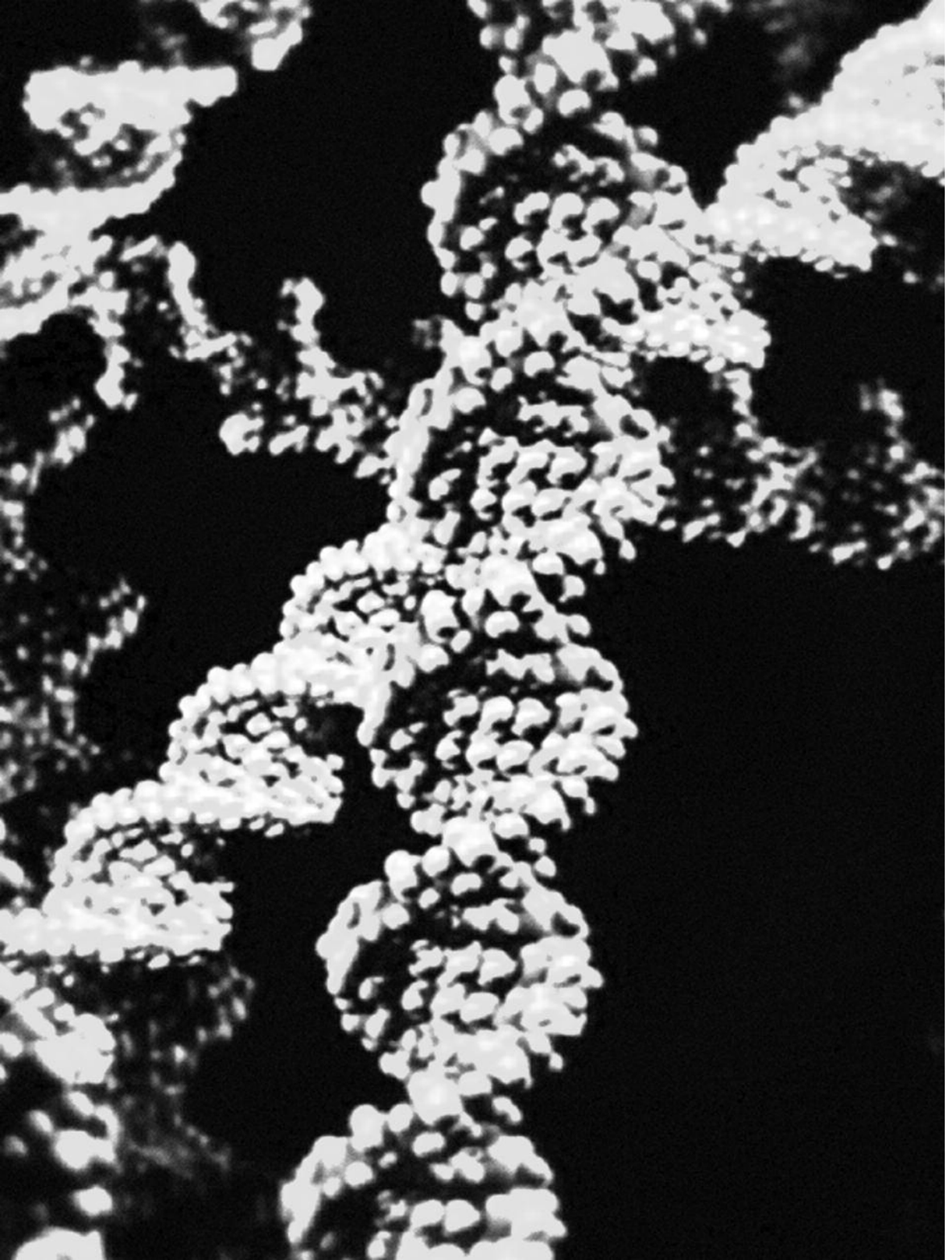


Leanna OEN

Under the Microscope

POP CULTURE VISUALIZATIONS OF DNA

Original image accompanying James Watson and Francis Crick's 1953 article "The Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid"

I. Two Scientists Walk Into a Bar...

> *Carefully constructed families of pictures can act as a calculus all of their own. Like any successful systems of symbols, with an appropriate grammar they enlarge the number of things that we can do without consciously thinking.* —JOHN D. BARROW, *COSMIC IMAGERY*[1]

ON A COLD FEBRUARY EVENING IN 1953, TWO YOUNG SCIENTISTS walked into an English pub and announced "We have found the secret of life!" American biologist James Watson and British physicist Francis H. C. Crick were referring to their discovery of the molecular structure of DNA, the double helix. Indeed, these scientists revealed to the world one of the most important discoveries of the twentieth century, one that would affect natural science and medicine, as well as social science and popular culture. In April of that same year, their article "The Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid," was published in the science journal *Nature*. They argued that "This structure has novel features which are of considerable biological interest."[2] Their paper continued to describe the double helix, its function, and how the structure allowed for genetic material to be copied and passed from one person to another. While the value and excitement of this discovery can be demonstrated in subsequent scientific literature, its

impact on popular culture is more difficult to ascertain. A line drawing of the spiraling double helix accompanied the text; though simply drafted, this visualization of DNA has had a significant impact on the popular imagination.

In the wake of Watson and Crick's *Nature* article, DNA could be described with an image. Soon the concept of biological difference took hold, and began to alter the modern individual's perception of self. It allowed people to look through the lens of science and understand themselves on a molecular level. This study argues that this way of looking, encouraged by visualizations of DNA in popular culture such as the form of the double helix and the forensic tool of gel electrophoresis, have conflated biological and subjective individuality. Using the work of biologists, legal scholars, genealogists, and philosophers, I explain how this conceptual blurring came about.

To understand the ways in which biological and subjective individuality have been collapsed, we must first examine the meaning of "individuality." According to the *Oxford English Dictionary*, the term has three different but interrelated definitions.[3] The first speaks to its etymological roots; it originally meant "unable to be divided," or indivisible. In other words, it describes the state of an individual who is a complete entity unto himself and cannot be divided any further. The second, related definition is "single or existing separately." In this understanding, the individual exists in a liminal space that is singular, but only because of the presence of others. It is the existence of other people that allows the individual to distinguish himself as a separate, single entity. The third and final designation of individual is "special and distinct from others," which speaks not to the physical proximity of someone in relation to other people, but refers to an individual's abstract, unique characteristics. What is key to note here is that these definitions move from physical, exterior attributes to interior, personal character traits. Thus, the word *individual* itself contains the possibility for the conflation of biological and subjective individuality, which makes the concept of the individual ripe for further modulation.

In using the term biological individuality, I refer to phenotypical uniqueness and characteristics that exist on the corporeal level. Causes and effects occur and can be quantifiably measured in biological understandings of corporeality. In her writings on genetic determinism, legal scholar Susan Oyama writes, "biological nature tends to be thought of as fixed, and so beyond individual or social control."[4] That is, the biological self is the body into which one is born, complete with innate and inherent characteristics marked by visually distinguishable phenotypes, such as hair or eye color, shoe size, or height. Another way to understand biological individuality is to consider the nature-nurture debate, in which the body is related to nature and the mind is associated with nurture. The corporeal is what people are born with and includes tangible attributes that differentiate and distinguish an individual from others. This biological self is created at the moment of conception, when our genes begin to be formed and coded, and cannot be changed without drastic interventions.

Based on this understanding of biological nature, its converse would be subjectivity. Personal actions, preferences, habits, and personality traits all fall under the category of subjective individuality. This understanding of subjectivity is linked to nurture as opposed to nature and can also be associated with the concept of the mind. This self is malleable and subject to change. It can be influenced by experiences or by the way one chooses to live one's life. When Oyama writes that "we constantly acknowledge and deny authorship of our behavior," the subjective self is the self that we acknowledge and for which we take responsibility.[5] Choices, decisions, and actions are all part of and dependent upon subjective individuality.

While these two understandings of the self would initially appear to be polar opposites, I will demonstrate that popular culture blends these two perceptions of personal uniqueness. "Pop culture" is defined here as any mass communication that is intended for a non-specialized audience. Such a definition can include television shows, films, newspaper articles, and websites, among other media. While these sources may not be considered scientifically factual, they are useful to examine as they often indicate and reflect the cultural beliefs of a large and diverse audience. In contrast, *Nature*'s readership represents a distinct subgroup: In 2010, 85 percent identified themselves as scientists, 60 percent worked at universities or hospitals, and its print journal had a weekly circulation of 49,540.[6] The daily circulation of the *New York Times* in 2009 was approximately 1.6 million, while only 14 percent of the paper's readers had a graduate degree or higher, and 18 percent identified their occupation as "professional" or "managerial."[7] *Nature*'s target audience, therefore, is a highly specialized demographic, whereas the readership of the *New York Times* is much larger, representing a variety of experiences and education levels. Of the two publications, the *New York Times* would be considered pop culture while *Nature* would not because it has a specific, specialized target audience.

Analyzing articles in the *New York Times* is therefore useful in gauging the ideas circulating within a large population. In this context it becomes obvious that the public is more familiar with scientism than with science. Scientism, first described by George Bernard Shaw in 1921 in his series of plays *Back to Methuselah*, is the excessive belief in scientific knowledge, methods, and techniques. This way of thinking raises scientists to the status of infallible demigods who can reveal truths about the natural world and even our own notions of individuality. Scientism also implies two things: first, that an ultimate, natural truth exists and is waiting to be uncovered and, second, that knowledge is something to be accumulated, like data. However, science is a practice that involves much time and error; it is not the glamorized endeavor that pop culture makes it out to be.

The first instance in which DNA was successfully used as a tool of identification was a 1987 investigation of the murder of two young schoolgirls. This case marked the beginning of the practice of referring to microscopic genetic material for identification purposes and is used here to gauge public reception of the technical application of the visualization of DNA. The process of gel electrophoresis made it possible to visualize the evidence; this visualization was then treated as irrefutable proof and ultimately led to a conviction. Although this identification technique was developed almost thirty years ago, it is still used by forensic scientists today. Examining the language of newspaper articles surrounding this case reveals that this type of visual forensic evidence links an individual's actions to their genes; further, because of its visual nature, its conclusions are presented as obvious and self-evident.

Certainly DNA and the double helix did not create the concept of individuality, but the visualization of DNA has contributed to Western notions of a unique self. While as a side effect of this investigation of pop culture uses of DNA, the authority of science may appear to be called into question, it is actually pop culture's scientism that is under scrutiny. The old expression "seeing is believing" may initially seem clichéd, yet sight is the basis of scientific observation and, increasingly, a means of contemporary interpretation of the self in pop culture. This essay explores the scientism behind pop culture representations of forensic evidence and analyzes popular visualizations of the invisible phenomenon of DNA in order to reveal conceptual linkages between biological material and subjective actions.

Title screen from CSI: Crime Scene Investigation, *2003*

II. Visualization and Criminalization

PETE TOWNSHEND'S GUITAR AND ROGER DALTRY'S DISTINCTIVE voice are the first sounds heard in the opening credits for *CSI: Crime Scene Investigation*, a popular television show set in Las Vegas. The guitar chords accompany an aerial view of the Las Vegas strip before a video montage quickly flashes the faces and names of the actors, interspersed with microscopic shots of cells, blood, and hair follicles. As Daltry's voice repeatedly asks, "Who are you? Who, who?" images of green double helices, computer-generated versions of the sketch that accompanied Crick and Watson's description of DNA, twist against a black background. Long after the opening credits end, the question of identity remains and is linked in the viewer's mind to the spinning strands of DNA.

During its fourth season, in 2003, *CSI* boasted tens of millions of viewers in the U.S. and around the world.[8] The show has since been dubbed in several languages and continues to reach a wide audience. Those green, twisting double helices from the opening credits have been seen repeatedly by innumerable people. Repeated exposure to the double helix in this context teaches viewers to see and understand themselves as molecularly unique. The formula of *CSI*, its three spin-offs, and similar television shows in the genre uses forensic DNA evidence to narrow down a population to a singular suspect who can then be arrested and sent to prison. By relying on this forensic formula, police crime dramas are able to conflate subjective and biological individuality. Using images of the double helix and relying upon the authority of science, *CSI* informs the public about forensic DNA and individuality.

The structure of the opening sequence is significant: From the Vegas strip it cuts to a graphic treatment of the show's title that is

interspersed with magnified technical and scientific images. The camera roves over a pair of microscopic slides, a magnified hair follicle, and a moving bullet before the television screen proudly announces the name of the show. This pattern, beginning with a macro view and narrowing down to a micro view, is carried through each episode, and stresses the importance of looking as a means of gathering information and solving crimes. The actors themselves model this kind of looking: as their names appear in the credits they are shown with flashlights or other tools of the trade, their brows furrowed as they gaze intently at miniscule details that the audience cannot yet see.

Television shows in this genre—such as the *CSI* series, *NCIS*, *Bones*, *Cold Case*, and the *Law & Order* franchise—glamorize science as an infallible method of identifying suspects to a public that does not fully understand the processes of forensic DNA technology. These shows typically depict DNA profiling as a quick and accurate investigative method. In reality, however, this process is slow, tedious, and fallible. While DNA profiling has been the standard in forensic identification for the past twenty years, it is still an evolving technology. In fact, low-copy-number analysis (LCN), the process of profiling using an incredibly small amount of DNA, has recently been called into question. How can a suspect be correctly identified on the basis of such a small sample?[9] This science has not been thoroughly tested or peer reviewed by either academic or forensic scientists, yet it is legally considered sufficient evidence on which to base a conviction. That LCN is still admissible in court, despite its flaws and the contestation surrounding it, speaks to our society's faith in scientific and (seemingly) objective facts. Juries and the public ask suspects "who are you?" Then they turn to science to answer that question and assign judgments of innocence or guilt.

Double helices from the title sequence for CSI: Crime Scene Investigation*, 2003*

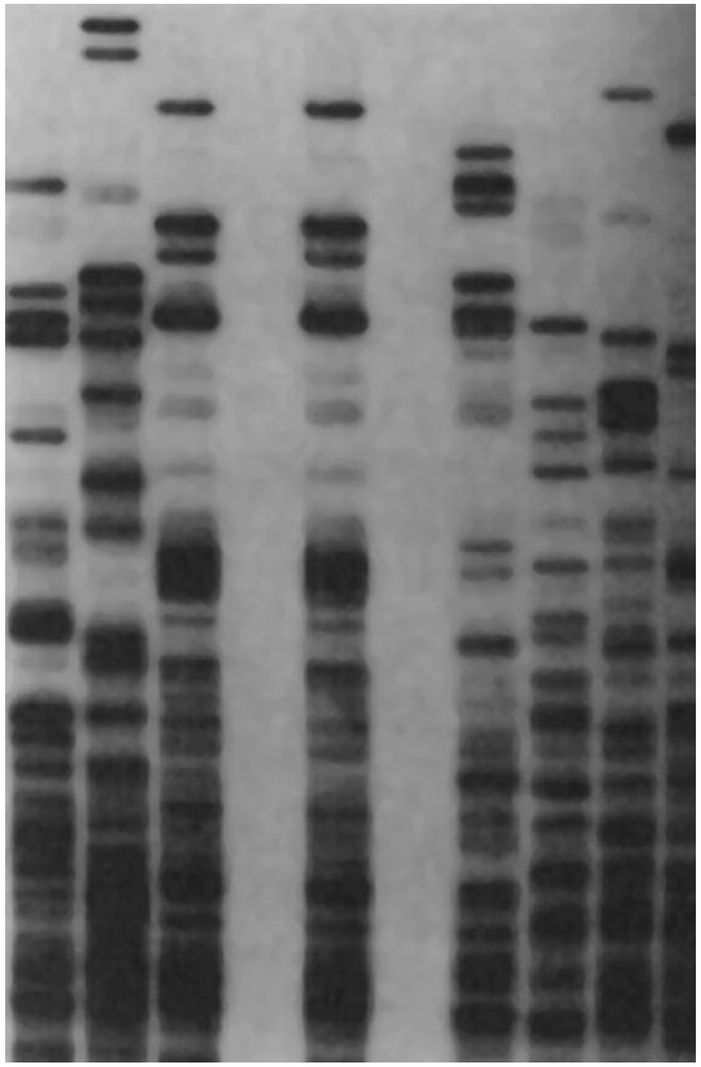
The conflation of biological and subjective individuality has been made possible by the pervasive visualization of DNA. With the formulation of the double helix by Watson and Crick, biological individuality on a molecular level became something that could be clearly seen and understood. Without the double helix, biological individuality would still be a hazy mystery to the public. Biologist Sean B. Carroll says that "we believe what we witness with our own eyes. Throughout scientific history, new ways of seeing have played a critical role in the discovery and acceptance of new ideas."[10] According to Carroll, once a phenomenon can been seen, it can be understood and accepted as factual, even if what is seen had never before been visualized. It follows that the representation of DNA in pop culture reinforces public understanding of the individual self as biologically unique. When *CSI* uses the double helix in its opening credits and then continues, within each episode, to narrow down a group of people to one suspect based on DNA evidence, it is visually making connections between subjective and biological uniqueness.

The use of DNA as a tool of identification in criminal profiling finds its authority in scientific and seemingly objective knowledge. In foregrounding DNA evidence—and its visual symbol, the double helix, *CSI* implies that subjective and biological individuality can be conflated. Looking at the history of criminal identification technology reveals that the use of biological material is only one of many techniques based in the field of science, following serology, fingerprinting, craniometry, and even phrenology. Criminal profiling has long been based on sight. While some of these techniques may seem outdated, at one point their conclusions were treated as fact. What these identification technologies have in common with DNA profiling is that all of them fuse biological markers—blood, fingertips, or head shape—with the actions of a unique, subjective individual. The method of identifying suspects may change but the persistent use of bodily evidence continues the conflation of biology and subjectivity.

CSI has been so effective in educating its viewers about their biological individuality that the outcomes of real court cases have been swayed in favor of the science. This is the *CSI Effect*: the excessive belief in the efficiency and accuracy of using forensic evidence to solve a crime. In a 2007 *New Yorker* article, scholar Carol Henderson recounts this anecdote: "'I just met with the conference of Louisiana judges and when I asked if *CSI* has influenced their juries, every one of them raised their hands. . . . People are riveted by the idea that science can solve crimes.'"[11] The general public is seemingly unable or unwilling to separate fictional, televised representations of science from actual forensic science. This confusion is one example of the public's scientism. Using the phrase, "we have a match," *CSI* scientists are quick to draw conclusive and certain results, whereas their real life counterparts rarely express such certainty. The certainty provided by scientific evidence is appealing, yet fictionalized depictions are just that: fiction.

Yet the police investigations and court cases of *CSI*, while fictional, have real impact on their audience and are often translated to real-life scenarios. The authority of science to provide clarity where once there was none is dangerously appealing. Just as juries have come to depend on forensic narratives to identify criminals, the public has increasingly made DNA fundamental to understanding themselves. Through repeated exposure to the double helix and the allure of an accurate and verifiable truth, audiences have embraced the idea that they are molecular beings. It is worth noting, however, that while the *CSI Effect* has had an impact on contemporary juries, even juries prior to 2003 were attracted to forensic science.

Alec Jeffreys, a geneticist at the University of Leicester, developed DNA profiling in the 1980s. This technique is based on con-



An example of an electrophoretic gel used in forensic science

trastive visualizations made possible as the result of a process called gel electrophoresis. DNA collected at a crime scene (in the form of hair, blood, saliva, or semen) is put into an agarose gel. An electric current is then run through the gel. As the current moves through the gel, the negatively charged phosphate in the DNA travels through the gel toward the positively charged end at the opposite side. As the DNA travels, the heavier molecules stop at certain points, leaving distinctive band-like markings. Each DNA sample creates a unique set of bands in the gel due to the varying weights of the molecules. Forensic scientists compare the electrophoresis of suspects to the DNA found at the scene of a crime to see which samples visually match.

Jeffreys's technique for comparing DNA samples was first used in a forensic context in a 1987 murder trial. In 1983, on a cool November day in Leicester, England, fifteen-year-old schoolgirl Lynda Mann was walking to a friend's house. But she never made it. Instead, she was found raped and strangled with her own scarf. Three years later, Dawn Ashworth, another fifteen-year-old schoolgirl, met the same fate. After a long and tedious investigation, in which blood or saliva samples were taken from five thousand local men, Colin Pitchfork, a twenty-seven-year-old baker, was eventually arrested. He was the first person to be identified and convicted based solely on DNA evidence.

It was his genetic material—visualized by an electrophoretic

gel—that enabled Pitchfork to be caught. During the investigation he had evaded voluntary DNA collection by getting a friend to donate in his stead; he was arrested when someone overheard him bragging about this evasion. Once he was under custody, police obtained a DNA sample that matched the sample from the crime scene. Pitchfork was ostensibly proven unique both by his actions *and* by his genetic makeup.

Forensic science has provided an authoritative basis on which to link biological and subjective individuality. One of the sources of this authority is the representation of DNA as the double helix, another stems from processes such as gel electrophoresis that help visualize genetic evidence. Photography has played an important role in the translation of such forensic tools to visual evidence that can be understood by the general public. A photograph of an electrophoretic gel accompanies a 1994 *Financial Times* article discussing the evidentiary use of genetic material. That DNA is being visualized in a photograph attests to its authority, since photography has its own authority. In his discussion of the use of photography in the legal system, scholar John Tagg describes the power of photographs. Quoting Roland Barthes, Tagg states:

> *Beyond any encoding of the photograph, there is an existential connection between "the* necessarily *real thing which has been placed before the lens" and the photographic image: "every photograph is somehow co-natural with its referent." What the photograph asserts is the overwhelming truth that "the thing has been there": this was a reality which once existed, though it is "a reality one can no longer touch."*[12]

According to Tagg, then, photographs attest to the existence of the thing photographed. When newspapers publish photos of electrophoretic gels, those images by their very nature work to reinforce and confirm the existence of the genetic material. Newspaper photographs of DNA speak to the truth of DNA's actuality. The combination of its scientific origins, the use of photography to illustrate molecular differences, and the use of DNA as evidence operates to construct an air of truth around this method of identification.

DNA is presented as statistically irrefutable and as a major contribution from science to the legal system. Such claims are often supported by photographs, which support verbal testimony offered in newspaper articles and court cases. In a 1988 *New York Times* article discussing forensic evidence, journalist Stephen G. Michaud describes the use of DNA in suspect identification as a nearly flawless technique: "researchers now can literally disassemble DNA, and examine it for microscopic variations that make human beings (except identical twins) verifiably unique to a statistical certainty."[13] Using language like this, Michaud portrays DNA as a perfect form of identification. By defaulting to the seemingly neutral authority of statistics and science, the author contributes to the conflation of one's biological make-up and one's subjective understanding of self. He continues to say, "the potential for 100 percent certainty makes this a singular forensic tool." While responsible forensic scientists would never make the claim that DNA identification is perfect or flawless, Michaud creates the illusion that this technique is infallible. His portrayal of the potential and use of forensic science valorizes the process and contributes to unrealistic standards and expectations in juries.

When presented with such authority, science becomes even more effective at structuring the conflation between biology and subjectivity because it is trusted to be unbiased. Michaud was not the only journalist whose coverage of the Pitchfork case highlights this phenomenon. In a 1987 article in the *Anchorage Daily News* covering the use of forensic evidence, journalist Tyler Marshall wrote:

DNA—deoxyribonucleic acid—found in the chromosomes of all living beings but in uniquely different patterns. The arrangement of the series of bands that make up the DNA is as individually specific as a fingerprint, with the chance of two persons having identical patterns estimated at between 30 billion and 100 billion to one, according to Jeffreys.[14]

Here, the journalist invokes both science and statistics by explaining how DNA profiling works and providing the mathematical estimation of its accuracy. This example of scientism demonstrates the prevailing pop culture perception of science as error-free and veracious. Hailed as a seemingly precise and factual method of identification, DNA is then naturally used to convict criminals of actions driven by subjective and personal motives. The conflation of biological material and subjective behavior is made relevant and accurate because it uses science as an authority for the facts provided.

Colin Pitchfork's case laid the groundwork for shows like *CSI* to exist and to capture the public's imagination. The use of DNA evidence in his trial was groundbreaking for science and for law enforcement. While science and the law have had a long relationship that goes back to Sir Robert Peel's London bobbies in 1829, the use of forensic evidence made the science of identification more precise than ever. However precise this new technology is, what is admissible as evidence is constantly evolving and changing. Tagg touches on this when he says:

…an image produced according to certain institutionalized formal rules and technical procedures which define legitimate manipulations and permissible distortions in such a way that, in certain contexts, more or less skilled and suitably trained and validated interpreters may draw inferences from them on the basis of historically established conventions. It is only in this institutional framework that otherwise disputable meanings carry weight and can be enforced.[15]

According to Tagg, images can be altered and still admissible as evidence as long as the alterations abide by a preestablished framework that is deemed acceptable. That framework necessitates change when technologies for making an identifying image change or evolve. Once DNA evidence could be presented visually, it became not only admissible but deeply compelling in courtrooms around the world.

When Pitchfork's case established DNA as a viable form of evidence, it had repercussions outside of the courtroom. Finally science could distinguish an individual from billions of other possible genetic combinations. Scientists were able to prove that everyone was biologically unique. One sector of the public quickly made use of this fact to further their own interests. Those interested in ancestral research used DNA to look further down the family tree. Much like forensic DNA, ancestral research manages to confuse and combine subjective and biological individuality. It is tempting to use biological uniqueness to explain subjective traits; however, that would totally disregard other factors that contribute to identity such as environment, family, culture, and education.

III. Why It Matters

ALTHOUGH THE CONFLATION OF BIOLOGICAL AND SUBJECTIVE individuality may initially seem inconsequential, the consequences are actually twofold. First, when the boundary between the two types of individuality is blurred, one can no longer be held accountable for one's actions. Second, the fusing of biology and subjectivity can influence the ways science is practiced. Amy Harmon's two-year *New York Times* series and the ideas presented in Thomas Kuhn's *The Structure of Scientific Revolutions* are useful frameworks within which

to examine the consequences of this conflation of selves.

When biological and subjective individualities are combined, the onus of responsibility for one's actions and behaviors can be transferred to one's genes. In writing about DNA, one aspect that Harmon explores is how the understanding of human genetics impacts daily lives. She interviews a computer programmer, Mike DeWolfe, who wonders if his stocky build is related to his genes: "I really would like to have a test, because it would help reduce my guilt over it." He also states that "[having a genetic treatment as opposed to dieting] would make a big difference."[16] Discovering that the reason he can't seem to lose weight might be associated with his biological individuality, DeWolfe concludes that he is not responsible for exercising and adopting healthy eating habits—actions that would be performed by his subjective self.[17] If his subjective choices can be explained using DNA and his genes, then his decisions are linked with his biological self and he longer has to feel guilty or responsible for his lifestyle choices.

Who is responsible for alcoholism, childhood obesity, or attention deficit disorder? While it's easy to blame these negative traits on genes, it's more difficult to relinquish responsibility for those characteristics that are viewed in a more favorable light. When dancers were told that their dancing skills might be associated with their genes, they were upset and prompted the director of *Pointe* magazine, Virginia Johnson, to say that "being a dancer requires so much more than what's there in your body, an emotional strength."[18] Admitting that part of her dancing skill could be attributed to her genes takes away her sense of accomplishment and pride in her skill. When the biological becomes confused with the subjective, achievements and superior performance can be trivialized.

Suggesting that genes are responsible for specific traits relates these traits to diseases that then can and should be cured. If it is found

that there is a gene responsible for pedophilia or violent behavior, what is society's role in handling people with these hypothetical genes? This line of thinking quickly points toward the ethically murky field of eugenics. In its modern form, eugenics is the practice of improving the genes of the human population through selective breeding. Eugenics is fraught with ethical problems and has mostly been abandoned in the sciences, especially after Adolf Hitler's Nazi Germany used millions of Jews, mental patients, and disabled people for eugenics experiments.[19] Currently, scientists are exceedingly careful when describing the relationship between genes and behavior; it is the mainstream media that conflates the two forms of individuality.

The second consequence of the conflation of individualities impacts science itself. If science has been so influential in changing the concept of the individual, one begins to wonder if the reverse is also applicable. Can the individual affect the work of scientists? For the answer to that question, Kuhn suggests that paradigm shifts in the sciences occur in part because of the changing views of society. He states,

> *Observation and experience can and must drastically restrict the range of admissible scientific belief, else there would be no science. But they cannot alone determine a particular body of such belief. An apparently arbitrary element, compounded of personal and historical accident, is always a formative ingredient of the beliefs espoused by a given scientific community at a given time.*[20]

According to Kuhn, societal beliefs do not simply affect scientific practices; they are in fact fundamental to science. This directly contradicts popular scientism which understands science to be free and separate from human interference. With the long-standing interest in "who are we?" and "why we are this way?" acting as an inspiration and influence on science, it is no wonder that visualizations of DNA in pop culture are confusing the biological individual with the subjective one.

And if one were to follow Kuhn's implications to their logical end, it would mean that a revolution, in both scientific and popular knowledge, would have to occur, thus eradicating or proving worthless current notions of both DNA and forms of individuality.

Between assuaging the public from guilt or having an influence on the way that science is practiced, when subjective and biological individuality are combined the ramifications have real effects on the public. Just as the concept of DNA has changed the way one understands oneself, the way information surrounding DNA is disseminated has changed cultural understandings of subjectivity. Ancestral DNA can contextualize people in a familial lineage that goes far beyond any paper trail and places the researcher in a timeframe of thousands of years. Forensic DNA combines the powers of law and science to create a new form of evidence that is nearly impossible to refute. When DNA is visually represented in these two contexts, the conflation of unique individualities is inevitable.

Notes

1 John D. Barrow, *Cosmic Imagery: Key Images in the History of Science* (London: Bodley Head, 2008), 3.

2 James Watson and Francis H.C. Crick, "Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid," *Nature* (April 1953), 737.

3 *Oxford English Dictionary Online*, s.v. "individual," accessed February 20, 2011, http://0-www.oed.com.bianca.penlib.du.edu/view/Entry/94633?redirectedFrom=individual#eid.

4 Susan Oyama, *Evolution's Eye: A Systems View of the Biology-Culture Divide* (London: Duke University Press, 2000), 169.

5 Oyama, *Evolution's Eye*, 169.

6 "2011 Nature Media Kit," Nature Publishing Group, accessed February 20, 2011, http://www.nature.com/advertising/resources/pdf/2011naturemediakit.pdf).

7 New York Times Customer Insight Group, "New York Market Demographic Profile, 2009," New York Times, accessed February 20, 2011, http://www.nytimes.whsites.net/mediakit/pdfs/newspaper/Scarborough_Quality_Reach_NY.pdf.

8 On October 7, 2004, *CSI* had 27.8 million viewers, on October 6, *CSI: N.Y.* had 16.9 million viewers and on October 4, *CSI: Miami* had 20.7 million viewers. See Allison Romano, "ABC Gets Big Rise Out of Fall," Broadcasting and Cable, accessed October 12, 2010, http://www.broadcastingcable.com/article/96130-ABC_Gets_Big_Rise_Out_of_Fall.php.

9 Further information regarding the admissibility of low-copy-analysis evidence in court can be found in Natasha Gilbert, "DNA's Identity Crisis," *Nature* (March 18, 2010), 347–8.

10 Sean B. Carroll, *The Making of the Fittest* (New York: W.W. Norton, 2006), 217.

11 Jeffrey Toobin, "The CSI Effect: The Truth About Forensic Science," *The New Yorker*, May 7, 2007 under "Annals of Law," accessed February 12, 2011, http://www.newyorker.com/reporting/2007/05/07/070507fa_fact_toobin?currentPage=all.

12 John Tagg, *The Burden of Representation: Essays on Photographies and Histories* (Amherst, Massachusetts: University of Massachusetts Press, 1988), 1.

13 Stephen Michaud, "DNA Detectives," *New York Times*, November 6, 1988.

14 Tyler Marshall, "Scientific Clues Help British Police Track Crime Suspect," *Anchorage Daily News*, September 22, 1987.

15 Tagg, *The Burden of Representation*, 2.

16 Amy Harmon, "That Wild Streak? Maybe It Runs in the Family," *The New York Times*, June 15, 2006.

17 In 2006, a gene was linked with obesity. See Alan Herbert et al., "A Common Gene Variant is Associated with Adult and Childhood Obesity," *Science*, April 14, 2006.

18 Harmon, "That Wild Streak? Maybe It Runs in the Family," 2006. In 2005, two genes were linked with creative performance, social communication, and dancing. Rachel Bachner-Melman et al., "AVPR1a and SLC6A4 Gene Polymorphisms are Associated with Creative Dance Performance," *PLoS Genetics*, September 20, 2005.

19. James Watson is quite outspoken about his views regarding eugenics, going so far as to say that the population of Africa is genetically inferior, that parents should be allowed to abort homosexual children, and that selective breeding to create "pretty" girls would be "great." For more information see Michael Gerson, "The Eugenics Temptation," *The Washington Post*, October 24, 2007; and Robert Koenig, "Watson Urges 'Put Hitler Behind Us'" in *Science*, May 9, 1997.

20 Thomas Kuhn, T*he Structure of Scientific Revolutions*, (Chicago: University of Chicago Press, 1996), 4.