may not know it exists—or bias may be completely known to everyone.

The tendency towards bias is an affliction to which no one is immune. Like a good cold, bias seems to always crop up at the most inopportune time; like alcoholism, bias is always with us and will never go away. A good attorney will always find an expert's biases, or at least make it seem that way, and exploit them. Accordingly, the best defense to this impediment is to understand what one's biases are, what they could be and how they could affect one's opinions.

The key to an objective scientific investigation is understanding the biases that may exist, how they can affect the work and how to mitigate them, if at all possible. For the forensic scientist, an understanding of his or her biases will help in convincing a court, or the parties involved, that their opinions are objective and truthful.

In this article we will discuss some of the biases that afflict the human mind, identify the sources of these biases, provide some examples of when and how they occur, and offer some guidelines on potential ways to resolve these problems.

### *Some Background on the Scientific Method*

The philosopher René Descartes (1596–1650), a Frenchman who adopted Holland as his home, is considered by many to be the father of modern science. His 1637 pamphlet entitled a *Discourse on the Method for Conducting One's Reason Well and for Seeking the Truth in the Sciences* provides a step-by-step method to be applied to scientific investigations, or even to philosophical problems (Descartes, 1637). In a previous article in this journal,

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I discussed some of Descartes' methods to problem solving and his philosophy on the scientific method (Oudijk, 2005b).

Unfortunately, Descartes skirted the issue of bias, but he did discuss the steps needed to tackle some of the difficult and cumbersome problems that scientists often encounter. Probably Descartes' most important advice was the need to remove all premises that could not be doubted. Descartes' guiding principle was "If you are a real seeker of truth, it is necessary that at least once in your life you doubt, as far as possible, all things." (Descartes, 1637) This concept is important for the forensic scientist. Descartes is essentially telling us to: examine, dissect, and scrutinize everything, enumerate, itemize, and detail all your findings, and—only when the undoubtable is left standing—draw the conclusions. Regrettably, Descartes did not directly address the problem of biases and how they can affect our observations.

The first modern philosopher to really tackle the problem of bias, and who actually predated Descartes by a few decades, was the Englishman, Sir Francis Bacon (1561–1626). Bacon was a lawyer, statesman, essayist, historian, intellectual reformer, philosopher, and champion of modern science. Bacon claimed "all knowledge as his province" and strived to restructure traditional learning and investigative techniques (Bacon, 1620). In his day, concepts such as alchemy, witchcraft, the supernatural, and magic were commonly believed, but he proposed an entirely new system based on empirical and inductive methods. The ultimate goal of these new methods would be practical knowledge for "the use and benefit of men" and a relief of the human condition (Bacon, 1620). Bacon's goal was to unshackle the chains binding the human mind, similar to what the Greeks wanted and did centuries before, but he was taking it one step forward.

Early on in his career, Bacon rejected the concept of syllogism. A deductive scheme, *syllogism* is an argument consisting of a major and a minor premise resulting in a conclusion (Mish, 2003). An example of a syllogism is: Every president is laudable; virtue is laudable, therefore, presidents are virtuous. Obviously, this kind of logic does not always work. Bacon's alternative to syllogism was induction, which is a much slower and tedious process.

Bacon is considered the father of inductive reasoning. Induction is a type of reasoning that posits that a general law exists because particular cases seem to be examples of its existence. Deduction, in contrast, is reasoning that something must be true because it is a particular case of a general law known to be true (Ehrlich et al., 1980). Bacon states in his 1607 work, *Cogitata et Visa*, that his inductive procedure is one that "which by slow and faithful toil gathers information from things and brings it into understanding. (Durant, 1967)" Bacon, therefore, trusted his senses and thought that scientists should base their conclusions on observations and experience, in other words, on clinical, diagnostic, and empirical evidence. In the modern world, this premise seems fairly obvious, but in the 17th-century world of witchcraft and warlocks, this idea was novel. For some in today's faith-based world, this idea may still be innovative.

Bacon thought that science was a slow, tedious, and arduous task: sifting through stacks of data, compiling lists, and making hypotheses, most likely over and over again and finally refining conclusions to fit the piles of information. In some respects, being a good scientist is like being a good bookkeeper: Somewhere an excellent filing system must be made, either in your cabinet, desk, or head.

Bacon came to the insight that scientists cannot collect *facts* from nature, but they must be obtained by methodical procedures, similar to the steps laid out by Descartes in his *Discourse on Method* (Descartes, 1637). Facts can only be the result of inductive generalizations through empirical observations. Bacon's inductive reasoning, founded on the collection, review, analysis, and exclusion of evidence, proved to be a revolutionary achievement for science. Through Bacon and Descartes, the modern scientific method was conceived and is one of the gemstones of The Enlightenment.

According to Bacon, knowledge may be gathered from the past through tradition: *Every day, we use the knowledge given to us by Newton, Galileo or Darcy*. This knowledge may be accumulated and augmented by observation: *We collect new data on all of our cases*. But this new knowledge must be proven and established through experimentation: *We review and analyze these data on each case, maybe collect additional data and, based on these data or observations, formulate a theory or model*. No theory is relevant until some type of method has proven it to be true. Thus, Bacon set up the machinery of control that has since become almost an obsession with good scientists. Without this control, disputes would be resolved solely with *net opinions*, which is testimony that is not based on facts or data. Most judges will not consider net opinions; they tend to throw them out or consider them irrelevant.

### *Bacon's Idols*

In 1620, Bacon wrote the *Novum Organum* (or *True Directions concerning the Interpretation of Nature*). *Organum* in Latin means a "tool" or an "instrument," and Bacon believed that he was providing the world with a new instrument for guiding and correcting the mind in its quest for an understanding of nature and the truth. With Descartes a few years later, this tool was an opening of the mind and a major part of the Enlightenment.

In the *Novum Organum*, Bacon presents his famous principle of the *idols*. The idols are characteristic errors, natural tendencies, intellectual fallacies, or defects that plague the mind and prevent it from gaining a full and accurate grasp on nature or reality. In modern terms, Bacon thought that the mind's hardware was perfectly matched to understand nature, but very often, the software was ill suited to accomplish the task.

Bacon probably used the term *idol* because an idol is that which people often worship or are fixated on, sometimes without even knowing it. To the forensic scientist, we could consider an idol to be synonymous with a bias, an obstacle to objective reasoning. Bacon points out that recognizing and opposing these idols, or biases, is as important to the study of nature as the identification and refutation of bad arguments are to logic.

The word *idol* is derived from the Greek word *eidolon*: a phantom, a spirit, or a ghost. However, Bacon is not using the term *idol* in a religious or mystical sense. Bacon's idol is a potential deception, a source of misunderstanding or some kind of error in the mind's reasoning, especially one that clouds or confuses our knowledge of nature (Fieser and Dowden, 2006).

Bacon identified four idols with each originating from a discrete source and each having its own special difficulties, intricacies, and complexities, although, in my opinion, the four overlap to some degree.

#### *Idols of the Tribe*

These idols are the natural weaknesses, deceptive beliefs, and tendencies common to human nature; a propensity to embellish, exaggerate, distort, and "blow out of proportion." Thus, our ancestry gazed into the heavens and perceived a certain order to the universe but were not content merely to reflect or record what they had seen. They extended their opinions, investing the starry heavens with immeasurable and imaginary qualities that were never there. They put gods and spirits on the moon and made planets into deities, and very quickly, these imagined beliefs gained dignity and merged with the facts until they were inseparable.

Because these tendencies are innate, they cannot be completely eliminated, but only recognized and compensated for. Some examples of man's afflictions are:

- The human mind has a tendency towards wishful thinking and an inclination to accept, believe, and even prove what we would prefer to be true. This affliction commonly occurs with expert witnesses who have been hired to represent a particular client, especially a client they admire and respect. It is obviously a virtue for an attorney, but for an expert, it can be unfortunate, especially if presented before a perceptive judge;
- Our senses, insights, and perceptions are inherently clouded, dulled, and easily manipulated. Accordingly, Bacon recommends instruments and strict investigative methods, such as protocols, to keep these problems in check. It is for this reason that work plans are prepared in advance, a particular scientific method is followed and certain instruments are used. The human senses are very easily fooled. Many times, field observations are in complete contradiction to the laboratory results. Examples abound in which samples thought to be contaminated are clean as per the laboratory and vice versa. Furthermore, both Descartes and Bacon felt that all the evidence, good and bad, should be put on the table, where it can then be reviewed, discerned, and differentiated so the undoubtable is kept and the rest can be discarded. I cannot count how many times a case hinged on one piece of paper found in a file and read five times before its full meaning was understood. It is only through this slow and tedious process can conclusions be ascertained;
- The human mind has a tendency to discern, and even impose, more order to nature than actually exists. Human nature is likely to find semblance where there is actually singularity,

regularity where there is arbitrariness. Our culture is predisposed to believe that science and engineering can accomplish the impossible. Chaos is an integral part of the universe, some things just cannot be explained and many things cannot be predicted. We have experienced this problem on many occasions for which a client or an attorney expects an opinion or a conclusion when one cannot be adequately provided. In this case, we often preface our opinions with its corresponding limitations, often to the displeasure of attorneys and clients, but often gaining a bit of admiration from the judge; and

- We have a propensity to rush to conclusions and make premature judgments, instead of gradually and painstakingly amassing evidence. This tendency is particularly acute with scientists of experience who have "seen this all before" and are inclined to base their conclusions on a handful of facts. As discussed previously and articulated very well by Bacon and Descartes, the scientific process must be thorough, meticulous, often time-consuming, and usually expensive. Many years later, with the forensic scientist's dilemma at heart for sure, the poet William Blake, in the early 1800s, (Blake, 1965) wrote,

Reason says Miracle; Newton says doubt  
Aye that's the way to make all nature out  
Doubt Doubt & don't believe without experiment.

#### *Idols of the Cave*

Unlike the Idols of the Tribe, which are common to everyone, those of the cave vary from individual to individual and arise within the mind of the individual. Our mind is symbolically a dark cavern and our thoughts wander through this deep abyss, transformed by outlook, temperament, education, habit, environment, and even by accident. Accordingly, anyone who devotes their life to some particular field or livelihood becomes fixated on this subject and interprets all other fields through their lens. A geologist sees geology in everything, whereas a biologist sees biology.

These tendencies, or biases, arise not from nature but from culture and reflect the peculiar distortions, prejudices, and beliefs that we are all subject to resulting from different nationalities, our way of life, childhood traumas, education, training, gender, handicaps, religion, social class, and much more. Some examples include:

- *Special loyalty, allegiance or commitment to a particular philosophy, theory, discipline, or way of thinking.* Engineers often may see things through a quantitative lens, whereas a scientist may see it qualitatively. An expert working for the government may lean towards the environmentally safe approach, whereas one working for a multinational firm may approach the issue in the opposite direction;
- *High esteem for a few select authorities.* This tendency is often a result of education in which a scientist may follow in the footsteps of an illustrious professor or mentor or maybe the way his or her father or mother addressed a problem. I have an inclination to imagine what my father would do in

a certain circumstance, instead of actually thinking out the problem and trying to create a solution; and

- *A tendency to relish the past or solely anticipate the future.* Because this article is the second I have produced on philosophers from the 17th century, one may come to the conclusion that I do not trust modern thinkers and would only believe one who had read these “ancient” classics. Unfortunately, there may be some truth there.

#### *Idols of the Marketplace*

These are obstacles to clear thinking that develop, according to Bacon, from the “intercourse and association of men with each other (Bacon, 1620).” These are errors arising from the false importance bestowed upon words. The main culprit here is language, though not just common speech, but also, and perhaps particularly, the special discourses, vocabularies, and jargons of the various scientific disciplines. The key here is that no language perfectly expresses our feelings or our thoughts and our use of the language is often much less than perfect.

According to Bacon, men form thoughts into words to express their opinions, but words often arise as substitutes for these thoughts and it is believed that an argument was won because the opponent was outmaneuvered verbally (Bacon, 1620). The impact of using words without attention to their true meaning, or the misuse of the language, causes misinterpretation, confusion, and false rumors. Words often betray their purpose, obscuring the thoughts that they were designed to express.

As discussed previously, our use of language, whatever language it may be, is always less than perfect. Two people often keep different definitions in their mind for the same word and a good attorney will often make an expert define the words that he or she uses. It is for this reason that all words used by an expert witness, whether spoken or written, must be fully understood and definitions be well established. A good expert will have a library of dictionaries and thesauruses to consult at all times. It is noted that Isaac Newton left behind a very limited amount of published writings. His command of English was much less than perfect and Newton preferred to use mathematics, which could be considered to be a perfect language, at least for the scientist (Gleick, 2003). Bacon points out that “the idols imposed by words on understanding are of two kinds (Bacon, 1620):”

- “[T]hey are either names of things that do not exist,” such as the *ether* that confused scientists for centuries, Newton in particular, or *intelligent design*, the theory that has gained much popularity lately in this country; and
- Ambiguous, imprecise, or misleading names for things that do exist, but can have multiple meanings and can be a particular source of confusion. One example is the term *parts per billion*. In the United States, a billion is a *thousand million*, but in Great Britain, it is a *million million*. Obviously, two English-speaking scientists could have problems here. Furthermore, as shown in the previous several paragraphs, we have used in this article numerous adjectives to describe the same meaning, words such as *embellish* and *exaggerate*. In

courtroom proceedings, the use of such words may confuse or give an alternative meaning to a judge or a jury. A solution to this problem is to minimize the use of such words and write or speak in the style of Hemingway where the least number and simplest of words are used. Flowery language in a courtroom has limited use.

#### *Idols of the Theatre*

Like the idols of the cave, those of the theatre originate from culture, instead of being inherent to the individual. The allegory of the theatre implies an impersonation of the truth, as in a play or a movie; however, these idols are derived mainly from certain distinct beliefs, attitudes, viewpoints, or philosophies. This idol originates from different classes of theologies, philosophies, or scientific methods, and—because they are defended by many learned, educated or influential people, such as my respected geology professor, my boss, my client, or my father—they are accepted without question by myself and the masses. We tend to respect ideas or theories espoused by people we know, revere, and admire. Theories adopted by people unknown to us are often considered suspect or second class and often viewed with disrespect. Research completed at Harvard carries more weight in an American courtroom than that conducted in Botswana. In addition, theories that are constantly repeated by some type of authority, say the government, no matter how unwise or foolish they may be, eventually become believed and taken as fact.

Two excellent modern examples are the theory of *creation*, or even *intelligent design*, and the recent attacks waged on *global climate change* (there is no need, at this point, to discuss *weapons of mass destruction*). These theories are often promoted by learned theologians, popular politicians or influential corporations. When false philosophies have been developed and have attained significant influence, they are commonly taken for fact and not questioned. For close to 60 years, we believed that breathing automotive exhausts laced in lead was not a problem. However, houses built on weak foundations usually come tumbling down. Unfortunately, it may take decades or centuries for man to see these problems.

Bacon found three particular types of philosophy to have an adverse affect on the mind (Bacon, 1620):

- *Sophistical philosophy*, which is a philosophy based on just a few informal observations or without opinions; any experimental evidence at all and thus erected mainly out of supposition, conjecture, and hearsay. This type of philosophy may be the origins of net opinions.
- “*Universal theory*” *philosophy*, which is a philosophy based on one or just a few observations, a limited base of inquiry, which is then used as a pattern to explain all different kinds of phenomena. As discussed previously, the universe is probably too complex for one unified theory to explain everything; and
- *Superstitious philosophy*, which is Bacon’s term for any type of thought that mixes theology and philosophy. The best

examples of this philosophy in today's world are the creationists or the skeptics of stem-cell research.

### *How Do We Alleviate the Ill Effects of Bias?*

The inherent problem of bias in today's forensic scientist may be in "following the money." Just like an elected judge, a forensic scientist may be unable to control their biases when thoughts of food and shelter or re-election come to mind. Other countries have come up with public scientists who are retained directly by the court. This possibility is one to consider, although public scientists may also have many biases as well, just different biases.

The first means of attacking bias in our professional and personal lives is to admit that it is there. It exists in every facet of our lives. But is there a roadmap to travel around it or one that can soften its blow? Probably not, at least not fully. Where is the highway to clear thinking and objectivity? These are age-old questions that can never be answered, especially not by this writer. As discussed previously, it is one of mankind's biases that we believe that we can fix anything. This predicament is one that probably can never be mended fully, although some improvements to this affliction are certainly possible.

Human nature is dynamic, it can change. I do not believe that intolerance, subjectivity, and eternal strife are in our DNA. In the past two centuries, we have uprooted ourselves from enslaving our neighbors to accepting gay persons in society, at least somewhat. Maybe this garden can be cultivated. So, how do we do that? Probably very slowly.

A full understanding, if that is even possible, of the scientific method is probably a good start, especially for us forensic scientists. We need to return again and again to Descartes' ideas of doubting everything, questioning every "fact," scrutinizing each piece of data and not jumping to conclusions. Skepticism often makes for good science because it gives us some time to stop and think about the conclusions that were made far too quickly. An attentive respect, an adherence or at least a tolerance, for skepticism may be a pathway to more objective thinking.

Critical self-examination or turning the mirror on yourself is an approach that can be helpful to alleviate bias. It allows the other story to be told, the one that normally never enters one's mind. Others may call this *the awful truth*. Furthermore, understanding where one originated from and the debt to others is crucial. Newton said that he could see further than others because he "stood on the shoulders of giants (Gleick, 2003)." Keep in mind that one of the greatest thinkers of our civilization attributed his genius to his forefathers. Maybe this is why Newton was able to think so clearly.

A mindful disrespect for authority, within limits, can often be an aid to the scrutinizing scientist. It does not matter if the authority is the government, big business, your mother-in-law, or the scientific establishment. As could be seen with our battles just this century, against leaded gas, dichloro-diphenyl-trichloroethane (DDT), and now with global warming, the status quo is often wrong, sometimes "dead wrong." Standing

up and saying so may be the first step in seeing through the darkness.

And finally, a tolerant mind is probably the best remedy to the affliction of bias. Intolerance is caused by fear: the fear of the unknown, the fear of being different, and the fear of not knowing, and intolerance has been the cause of most of mankind's woes: the wars, the genocides, the crimes against humanity. But it must be stressed that there is no universal solution to the problem of bias or even intolerance. Some may say that a liberal arts education and an immersing in the classics is the answer, others may believe that an understanding of the law or philosophy is the key. There are many exceptions to this rule and it must be believed that the solution for each person will be specific and possibly very different.

### *Bias in the Other Direction*

We have discussed many of the problems associated with bias that may afflict the expert witness, but there are biases that can influence the recipients of our opinions, such as the judge, the jury, the attorneys, and the public. Many of the same biases discussed previously, Bacon's Idols, may also impact these recipients. Provided below are some of the additional sources of bias which may affect expert testimony, but in the opposite direction:

- *Status hierarchy of scientific disciplines.* Because of the rush during the Cold War to produce nuclear weapons, jet fighters, and star wars defense systems, disciplines such physics, aeronautical engineering, and astrochemistry now command a higher respect in our society (Martin, 1979). Experts in such disciplines, their experience and knowledge notwithstanding, tend to be accorded greater respect, admiration, and reverence. There tends to be a pecking order in our culture where some disciplines are highly esteemed while others are looked down upon. Accordingly, the testimony of a nuclear physicist may garner more weight than a hydrogeologist even though the case hinges on groundwater issues;
- *Conformity.* To become an expert on any subject in today's society, a scientist must conform to its practices, culture, and externally imposed requirements of his or her training (Martin, 1979). Therefore, thinking "outside of the box" is often "frowned upon" and, actually could be unacceptable to the court per the *Daubert* standards (Ries and Burns, 2005). Accordingly, there is a predisposition to disbelieve any theory or idea that conflicts with culturally believed concepts. Experts known to hold beliefs such as atheism, racism, or communism, whether we agree with these concepts or not, could have a difficult time in an American courtroom even though these personal opinions are unrelated to their scientific testimony; and
- *Value judgments.* Science, in its purest form, is supposed to be morally, ethically, and politically neutral. However, judges and juries often have to make value judgments or value assumptions when considering the outcome of a particular case. Therefore, the question being answered may not be the one actually posed in the case. The predisposition of the court is often

to rule in a fashion that benefits the most people despite what the evidence may show. Mark Twain understood this problem of biases with judges and juries when he wrote in 1872:

On the inquest, it was shown that Buck Fanshaw, in the delirium of a wasting typhoid fever, had taken arsenic, shot himself through the body, cut his throat, and jumped out of a four-story window and broken his neck—and after due deliberation, the jury, sad and tearful, but with intelligence unblended by its sorrow, brought in a verdict of death “by visitation of God.” What would the world do without juries?

## Conclusions

Mankind tends to look to the future—we are impressed by modernity and technology. But sometimes, it is in our interest to look to the past, to see how our ancestors tackled some of the same problems that plague us today. What we will find is that some of these scientists or philosophers had a better grasp on the method, the process or the technique, that they used to come up with answers to many of those questions posed. Sometimes it is more enlightening and educational to use an abacus instead of an electronic calculator.

Bias, to a scientist, is like heroin to a drug addict or vodka to an alcoholic. It is a problem that will always afflict us and the only remedy is to recognize its presence and assume that it is always lurking somewhere behind us. An experienced attorney will search for an expert's biases, bring them to light, and exploit them in front of the judge and jury. The expert's only defense to such an attack is to understand those biases, what they are, and what they could be, and to acknowledge them and insure that these biases have not affected his or her opinions. Just like a seven-step program, acknowledging that a problem exists is the first step to recovery.

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