

The Arson Research Project

CASE STUDY REVIEW OF COGNITIVE BIAS IN FIRE INVESTIGATION



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The Arson Research Project is a criminal justice research project hosted by the Constitutional Law Center of Monterey College of Law. Our mission is to examine the reliability of evidence used in the investigation and prosecution of arson, and to identify convictions obtained secondary to unreliable evidence.

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ABSTRACT

This report will review three case studies where the conclusions of fire investigators were made in environments filled with the potential for cognitive bias. The methodology used in those investigations will be compared to the recommendations in the 2009 report by the National Academy of Sciences, *Strengthening Forensic Science in the United States; A Path Forward (NAS Report)* and the current standard of care expressed in NFPA 921: *Guide for Fire & Explosion Investigation (NFPA 921)*.

A companion report, “Measuring the Impact of Cognitive Bias in Fire Investigation” is available at www.Thearsonproject.org.

CASE STUDIES

Case studies were analyzed by review of the fire reports and trial testimony of the fire investigators, criminal investigators and forensic examiners involved in the origin and cause investigations. The three case studies reviewed in this report each involve serious fires that resulted in criminal prosecution for arson and, in two of the three cases, loss of life.

George Souliotes was convicted in Modesto, California of setting his rental property on fire in 1997, killing three of the residents. Fire investigators testified that abnormally hot fire conditions and burn patterns on the floor of the garage, kitchen and living room could have only been caused by a liquid accelerant. The investigator’s suspicions were bolstered by the use of a handheld ignitable vapor detector which alerted near all of the suspicious burn patterns. Before, during and after the initial scene examination the fire investigators were exposed to a constellation of domain-irrelevant information that was heavily relied upon in making a final determination of an incendiary fire and naming George Souliotes as the suspect.

Twelve years later, during a federal evidentiary hearing on Souliotes’ habeas corpus petition, the State of California stipulated that arson indicators relied upon by the original fire investigators were completely unreliable. However, after being exposed to the same biasing information as the original fire investigators, the state’s expert witness maintained a conclusion of arson based on fire dynamics analysis and a determination of multiple points of origin.

In 2001, twenty-miles north of Alexandria, Louisiana, **Amanda Gutweiler** was arrested for the murder of her three children after a fire investigator saw signs of spalling on the concrete slab in the area of origin. The investigator’s suspicions of an ignitable liquid were confirmed by the alert of an accelerant detection K-9 in the same area. A follow-up investigation by a prosecution expert dismissed the spalling and other burn patterns as indicators of the presence of an ignitable liquid but confirmed the conclusion of arson based on fire modeling and a determination of multiple points of origin.

In 2006 fire investigators from the Louisville Fire Department Metro Arson Unit, in Kentucky, determined a fire in a commercial building to be an act of arson, eventually leading to the arrest of *Susan Lukjan*. Their scene examination was conducted after the investigators had already begun to piece together a possible suspect and a motive for the crime. A follow-up investigation was conducted by the Bureau of Alcohol, Tobacco and Firearms (ATF) which confirmed the local fire investigator's conclusions. In forming their shared determination of arson, neither agency presented any fire based evidence of an incendiary cause; instead, they determined the fire was an act of arson by "negative corpus", eliminating all accidental and natural causes.

The purpose of this report is not to review all of the evidence of each case, nor is it to prove innocence or to confirm guilt. This report is concerned only with evaluating the reliability of the expert testimony and to study the role various cognitive and motivational biases may have played in shaping the investigative strategies and expert conclusions. It is the reliability of these conclusions that this report seeks to examine.

COGNITIVE BIAS AND THE STANDARD OF CARE

Cognitive biases are subjective biases which undermine the reliability of evidence. An observer may have difficulty perceiving details and observations that run contrary to pre-established beliefs. At its most extreme, the presence of cognitive bias can cause the observer to see and record something that did not exist, or fail to see and record something that did exist.¹

Common forms of cognitive bias in fire investigation include:

1. *Expectation bias*, the tendency for an observer to believe, certify, and express data that agree with their expectations for the outcome of an examination, and to disbelieve, discard, or downgrade the corresponding weightings for data that appear to conflict with those expectations;²
2. *Confirmation bias*, the tendency to search for or interpret information in a way that confirms the observer's preconceptions;³
3. *Selective re-examination*, where the second, independent examination is conducted by an examiner who is already aware of the conclusion drawn by the original examiner, is often made aware of the same domain-irrelevant information which tended to bias the original examination in the first place, and where there is a direct or indirect suggestion to the independent examiner as to the conclusion(s) he is expected to reach; and
4. *Role bias*, the change of perspective resulting from a forensic examiner's lack of independence from law enforcement.

In each case, the more subjective, ambiguous or ill-defined a forensic technique or measurement, the more it is subject to bias induced errors. Various circumstances conspire to make fire scene cause and origin investigation particularly susceptible to the affects of cognitive biases:

1. Fire pattern and burn indicator analysis, the key tools at the heart of most fire scene examination, are largely based on human interpretation. The ambiguous and ill-defined aspects of fire pattern/burn indicator analysis can be especially pronounced when flashover, ceiling collapse or extensive overhaul has occurred;
2. Because the fire scene examination is conducted in the field, rather than a laboratory, the presence and influence of domain-irrelevant information is difficult to control; and
3. Because of the mingling of cause and origin examination with criminal investigation, present in many public agency fire investigations, the effects of role bias can be of concern.

The *NAS Report* recognizes conceptual bias as a factor in all forensic disciplines⁴, and some of the *NAS Report's* strongest recommendations and sharpest criticisms are directed toward the importance of a forensic investigator's independence from law enforcement.⁵ *NFPA 921* acknowledges these biases as a concern in fire investigation.⁶

DOMAIN-IRRELEVANT VS. DOMAIN-RELEVANT YET UNRELIABLE INFORMATION

Expectation and confirmation bias are caused by the examiner harboring an expectation prior to conducting the scene examination. In each case, the observer's conclusions are contaminated with a pre-existing expectation and perception, reducing the observer's objectivity and laying the groundwork for selective attention to evidence.⁷ The key ingredients of these biases are exposure to information which is *domain-irrelevant* and information which is *domain-relevant yet unreliable*.

As the name implies, *domain-irrelevant* information is data that may be relevant to the wider criminal investigation, but is not relevant to the forensic examination at hand. For instance, in a fire cause and origin scene examination, the only *domain-relevant* information are fire patterns, burn indicators, heat damage and other combustion related artifacts. Additional contextual information, such as extraneous information on a suspect or motive, is outside the domain of the cause and origin examiner. Although important factors in an overall criminal investigation, to the forensic examiner this extraneous information is *domain-irrelevant*.

Information which is *domain-relevant yet unreliable* – that is, information which is relevant to the forensic discipline in question but lacks scientific validation or reliability – can have the same impact on creating a preconceived expectation as domain-irrelevant information. In fire scene examination, flashover conditions create a unique environment where burn pattern interpretation can be particularly subjective and, at times, demonstrably unreliable.⁸ These include the interpretation of irregular shaped fire patterns, concrete spalling or a perception that the fire burned abnormally hot or was “fast moving” as indications of the presence of an ignitable liquid, or the interpretation of various areas of deep charring as multiple areas of origin.

This is not to say that the expectation itself is not necessarily valid or reasonable. On the contrary; a perfectly valid and well reasoned expectation can create the bias and be equally harmful to an otherwise objective examination.

However, the role of the fire investigator, as a forensic examiner, is to draw expert conclusions within her discipline based solely on reliable, domain-relevant information.

EFFECTS OF COGNITIVE BIAS IN THE CASE STUDIES

The influences of cognitive bias in the case studies were evaluated by reviewing fire reports, testimony and other case specific documents. Only the possible biases present in the record are discussed. It is impossible to know if exposure to the domain-irrelevant or unreliable domain-relevant information present in these cases caused a significant bias in the minds of the fire investigators and any attempt to do so would be speculative.

Each case study is separated by bias. This separation and categorization is somewhat arbitrary; some of the circumstances represent more than one potential bias. Perhaps some examples would be better placed under a different bias altogether.

However, the title attached to the bias is less important than their common result; a distorted conceptual framework leading to unreliable conclusions.

George Souliotes

Fire Department investigators arrived at 1319 Ronald Avenue in Modesto, California, before the fire had been completely extinguished. The fire scene was a three-bedroom residential house whose garage, living room and kitchen were gutted by fire. Ceiling collapse in the garage and living room as well as continuing extinguishment efforts delayed the initial scene examination. Eyewitness and expert testimony would later confirm that the fire had burned for 15 to 20 minutes past flashover before firefighters were able to put the fire under control.

Expectation Bias: Exposure to unreliable indicators of arson and domain-irrelevant information suggesting a suspect and a motive may have biased the fire department investigators.

Because of ceiling collapse and continued fire suppression activity, the first fire investigator on the scene was unable to enter the areas of greatest fire damage, but he conducted an initial scene survey mostly from the outside of the building, peering through doorways and windows. During his initial survey he “saw evidence of an extremely hot, extremely fast traveling fire...” Firefighters told him that the fire was abnormally hot, that smoke conditions were intense, and that low burning was seen in the kitchen and garage.⁹

The investigator noted a large burn pattern on the rear deck, near where the aluminum framing of the sliding glass door to the living room had melted. His final report of investigation described his initial observations and preliminary conclusions:

“All conditions noted are conditions far outside the parameters of what would normally be found in a residential structure fire absent the presence of an abnormal fuel such as a flammable liquid...All this indicated extreme heat or the use of a liquid poured in this area.”

NFPA 921, along with many other studies on fire behavior, reject the fire pattern and burn indicator analysis proffered by the Modesto fire investigator as being unreliable¹⁰; each of these indicators is present in any fire that burns beyond flashover. However, burn pattern analysis of this type is as subjective as it is unreliable; the perfect type of analysis needed to create and support a bias based on expectation.

After a brief initial scene survey, the investigator began to suspect arson and called for a search warrant. While waiting on the completion of the search warrant, he interviewed an eye-witness who claimed to have seen a suspicious person in the area just before seeing the flames:

“I then conducted an interview with (the witness), who stated that she had witnessed an RV drive up and down Ronald Avenue several times that night, and had stopped in front of the (fire) structure. She saw a man step out of the vehicle carrying something in his hand and go in the backyard of (the fire building). A few minutes later he returned to his vehicle and drove away in a south direction on Tully Road. Her vantage point was the balcony of the apartments at Tully Road and Ronald Avenue. (her apartment balcony being on Ronald Avenue) she had a clear vantage of the (fire building). A few moments after the RV left, she heard what she described as a ‘whooshing’ sound and saw fire coming from the back of the structure...”¹¹

“Based on what (the witness) saw from her balcony, we knew very early on in our investigation that the responsible person was driving a Winnebago motorhome (sic)”¹².

The investigator also noticed a for-sale sign in the front yard of the fire building and called his brother-in-law, a local real estate agent, to acquire listing information. He found out that the home was owned by George Souliotes¹³ and that it was under foreclosure.¹⁴

The fire investigator directed the police department to drive by Souliotes' house to see if he owned an RV.¹⁵ Before beginning his interior scene examination, the investigator was told by Modesto Police that Souliotes did own an RV and that he generally matched the description given by the eye-witness.¹⁶

As a result of this domain-irrelevant information and clearly unreliable domain-relevant information, and before ever conducting a thorough scene examination, the fire investigator had already begun to piece together a suspect (Souliotes), a motive (financial), and a cause (arson).

Confirmation Bias: A preliminary determination of arson was confirmed with observations of suspicious burn patterns and use of a hand-held combustible gas indicator.

Modesto fire investigators testified repeatedly that the presence of irregularly shaped "pour patterns" on the garage floor, deep charring and burn through to the hardwood floors of the living room, separation and curling of vinyl kitchen tile and the unusual heat of the fire were irrefutable evidence of the presence of a liquid accelerant in the form of an ignitable liquid.

During the scene examination, fire investigator used a hand-held combustible gas indicator to bolster his belief that suspicious burn patterns on the floors of the living room, kitchen and garage were the result of an ignitable liquid. The model of hydrocarbon detector used by Modesto fire investigators was the subject of testing by the Arson Research Project and found to be a completely unreliable indicator of the presence of an ignitable liquid in a post-flashover environment.¹⁷ When tested on burn debris from a post-flashover fire, the false positive rate was nearly 100%.

Nowhere in the fire investigator's final report or his court testimony is flashover acknowledged as a possible cause for the burn patterns or the particularly hot fire conditions.

Selective Re-examination Bias: An expert witness hired to conduct a secondary evaluation of the case was exposed to the same biasing information as the fire department investigators and made aware of the original investigators' conclusions of arson.

Twelve years after his conviction, Souliotes was granted a federal evidentiary review as part of his habeas corpus claim.¹⁸ Recognizing that flashover conditions create all of the suspicious burn patterns and fire indicators which had been attributed to an ignitable liquid at the original trial, the prosecution hired a cause and origin expert witness to review the case.¹⁹

The expert reviewed the original fire investigator's report, including all of the domain-irrelevant information it contained, and was clearly aware of the report's conclusions.²⁰ The expert rejected the first investigator's reliance on burn patterns and the use of a hydrocarbon detector as evidence of an ignitable liquid, but maintained that the fire was still the result of arson. His conclusion of arson was based on an equally subjective method – *fire dynamics analysis* leading to a determination of *multiple points of origin* in a post-flashover fire.

The expert's conclusions were based on a timeline which made a single point of origin difficult for the expert to justify:

“...there is no evidence of an accidental fire that could have accomplished the documented damage to both the garage and the living room in the time established by witnesses and fire suppression times...There were no identifiable mechanisms for timely extension of a single fire (ignited in either the living room or garage) to the other area that could be supported by fire dynamics analysis”²¹

At first glance, the expert's conclusions seem to be based entirely on an analysis of fire behavior. Although clearly subjective, fire dynamics analysis was well within his area of expertise. However, on closer review, his written report mentions several of the pieces of domain-irrelevant information used by the original fire investigators in their conclusion that the fire was an act of arson.

Discussing the eye-witness account of a suspicious person in the area prior to discovery of the fire, his report reads:

“...(the eyewitness) also reported seeing a man enter the backyard of the house and then leave minutes before she detected the fire. Since this person made no effort to notify occupants or authorities of a fire he should have noticed, it is reasonable to infer his possible involvement with causing the fire.”²²

Discussing a possible entry point for an arsonist:

“The locked/unlocked status of the rear slider could not be determined post-fire. This door could have been left unlocked or, if locked, can often be easily defeated.”²³

Role Bias: Fire department investigators worked alongside police detectives in aspects of the investigation well beyond the cause and origin determination.

Both Modesto fire investigators worked closely with the Modesto Police Department throughout the investigation and prosecution. The relationship between the Modesto fire investigators and the Modesto Police Department is clear in the final report:

“(Evidence collection) was done through a concerted effort of investigators Evers, Mark Crook and me; crime scene detective Rudy Skultety, I.D. technician Doug Lovell and arson/bomb detective Dode Hendee.”²⁴

The fire investigator's interview with the eye-witness was conducted with a Modesto police detective, and after speaking to his brother-in-law on the phone and determining that Souliotes owned the fire building, it was the fire investigator that dispatched police officers to Souliotes' house to search for an RV.

The search of Souliotes' house continued with another Modesto fire investigator accompanying Modesto Police homicide investigators to serve a search warrant. This investigator used the same type of hand-held combustible gas indicator to confirm the presence of ignitable vapors on Souliotes' clothing.

Amanda Gutweiler

In early January, 2001, a fire in a two-story residential house took the lives of three children. Their mother had left them alone in the house while running errands and reported finding the house full of smoke, with flames coming from her bedroom window when she returned. Although the fire occurred in the mid-afternoon, by the time the fire was completely extinguished and the State Fire Marshal investigator was ready to go inside the house to examine the scene it was already dark, so the scene examination was postponed until the following morning.

Expectation Bias: Spalled concrete in the area of origin was determined by the fire investigator to have been caused by an ignitable liquid and may have created an expectation of an incendiary fire.

The state fire investigator's scene examination determined the area of greatest damage to be Amanda Guweiler's bedroom (described in the fire report as “on the west side of the structure approximately

twenty five feet south of the front”²⁵), the room whose window witnesses saw flames coming out of early in the progression of the fire. The investigator saw the fire patterns and indicators consistent with a flashover fire that had burned in the bedroom, kitchen and living room of the first floor.

In addition to the signs of flashover, the investigator saw a fire pattern on the concrete slab of the bedroom that caught his attention:

“Debris was cleared from the concrete slab and evidence of spalling or popping of the slab’s surface was noted. Spalling is caused by intense heat liberating moisture in concrete, leaving its surface chipped and pitted. Ignitable liquid poured on a concrete surface can cause this to occur...Spalling can also occur as the result of class A or B combustibles burning, but the resulting patterns are not in flow or pour-like shapes as these were.”²⁶

NFPA 921 dismisses spalling on concrete as being a direct indicator of the presence of an ignitable liquid.²⁷

In this case, instead of an expectation bias primarily based on domain-irrelevant information, the state’s fire investigator’s expectation of an incendiary fire cause was based on the domain-relevant, yet scientifically unreliable relationship between spalled concrete and the presence of an ignitable liquid.

Confirmation Bias: The presence of an ignitable liquid was confirmed with an accelerant detecting canine and additional suspicious fire patterns.

The discovery of spalling and the investigator’s belief that spalling, in this case, was the result of the presence of an ignitable liquid, led the investigator to call for an accelerant detection K-9 to confirm his hypothesis:

“Once the evidence of spalling was found, Deputy Fire Marshal Kurt Myers brought an accelerant detection canine to examine the scene.”²⁸

The K-9 apparently alerted “several times around the bed springs and in an area in the soil about 12 inches of the west side of the slab. Samples were secured for laboratory analysis.”²⁹

The only sample where gasoline was confirmed through laboratory analysis to be present was from soil samples taken from the exterior of the house. No samples taken from inside the structure were found to contain any ignitable liquid. There is no evidence in the record that the negative laboratory results for the presence of an ignitable liquid for any samples taken from the interior of the house shook the investigator’s confidence.

Armed with a confirmed hypothesis, the investigator went on a search for additional fire patterns that would show the presence of an ignitable liquid and further support a conclusion of an incendiary cause. In order to get a clear view of the concrete slab, the entire structure was torn down:

“Once the canine indicated the possibility of the presence of an accelerant, a search warrant was obtained in order to conduct a more thorough scene examination. The remaining structure was unstable and unsafe to enter, therefore, an excavating machine was utilized to dismantle and remove the remaining walls and roofing...At this point, all remaining debris was removed and the slab rinsed off. Heavy spalling was found in the den area near the front entrance...The aluminum threshold beneath the front door was partially melted away. All of these patterns are consistent with an ignitable liquid being poured on the floor.”³⁰

NFPA 921 warns against attributing melted aluminum thresholds and door framing to the presence of an ignitable liquid.³¹ Here, the state's fire investigator appears to have confirmed a hypothesis based on unreliable domain-relevant evidence with even more unreliable evidence.

The fire investigator concluded the fire to be incendiary:

“In view of the spalling patterns, the rapid fire spread, and the presence of gasoline in the sample, it is the conclusion of all investigators involved that this fire was incendiary in origin.”³²

Selective Re-examination Bias: An outside expert, exposed to the same biasing information as the original investigator and aware of the conclusions of the first examination, confirmed the original investigators conclusions.

An outside expert was brought in to evaluate the case and asked to review the original cause and origin report. He quickly dismissed the spalling and melted aluminum as indicators of an ignitable liquid.³³ However, he still determined the fire to be incendiary.

With the aid of the fire report, photographs and diagrams from the scene and witness statements, the expert was able to evaluate fuel load size and location, construct a time line, and estimate the rate of fire growth and fire spread, which led the expert to conclude that the fire must have had more than one area of origin and to imply the presence of an accelerant.

“Based upon the estimated fuel load of the rooms involved, the size of the rooms and the reported rate of fire development, multiple points of origin or the use of an accelerant are very strongly indicated.”³⁴

A second report by the same expert used computer fire modeling to estimate rates of heat release, fire growth and spread. The expert made a long list of all of the furniture and other combustible items believed to be in the house. He estimated the size of various rooms using the diagrams from the original scene examination and entered door and window positions as they were reported at the time of the fire.

“Using the dimensions recorded by investigators measuring features remaining on the floor slab, photographs, and descriptions offered by (witnesses), the rooms and their contents were reconstructed using documentation forms as suggested in published texts.”³⁵

With all of these assumptions in place, he attempted to calculate the heat release rate, fire growth and fire spread in each room under different area of origin scenarios.

Using three different computer modeling programs, each with its own input factors, the expert derived various results for each calculation. The variation in magnitude between the highest and the lowest of the three results for each calculation was in the range of 82 to 102%.³⁶ In order to determine a single, usable result for any given computation, the expert simply used the average from the three programs:

“The disparity between calculated values is dependent on different factors in each formula. The numerical average of all three is the best approximation.”³⁷

The results, according to his report, confirmed his belief that the fire was incendiary secondary to multiple points of origin.

“(The fire) was the result of deliberate ignition of room contents in separate rooms – kitchen and master bedroom. This was the single hypothesis of all those considered that best fit the available data.”³⁸

Susan Lukjan

In August 2006, Susan Lukjan owned a small business, Campbell’s Gourmet Cottage, in St. Mathews, Kentucky. The fire, reported about 20-minutes after closing time, was first investigated by two members of the Louisville Arson Investigation Unit.

Expectation: Discarded financial documents discovered by Louisville fire investigators prior to their scene examination may have provided an expectation of financial distress, suggesting a motive for arson.

After arriving on the scene, “(fire investigators) secured the building; in so doing, they discovered a stack of financial documents relating to Lukjan’s business in two outdoor, open trash cans. (The fire investigators) collected the documents.”³⁹

The Louisville fire investigators that found the financial documents described the discovery in this way:

“Later in the investigation, but before fire scene overhaul, the exterior area was examined to determine any indications of a burglary where stolen property had been left outside the building, however none was found. It was determined that a large amount of financial records have been thrown into two small plastic garbage cans outside the south rear door. These documents were later collected as evidence.”⁴⁰

It is clear from the fire investigators’ testimony at trial that the financial documents were discovered, and recognized by the investigators to be late notices and past due bills, before the investigators had begun their interior scene examination.

Ironically, the discovery of the financial documents was made while the fire investigators were actively searching for other pieces of domain-irrelevant information, “indications of a burglary”.

Louisville arson investigators initially ruled the fire to be incendiary based on a lack of accidental ignition sources at the “initial point of origin”, determined to be in or near boxes on the basement floor, and a “second fire” starting at the top of the basement stairs:

“Based on the examination of the scene, it is this investigators opinion that the initial point of origin was in the south basement. As the fire developed, it spread vertically from this location, but without the fuel load and conditions to cause the damage found on the first floor. A second fire originated on the first floor cause additional damage.”⁴¹

The electrical conduit located in the uncovered basement ceiling, directly above the “initial” area of origin, was melted at a conduit coupling, exposing the electrical wiring inside the conduit. Louisville arson investigators examined the melted coupling and the wiring: “There were no indications of shorting within the conduit that could have caused this fire above the area of origin.”⁴²

Confirmation Bias: A separate fire scene examination, confirming an incendiary fire, was conducted by an ATF investigator. The secondary examination was conducted in the presence of the fire department investigators who had conducted the original fire scene examination.

Three days after the fire, the Louisville Fire Department Arson Unit contacted the local field office of the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) for assistance “with the investigation of the scene and cause determination of the fire”.⁴³ The Louisville investigators advised the ATF cause and origin investigator of the discovery of the financial documents and the ATF scene examination was conducted in the company of the same Louisville fire investigators who had performed the initial fire-scene examination and had determined the fire to have been incendiary.

The ATF investigator dismissed the Louisville fire investigators’ determination of multiple areas of origin, saying the fire damage at the top of the stairway was caused by the fire extending from a single point of origin in the basement.

However, the ATF investigator maintained that the fire was still incendiary based on the lack of accidental competent ignition sources in the now confirmed area of origin, the basement floor. The ATF investigator also examined the electrical wiring located above the suspected area of origin but dismissed it as a source of ignition.

After the ATF scene examination, the Louisville fire investigator who had originally concluded there were two areas of origin modified his conclusions. The final report reads:

“Based on the examination of the scene, it is this investigators opinion that the initial point of origin was in the south basement. As the fire developed, it spread vertically from this location, *up into the stairwell area. A possible second fire originated on the first floor, just inside this stairwell area, or originated as the fire vented from the basement igniting combustibles displayed around the doorway.*”⁴⁴

(Emphasis added to portions changed from the preliminary fire report)

Selective Re-examination: An electrical engineer was hired to examine the electrical system after being told that the electrical system was not responsible for the fire and that his assignment was to exclude the electrical system as the cause of the fire. Being made aware of the conclusions of previous examinations may have influenced the engineer’s conclusions.

Nine months after the fire an electrical engineer was hired by the prosecution to examine the electrical system in the fire building, specifically the circuit that ran in the basement ceiling directly above the suspected area of origin.

In courtroom testimony, the engineer described the purpose of his investigation:

“The arson bureau investigators wanted me to determine, if possible, or to render an opinion that in fact this electrical conduit and the wiring and so forth, did not, in fact, cause the fire...that’s what I was asked to do”.⁴⁵

He also testified that one of the Louisville Arson Unit investigators told him, prior to his scene examination, that they suspected the fire started on the basement floor below the conduit, and that the electrical system did not start the fire.

His report describes his assignment and some of the information he was given prior to the examination:

“After conducting its investigation, the Arson Bureau of the Louisville Division of Fire has determined that this electrical conduit was routed above the fire’s point-of-origin, the point-of-origin being near or on the basement floor, and that a conduit coupling (which connects two sections of this conduit together) was located directly above the suspected point-of-origin. Investigators requested that I confirm their belief that the electrical system in this area did not cause the fire.”⁴⁶

The text of this portion of the engineer’s report and his corresponding testimony exposes the biasing information the engineer was given prior to what should have been a separate, independent examination and reveals the engineer’s self-perceived role; to confirm the conclusions of the fire investigators that “the electrical system in this area did not cause the fire”.

This re-examination of the conduit and electrical wiring could have been conducted in a “blind” environment. The electrical engineer’s assignment could have consisted of simply examining the evidence within his area of expertise (the electrical circuit, associated electrical breaker(s), and damaged conduit and conductors) and asked to determine if the electrical system was or was not involved in the fire’s ignition.

Instead, he was provided with the conclusions of the agency retaining his services, that the area of origin had already been established to be on the floor below the conduit, and told that his job was to eliminate the electrical system as a possible accidental source of ignition.

Role Bias: Throughout the lengthy investigation, Louisville Metro Arson Unit fire investigators and the ATF shared investigative responsibilities, both for the determination of the fire’s cause and origin and for the wider criminal investigation leading to Susan Lukjan’s arrest on charges of arson.

Both Louisville Fire Department fire investigators had attended the local police academy and had full police powers. They were assigned to the Louisville Metro Arson Unit and worked hand-in-hand with the ATF during what would eventually become a two-year investigation. An ATF special agent would later testify that the ATF worked closely with the Metro Arson Unit on this investigation, including areas of the investigation having nothing to do with determining the cause and origin of the fire.

The senior Louisville Metro Arson Unit investigator testified at trial that he and investigators from his unit assisted ATF with preparation of over one hundred subpoenas for records involved in the forensic accounting investigation of Susan Lukjan’s finances, as well as dozens of follow-up interviews.

Neither the Louisville or the ATF cause and origin investigators provided any domain-relevant evidence or testimony to show that the fire had an intentional cause. Their testimony was limited to a showing that all accidental and natural competent ignition sources in or near the area of origin had been inspected, considered, and eliminated.

The process of concluding a fire had a specific cause, such as incendiary, by eliminating all other causes, in the absence of evidence to directly support the underlying conclusion, is known in the fire investigation community as “negative corpus”.⁴⁷

NFPA 921 rejects negative corpus as a valid methodology for determining the ignition source or cause of a fire:

“This process (negative corpus) is not consistent with the Scientific Method, is inappropriate, and should not be used because it generates un-testable hypotheses, and may result in incorrect determinations of the ignition source and first fuel ignited. Any hypothesis formulated for the causal factors (e.g., first fuel, ignition source, and ignition sequence), must be based on facts. Those facts are derived from evidence, observations, calculations, experiments, and the laws of science. Speculative information cannot be included in the analysis.”⁴⁸

...In the circumstance where all hypothesized fire causes have been eliminated and the investigator is left with no hypothesis that is evidenced by the facts of the investigation the only choice for the investigator is to opine that the fire cause, or specific causal factors, remains undetermined...That is, it is improper to opine a specific ignition source that has no evidence to support it even though all other hypothesized sources were eliminated.”⁴⁹

(These passages appear in the 2011 edition of *NFPA 921*. Significantly, expert cause and origin testimony in the Lukjan case was based on the 2008 edition which did not directly reference “negative corpus” and contained a different paragraph regarding the process of elimination as it applies to fire cause determination that warned against its use but did not reject it outright⁵⁰)

The only evidence in support of an incendiary cause presented by either Louisville or ATF fire investigators was clearly *domain-irrelevant*. In the absence of any *domain-relevant* evidence to prove their hypothesis, the only scientifically valid conclusion under the circumstances described by the investigators, and the only conclusion in compliance with the most recent *NFPA 921*, must be “*undetermined*”.

In light of this analysis, the final words of the Louisville Fire Department cause and origin report take on a new significance:

“Based on my examination of the scene, the cause and classification of this incident is incendiary.”⁵¹

ABOUT THE AUTHOR

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Paul has nine years of investigative experience with a concentration in fire cause and origin, death scene, and insurance fraud investigations, and 15 years in fire suppression and emergency medical services as a firefighter and paramedic. He holds a Bachelor of Science in Criminal Justice from Excelsior College and a Master of Legal Studies with a concentration in forensic investigation and international studies from Monterey College of Law.

¹ For specific examples of error resulting from observer effects in science, see *generally* Alexander Kohn, *False Prophets* (rev. ed. 1989)

² M. Jeng, *A selected history of expectation bias in physics*, *American Journal of Physics*, 74 (7): 578 (2009) at 583.

³ M. Oswald, S. Grosjean, “Confirmation Bias” in *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgment and Memory*, Psychology Press (2004), 79–96.

⁴ NAS Report, *Strengthening Forensic Science in the United States, A Path Forward* (2009), at 122.

⁵ *Id.*

⁶ NFPA 921, *Guide for Fire & Explosion Investigation*, sec. 4.3.8 and 4.3.9, (2011), at 18.

⁷ For more information on expectation and perception, see *generally* U. Neisser, *Cognition and Reality: Principles and Implications of Cognitive Psychology* (1976).

⁸ See *generally*, P. Bieber, *Fire Pattern Analysis and Case Study Review*, The Arson Research Project, www.the arsonproject.org.

⁹ *Id.*

¹⁰ *Id.*

¹¹ *Fire Investigation Report of Capt. Tom Reuscher* (undated), Modesto Fire Dept., Fire & Arson Investigation Div., at 2.

¹² *Id.* at 9.

¹³ *Id.* at 2-3.

¹⁴ *Id.* at 10. It is not clear from Reuscher’s final fire report or his courtroom testimony on what information he based his conclusions that the house was in foreclosure or that the tenants were being evicted or the circumstances under which that information was obtained.

¹⁵ *Id.*

¹⁶ *Id.*

¹⁷ See *generally*, *Test of the TIF 8800 Combustible Gas Detector in a Post Flashover Environment*; Available at <http://www.the arsonproject.org/research/research.html>.

¹⁸ See P. Bieber, Challenging the ‘Science’ of Arson (May 2012), at <http://www.thecrimereport.org/news/inside-criminal-justice/2012-05-challenging-the-science-of-arson>.

¹⁹ See *Souliotes v. Hedgpeth*, U.S. Dist. Court, Eastern Dist. of California (1:06-cv-00667 AWI MJS HC), *Findings and Recommendations Regarding Statute of Limitation Issues*, at 28.

²⁰ J. DeHaan, *Supplemental Report Re: Souliotes v. Evans*, Fire-Ex File Number 11-0602 (12/01/2011), at 7-8.

²¹ *Id.*

²² *Id.*

²³ *Id.*

²⁴ See *Reuscher Report*, *supra* note 11 at 3.

²⁵ M. Neck, *Supplemental Fire Investigation Report*, (01/31/2001), Department of Public Safety and Corrections, Office of the State Fire Marshal, at 1.

²⁶ *Id.*

²⁷ *NFPA 921*, *supra* note 6, at 45.

²⁸ See *Supplemental Fire Investigation Report*, *supra* note 25, at 1.

²⁹ *Id.*

³⁰ *Id.*

³¹ See *NFPA 921*, *supra* note 6, at 46.

³² See *Supplemental Fire Investigation Report*, *supra* note 20, at 2.

³³ J. DeHaan, *Report re: State v. Gutweiler (Tioga Fire)*, Fire-Ex File Number 01-1101 (07/03/2002), at 8.

³⁴ *Id.* at 11.

³⁵ *Id.* at 7.

³⁶ J. DeHaan, *Supplemental Report re: State v. Amanda Gutwiler*, Fire-Ex File Number 01-1101 (12/14/2004) at 8-9.

³⁷ *Id.* at 13.

³⁸ *Id.* at 13.

³⁹ *Susan Lukjan v. Commonwealth of Kentucky*, Appeal from Jefferson Circuit Court, No. 2010-CA-001509-MR, at 2.

⁴⁰ *Preliminary Cause and Origin Report of Sergeant Todd Leonard* Louisville Fire Department Arson Unit, (08/19/2006), at 4.

⁴¹ *Id.* at 8.

⁴² *Id.* at 7.

⁴³ SA J. Jaraczski, *Cause and Origin Report* (03/10/2008), U.S. Dept. of Justice, at 1.

⁴⁴ *Final Cause and Origin Report of Sergeant Todd Leonard*, Louisville Fire Department Arson Unit (undated), at 8.

⁴⁵ Testimony of Donald Scheer May 14, 2010, *Lukjan v. Commonwealth of Kentucky*.

⁴⁶ D. Scheer, *Opinion Report re: the fire at Campbell’s Gourmet Cottage* (11/08/2007), at 1.

⁴⁷ See *NFPA 921*, *supra* note iii, sec. 18.6.5, at 174.

⁴⁸ *Id.*

⁴⁹ *Id.*, sec. 18.6.5.1, at 174.

⁵⁰ *NFPA 921, Guide for Fire & Explosion Investigation*, sec. 18.2.1 through 18.2.6 (2008), at 156.

⁵¹ See *Final Cause and Origin Report of Sergeant Todd Leonard*, *supra* note 86, at 8.