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The Mutation of Altruistic Intents in Scientific Research

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Abstract

Although scientific research has revolutionized our daily lives, providing us with the comforts of antibiotics and cars, it undoubtedly has a dark side as well—such as the culmination of research scandals ending in destroyed careers or the development of drugs with side effects killing tens of thousands. I aim to highlight various risk factors which may lead to unethical research behaviors and ultimately disastrous consequences. One of these major risk factors is "pathological altruism," a term coined by Dr. Barbara Oakley. Pathological altruism is defined as "attempts to promote the welfare of others that instead result in unanticipated harm" (Oakley, 2012). First, I explore how these research reward processes can be connected to researchers' potentially harmful biases, as evidenced by fundamental psychology principles. Using concrete examples of science fair competitions and thought experiments, I reveal how these biases develop during a researcher's early education and career. Then, by examining the case study of stem cell scientist Haruko Obokata's scientific misconduct scandal, I expand on the "speed versus stability" model of scientific communication (Lewenstein, 1995), which provides further insight on external factors negatively influencing researchers. The case study highlights how the biases discussed in this paper harm individuals' careers, their research fields, and ultimately society. Rather than framing unethical behavior in science in terms of good versus evil, my research aims to provide a supportive framework for the discussion and analysis of the actual mechanism of how research ethics become compromised.

Introduction

Science fiction is rife with examples of scientists harming society by their desires to "change the world." Geneticists in *Jurassic Park* bring extinct dinosaur species back to life to bring families joy and wonder but end up with a number of gruesome deaths by the vicious predators they created. Doctor Octopus in *Spider Man* aims to create a source of clean energy but ends up nearly destroying New York City. Computer programmers in *Terminator* create Skynet as an artificially intelligent defense system, but it instead wreaks havoc on all of humanity.

And yet scientists are also commonly portrayed as heroes. Dennis Meredith, author of the book, *Explaining Research*, called it a "corrosive myth" that scientists are portrayed more often as villains than heroes (Meredith, 2010). Compiling a list of 140 films and television shows depicting scientists or engineers, Meredith's "analysis revealed about six times more scientist-heroes than scientist-villains" (Meredith, 2010). Indeed, the heroes of the first *Jurassic Park* installment were actually researchers as well: paleontologist Alan Grant, paleo-botanist Ellie Sattler, and mathematician Ian Malcolm. And multiple renditions of Spiderman actually depict him as having invented web-shooter devices himself (*The Amazing Spiderman*). Meredith declared that, "my aim [is] demonstrating that the public sees scientists as heroes…I also hope that the next time a scientist stands before an audience…he or she will do so confident in having the considerable advantage of being seen as a trusted, credible, hero" (Meredith, 2010).

Three years ago, I found myself in a giant convention center, eager to present my research on colon cancer as "a trusted, credible hero" at the Intel International Science and Engineering Fair (ISEF). Flaunting a slogan like "the brightest young minds inspired to change the world" (Society for Science and the Public, 2014), ISEF epitomized the hero-scientist promotion which Meredith called for. The science fair spread this idea in numerous ways, supported by the vast funds of its corporate sponsors. A series of inspirational TED-talk style speakers and even a panel of Nobel Prize winners were invited with fanfare, the convention center was outfitted with banners, posters, and even a gift shop full of souvenirs—all of which carried some variation of the idea that these students, with their altruistic motivations, can use science to "change the world."

This message is not only glorified through science fairs; it is also deeply entrenched in the scientific community. In a survey of around 500 undergraduates pursuing STEM (Science, Technology, Math/Medicine) careers, approximately 39% of students listed "making a difference" as a major motivator for their choice of career path (Harris Interactive, 2011). These results are not so surprising; it can be easy to assume that inspiring as many people as possible to make a positive difference can only be a force for good. Three years ago, as a student who first became inspired to do research through a cancer lab, I certainly would have been part of that 39% group as well.

However, as I have gained further research experience these past three years, I have also become increasingly aware of how this mentality may unexpectedly lead to issues in research ethics. I once encountered a particularly disturbing online survey about a science fair. It was conducted by two ISEF participants (Mooring & Smith) and revealed that out of a hundred Louisville Regional Science Fair participants, 60% admitted to some form of scientific misconduct, 55% had falsified data, changed hypotheses to fit results, or lied on fair entry forms, and 15% of respondents acknowledged doing all three. If we are to perceive these young scientists as heroes “inspired to change the world,” should these students who falsified data, such as those in the Louisville survey, be considered villains?

While it may be tempting to approach unethical behavior in science in terms of good vs. evil, doing so would fail to provide a supportive framework for the discussion and analysis of where the system goes wrong. My research will instead build on the more nuanced idea of “pathological altruism” and apply it to ethics in the scientific community. The formal term “pathological altruism,” coined by Dr. Barbara Oakley, has recently gained recognition in the academic community. Dr. Oakley defines the paradox as “attempts to promote the welfare of others that instead result in unanticipated harm” (Oakley, 2012). In the book *Pathological Altruism,* which she co-authored, Oakley refers to several cases studies. One case describes how empathetic nurses who initially tried to do more to help patients were found to have higher rates of burn-out and thus decreased long-term quality in patient care (Oakley, 2012). Building on these few case studies, Oakley and her colleagues then examined the psychological, biochemical, and evolutionary factors contributing to our inherent bias for the “altruistic.”

In regards to scientific research, pathological altruism does not mean that research or scientists always have inherent altruistic motives. Instead, it just emphasizes the inherent bias which exist in the overall research field and may or may not influence a scientist depending on what related professional and personal pressures the scientist may encounter. The study of pathological altruism in a specific field like research has certain unique elements that are important to consider. I will focus on two major elements which have led to millions of dollars in wasted money, destroyed careers, and even deaths. A major factor is publication bias. Publication bias is the tendency for positive outcomes with high impact implications to be favored for publication over studies with negative, contradictory, or inconclusive outcomes (Song, 2000). The second factor is scientific misconduct, which, similar to publication bias, may also stem from societal pressures for results with positive implications. More specifically, one of the most widely accepted definitions from The United States Office of Research Integrity defines “research misconduct” as the act of “1) fabrication, 2) falsification, or 3) plagiarism" (U.S. Office of Research Integrity, 2011).

My research therefore explores the mediating process by which altruistic research goals may lead to scientific misconduct and publication bias. I will first propose an association between "altruistic" research goals and the rewards a scientist may encounter in their early training. Then I will explain how the reward process is negatively influenced by the ways in which society places value on scientists' work. In doing so, rather than categorizing scientists as heroes or villains, I aim to highlight various risk factors—especially societal pressures—which may lead to unethical research behaviors.

The Research Reward Process—the Basis for Research Biases?

In a review article on pathological altruism, Oakley notes that the "reward circuitry appears to be an important determinant of altruistic behavior" (2012). To understand the association between conducting "altruistic" research and rewards, it is important to understand a fundamental concept in psychology called instrumental or operant conditioning.

One behaviorist from the early 1900s, Edward Thorndike, conducted a study involving placing cats in puzzle boxes. If the cat pushes a lever, the door will unlatch, allowing the cat to escape and reach food. Over time, Thorndike found that incorrect behaviors were "stamped out" through punishment and successful responses were "stamped in" through rewards. Thorndike called this the "law of effect" (Thorndike, 1927).

Analogous to the food or escape in Thorndike's study, rewards in scientific research may take the form of research funding, publications, and fame. Science fairs in particular award scholarship money, internships, and even the naming of asteroids in the winners' names. To determine the allocation of these rewards, the ISEF website lists on their science fair "Judging Criteria" page, two "areas of emphasis" (Judging Criteria for Intel ISEF, 2016).

One area of emphasis is the presentation. ISEF judges are permitted to spend only ten minutes with each project presentation, typically consisting of seven minutes of prepared spiels and three minutes of impromptu Q&A. Judges then only have minutes to bubble projects' criteria scores into a Scantron before moving onto the next project. Students know that judges must quickly form impressions and that their subjective feelings towards a project will undeniably bias how they see the rest of project.

The main factor influencing judges' subjective feelings is project "creativity," the second "area of emphasis" listed on the ISEF website. This excerpt is directly from ISEF's "Judging Criteria" webpage:

> Creativity: A creative project demonstrates imagination and inventiveness. Such projects often offer different perspectives that open up new possibilities or new alternatives. Judges should place emphasis on research outcomes in evaluating creativity. (Judging Criteria for Intel ISEF, 2016)

The “new possibilities or new alternatives” part of that statement is intuitive. If you were a judge, wouldn’t you be more impressed by a project with such altruistic goals as discovering a novel method for “curing cancer or “solving the energy crisis?” However, the problem is that this science fair then pushes students to pursue “high impact” problems over more discrete goals realistic to students’ time and resources.

Moreover, the process tells judges to place emphasis on “research outcomes”—in other words, on showing successful results; however, proper and thorough research is a time-consuming, tedious, and frequently unfruitful process. Seasoned and fully funded scientists spend decades researching “high impact” issues full-time to make any progress. One can hardly expect a 16-year-old to solve the problem in their garage with scrap metal and pocket change during the yearlong span allotted for a science fair.

A common science fair tactic is to design a project with low risk of experimental failure but possibility for over-exaggeration of its impact or novelty. For example, a student may slightly tweak an invention known by a very small niche of researchers to already work and pitch their modified invention as new and revolutionary. This type of positive bias can be dangerous not only to the careers of such students, but also to the community they interact with as they continue to pursue science. For example, though involving a number of different factors, the professional pressures which a physician may encounter can be similar to the competitive pressures which science fair students face. In his New York Times article “When Doctor’s Slam the Door” (Jauhar, 2003), Dr. Sandeep Jauhar discusses how surgeons have purposefully directed patients who have low chances of successful surgery to other hospitals, even if postponing the surgery increases patient risk. Jauhar explains how this serious problem arose from the system of monitoring surgery success rates in a way that pressures physicians to avoid risk. While a science fair competition and a hospital are very different contexts, the tactic of avoiding risk in order to gain more “success” is a dangerously tempting one.

Even more concerning though is when scientific misconduct is directly involved via the manipulation or exclusion of data. Consider a science fair participant who only had time to do five trials but determines that the results don’t look so promising. However, the student figures out that if he or she excludes data from two of the trials, the results tell a better story. While judges may not catch on and the student thinks he or she is off the hook, behaviors like this in practicing researchers destroy careers and even cost lives. In the real-life case study of the heart drug Lorcainide, developed in the 1980s, researchers recorded nine deaths in clinical trials but claimed they were just due to chance. They excluded these deaths from their published article and continued to push for the drug’s widespread distribution to treat arrhythmia. Horrifyingly, Lorcainide is now estimated to have caused a staggering 70,000 pre-mature deaths in the United States (Boseley, 1999).

The Need for Speed—Creating Danger in Scientific Communication

The tragedy of Lorcainide is now linked to publication bias, where positive results are published more often, skewing researchers' interpretations. This bias for "altruistic" and "sensational" results is even more prominent in processes that do not undergo peer review such as science fairs or the popular media. Dr. Bruce Lewenstein, Professor of Scientific Communication at Cornell University, highlights this phenomenon in his 1995 paper published in the journal *Social Studies of Science*. There, he discusses how in the absence of modern electronic communication, science was incorporated into the public through a complex and lengthy process of peer-review, publication, and gradual trickling down of new ideas into the realities of day-to-day life (Lewenstein, 1995). Lewenstein explains that, with the evolution of media, there also comes evolution in scientific communication. And it is this evolution that has caused a key dilemma in scientific communication, which Lewenstein elucidates in his "speed versus stability" model. The greater the push to get published or noticed by the media, he says, the less "stable" the science is—meaning that the research communicated may involve fraud or other mistakes. Although Lewenstein applies his model of speed vs. stability to television and other news mediums, ISEF—with its ten minute judging times and only year-long allotment of time to conduct experiments—clearly serves as another example where speed has been favored over stability.

Another aspect of this problematic reward system is the media. Optimistic, albeit unstable, news of novel innovations and the genius hero-scientists responsible are desirable to a public tired of hearing of wars, death, and tragedy. The media is driven partly by its own self-interest to sell itself and thus gives the public the information it desires, which in some cases can be the "inspirational" story of the hero scientist, even if the science itself has not been thoroughly evaluated and proven. And because these forms of communication, such as science fairs or TV, may reach unpredictable numbers and types of audiences, the science communicated may have unpredictable and widespread consequences.

Consider the case study of 31-year-old female Japanese researcher Haruko Obokata who claimed to have discovered a cheap "new alternative" to making stem cells (Hooper, 2014). The media latched onto her story and delivered it to the public at breakneck speed within days of her article's publication in the prestigious journal, *Nature*. What could be the contributing factors for Obokata to be brought forward so quickly into the spotlight? Could it perhaps be her image as a heroine scientist whose altruistic aims were to revolutionize medicine and encourage young women to pursue science?

Exhibiting a keen sense of style, a cheerfully decorated pink-painted lab with decorative stickers, a lab pet turtle, and a traditional Japanese wide-sleeved apron which she used in place of a standard lab coat, she demonstrated a youthful and feminine persona which became a rebellious symbol against the rigidity of the strict male-dominated Japanese academia (Hooper, 2014). While Obokata proudly displayed her chic side, she was not portrayed as an untouchable celebrity. Instead, using articles with titles such as "STAP cell pioneer nearly gave up on her research" (Nonake, 2014), the media capitalized on her likeable quality as an underdog heroine who persevered. Obokata herself had stated in her press conference, "There were many days when I wanted to give up on my research and cried all night long. But I encouraged myself to hold on just for one more day, and then I realized that five years had passed" (Hooper, 2014). Her story became so popular that sales even increased in the type of Japanese apron she used as a lab-coat, as fans wanted to follow her example (Hooper, 2014). Thus, through her contrast against the older male-dominated research community and her determination, Obokata seemed to have the potential to become the next inspirational "Marie Curie" figure that ISEF participants would idolize.

And these were not the only groups to take advantage of Obokata's hero-scientist image. A major group not yet discussed are the research institutions themselves. Could they also be an element negatively influencing the research reward process? Obokata's institute, Riken, had actually strongly encouraged her to show herself and her lab off to the media (Tōru, 2014). Riken Institute has a strong rivalry against Kyoto University—the institute of the famous Nobel laureate Shinya Yamanaka who first discovered induced pluripotent stem cells (Tōru, 2014). Riken eagerly seized what they believed was an opportunity to surpass their world famous rival. When institutions garner strong public support and international attention, the government is pressured to distribute larger grants to them and private companies and financiers are motivated to invest in them. With Obokata's charisma spreading Riken's name internationally throughout the Internet, from BBC to Facebook, Riken believed it could reap financial benefits and prestige.

However, all of these anticipations were brutally cut down within months of Obokata's rise to fame. Obokata's story instead combusted into scandal, shame, and tragedy. She was found by a number of parties to be guilty of scientific misconduct (McNeill, 2014) and featured in headlines such as "How Japan's most promising young stem cell scientist duped the scientific journal *Nature*—and destroyed her career" (McCoy, 2014). Furthermore, Obokata's public shaming had a profound effect on her longtime mentor, Yoshiki Sasai, who eventually committed suicide in the wake of the scandal (Spitzer, 2014). With an unsettling ruthlessness, the media that had indirectly contributed to Sasai's death attacked Obokata even further in its aftermath. As Obokata exited a taxi in front of a Kobe hotel, she was pursued by five reporters, including a cameraman, through the lobby, up the escalators, and finally to a restroom where Obokata hid. During the chase, Obokata sustained injuries, including a sprained right elbow and neck pain, which required nearly two weeks of recovery time (Japan Today, 2014). Moreover from her physical injuries, Obokata eventually experienced a mental breakdown in the wake of the tumultuous scandal and her mentor's suicide (Martin, 2014). For Obokata, the price for speed was certainly great.

Conclusions

Obokata was found to have blatantly copied and pasted information into her thesis, and indeed, Obokata had been proven to manipulate some of her images to support her paper's assertions (McNeill, 2014). These are serious violations of ethical research conduct. But was Obokata a villain who deserved punishment for her scientific misconduct? Her wrongdoings of plagiarism and data manipulation are ones commonly conducted in the science fair process. She could not have predicted such grave consequences as the complete destruction of her career, the death of her mentor, and the effect it would all have on her mental health. And I would not believe any science fair participant who had started out with altruistic goals—such as improving stem cell therapy—deserving of such trauma as Obokata experienced.

Is she then a tragic hero undermined by her own *hamartia*? While it may now be tempting to categorize her as such, I would argue against that. The downfall of a tragic hero is usually depicted as occurring solely from the character's internal character flaws or perhaps divine forces, without recognizing or critiquing any of the societal pressures that could have served as driving factors. While flaws like *hubris* may have played a role in the science fair students' and Obokata's decision-making, so did many external forces, like the pressures from the ISEF or Riken organizations for research to yield groundbreaking results.

Using Dr. Barbara Oakley's concept of pathological altruism—the process where "the road to hell is paved with good intentions"—to frame a nuanced discussion, I have identified some of these external forces which mutate altruistic goals into scientific misconduct and publication bias. In particular, I have examined models from psychology and scientific communication and applied their ideas to case studies such as science fair and that of Haruko Obokata. In the process, I elucidated the association between altruistic research goals and the reward process. I then demonstrated how the reward process may be skewed, depending on how society places value on scientists' work and how scientists' work is communicated through various mediums.

Despite our great dependence on scientific knowledge, from medicine to transportation, research ethics can be confounded by biases tied to the "inspirational" aspect of science. Usually, black and white statements against scientific misconduct are vaguely issued through bland, mandatory ethics courses or online modules (NIEHS, 2015). A researcher in such a setting can easily dismiss the idea that they would ever commit such an act, falling back on the idea that they are an ethical person with good intentions, not an evil fraud. And in doing so, the researcher may simply not recognize it as they transition from making seemingly benign image modifications in response to their bias to fabricating data and other unethical practices—which can be as destructive to society as cancer.

In my nearly five years of research experience, I have focused on cancer as a target disease. In keeping both cancer research and research ethics in mind, it seems there are a number of similarities between pathological altruism in research and cancer. First of all, they are both hard to recognize. Our immune system can fight off obviously bad foreign invaders while our sense of morality can help us recognize actions that blatantly stem from bad intentions. In the case of cancer, our body is unable to recognize cancer because it would have originated from the body's own good cells. Likewise, our altruistic intents can expertly disguise sinister consequences.

Moreover, cancers generally develop as a consequence of various mutations and risk factors, while pathological altruism in research may arise through risk factors such as biases for high impact studies and pressures from the media. Only through methodically gaining an understanding of the process by which harm was caused can we best learn how to approach treating the disease. It would be ineffectual to condemn individual scientists as the sole culprits responsible for cases of unethical science. The public's role in promoting ethics, accurate interpretation, and implementation of research has especially grown as alternative methods of funding and communicating research have gained more prominence. We, society as whole, provide the contextual backdrop that the scientific community works in, and we can decide whether we should continue turning a blind eye to this dumping of carcinogens into the research process.

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