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Why Frankenstein is a Stigma Among Scientists

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Abstract As one of the best known science narratives about the consequences of creating life, Mary Shelley's *Frankenstein; or, The Modern Prometheus* (1818) is an enduring tale that people know and understand with an almost instinctive familiarity. It has become a myth reflecting people's ambivalent feelings about emerging science: they are curious about science, but they are also afraid of what science can do to them. In this essay, we argue that the Frankenstein myth has evolved into a stigma attached to scientists that focalizes the public's as well as the scientific community's negative reactions towards certain sciences and scientific practices. This stigma produces ambivalent reactions towards scientific artifacts and it leads to negative connotations because it implies that some sciences are dangerous and harmful. We argue that understanding the Frankenstein stigma can empower scientists by helping them revisit their own biases as well as responding effectively to people's expectations for, and attitudes towards, scientists and scientific artifacts. Debunking the Frankenstein stigma could also allow scientists to reshape their professional identities so they can better show the public what ethical and moral values guide their research enterprises.

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Introduction

> The most enduring monsters lurk not in secluded castles but in the laboratory of the self
>
> (David J. Skal)

Written 200 years ago, Mary Shelley's *Frankenstein; or, The Modern Prometheus* is widely perceived as the preeminent tale of modern hubris, of the researcher who is doomed to be undone by his or her own scientific and technological discoveries (Stableford 1995).[1] *Frankenstein* tells us a compelling story about science and scientists, a mythical tale of the Modern Prometheus who is not the savior of humankind but rather the harbinger of destruction (van der Laan 2010). As a result, *Frankenstein* is often seen as a warning that research can easily become dangerous if irresponsible scientists, driven by their obsessive pursuit of scientific knowledge, defy the ethical principles of science (Haynes 2003). The Frankenstein story is ubiquitous because it provides a vivid illustration of the imagined problems and dangers of scientific applications by connecting the modern practice of research, just coming into view in Shelley's time, to older mythic traditions of alchemy, occult sciences, hubris, and forbidden knowledge (Newman 2004).

Frankenstein crystallized an old fantasy into a modern myth, linking humanity's endless pursuit of scientific discovery to ancient narratives of forbidden knowledge like Prometheus stealing fire from the gods (Marcus 2002). Encompassing society's enduring fears, hopes, and values, myths serve as pre-scientific attempts to interpret real or imaginary phenomena (Stein 2005). Mary Shelley's novel connects that long mythic tradition with the emerging scientific practices of the early nineteenth century, and since its publication her novel has had a remarkable effect on how people think about science. In fact, the Frankenstein myth has been so deeply embedded in contemporary conceptions of scientific work that it has become a typical rhetorical tool in understanding and imagining new scientific projects (Nisbet 2009). The cultural theorist Jon Turney (1998) argues that "we are never going to be rid of Frankenstein even if we want to be. The story is too deeply embedded in our culture now not to leave its traces or raise echoes whenever we discuss our attitude to science and scientists" (p. 220). Similarly, Skal (1998) stresses that Frankenstein "has become the dominant, if despairing, creation myth of modern times" (p. 57). Nisbet (2009) describes the Frankenstein myth as a prominent lens for imagining "bad" scientific practices and artifacts, showing that although the Frankenstein myth has gone through various incarnations over the years, it has retained its core meaning. For example, "Frankenfood" has become the

[1] The authors wish to make clear that we do not, in fact, subscribe to this reading of the narrative. We see Shelley's novel as a much more nuanced exploration of scientific creativity and responsibility. Nevertheless, the popular conception of *Frankenstein*, and many of its adaptations, interpret it as a cautionary tale.

symbol for controversial genetically modified crops (Hellsten 2003), "Franken-science" serves as an umbrella term for various sciences that are perceived as dangerous by the public (Turney 1998), and "Frankenstein economy" has been used in popular media discourse as a representation of the 2008 financial crisis (e.g., Harrington 2008). People may even suffer from "Frankenstein syndrome" when they experience fear of emerging scientific artifacts, like robots or artificial intelligence (Syrdal et al. 2011).

The figure of the scientist continues to be haunted by the modern myth of Frankenstein. Knust (1983) argues that the Frankenstein story touches on multiple questions around the responsible and ethical use of scientific knowledge, and that "the fascination with scientific interventions has given way to uneasy questions about the very identity of scientists" (p. 137). In this sense, perhaps the most innovative element of Shelley's novel was not the invention of Frankenstein's creature but Victor Frankenstein himself: a scientist who became famous through countless adaptations, translations, and reprintings. Interestingly, Shelley never uses the word "scientist" in the novel, instead presenting Victor as an artist and a student (Hindle 1990). In fact, the word "scientist" did not exist when Shelley wrote the novel; it was coined nearly 20 years later in 1834 by William Whewell, a prominent member of the British Association for the Advancement of Science (Hindle 1990). In other words, by illustrating how Victor's personal imperfections corrupt his work, Shelley's novel introduced a seminal conceptualization of the scientist and created an easily accessible and understandable image around it. As a constellation of stereotypes associated with the scientist, Frankenstein serves as a framework for people to imagine scientists and scientific practices. Within this schema, the white-coated scientist, isolated in a hidden laboratory, plays with materials (e.g., genes, biomass, atoms, animals, plants), making dangerous combinations from different sources. In this image, it is apparent that the scientist is not aware of the dangers her work poses to society. Despite her flaws, she still engages in dangerous scientific practices. This image of the scientist portrays scientific work as a dangerous project where, despite the potential for disastrous outcomes, there is little attention paid to societal or ethical implications (Liakopoulos 2002). According to the popular narrative, science is a two-headed force; its potential for good is matched by its potential for destruction. While science is capable of producing dangerous or even horrifying artifacts, it also discovers new ways to help people.

Consequently, rather than inventing new origin stories about science, people tend to rely on the Frankenstein myth to conceptualize science in terms of warnings against the dangers of excessive ambition (Hammond 1986). Serving as a powerful cultural template, we argue that Frankenstein helps people imagine "suspicious" scientific artifacts or practices such as "Frankenfood" or "Frankenscience," leading to the stigmatization of the scientist. Thinking of the Frankenstein myth as a convenient shorthand explains why it remains so persistent: it is a way to articulate fears and anxieties about scientists that are often not fully realized consciously or rationally. This is precisely why the term stigma applies: we use "stigma" to signify a socially constructed label that helps to categorize specific groups of people in terms of negative evaluations. Stigma does not have to be applied consistently; in this case, the stigmatizing Frankenstein myth can be wielded selectively as a social

and rhetorical tool to imply that some sciences are bad and dangerous. More specifically, the Frankenstein stigma can be used to identify "suspicious" or "potentially dangerous" scientists and scientific practices—for example, as a framework for justifying why sciences involving the creation or manipulation of human or human-like life are perceived as particularly bad and harmful.

As a stereotype associated with the "bad" and "dangerous" things, the Frankenstein stigma serves as a shortcut for the public to imagine science and scientists, especially those that are related to biosciences, medical sciences (Hammond 2004), artificial intelligence, and robotics (Mazlish 1995). The reason why the Frankenstein stigma is especially relevant within these fields is because they bear resemblance to Victor Frankenstein's scientific enterprise of bringing life to lifeless matter, either by creating life (e.g., cloning), simulating aspects of it (e.g. artificial intelligence and robotics), or modifying it (e.g., GMO, gene therapy). The Frankenstein narrative helps make the complicated work of scientists in these fields more concrete and understandable for the public, staging a compelling imagined (mostly negative) relationship between scientists and the products of their labor. In deploying the Frankenstein stigma, people engage in what political scientists call "system justification": the tendency of people and groups to defend and support the status quo, even when the existing system is less than perfect (Jost and Banaji 1994). The Frankenstein stigma is a means of coping with threats that people imagine scientific knowledge and practices might pose to them, and to bolster an inherently conservative scientific status quo.

Marked by the Frankensteinian stigma, scientists may believe that laypeople will devalue and reject their explanations or theories, hindering their attempts to effectively interact with the public. Even if scientists try to engage with the public, they often experience frustration because no matter how hard they try to tell the public what their work is about, their arguments are likely to produce new materials to spark debates over the potential dangers their science may pose to society (Locke 1999). This attitude of distrust, however, may inhibit their capacity—and maybe their motivation—to build trust and tailor messages that resonate with their audiences' preferences (e.g. Kahan et al. 2012; Dietz 2013). For instance, previous research has already shown that people's beliefs and values are stronger predictors of how they perceive science and scientists than what their degree of scientific knowledge would indicate (Lupia 2013; Kahan et al. 2010). Therefore, by exploring how the Frankenstein myth has permeated into the public's imagination, scientists may gain a better understanding of popular beliefs and values around science. This in turn could help them develop new ways to engage with the public more effectively and improve the public image of their profession.

In the following, we briefly present the Frankenstein myth with particular attention to the ways Frankenstein evolved into a stigma of the scientist and science. We introduce the Frankenstein stigma as a concept that better incorporates people's ambivalent and contradictory attitudes about science. Then, we propose that scientists should view the Frankenstein stigma as an empowering process that helps them create a new and more positive narrative around their work by defining science as part of normal everyday life.

The Frankenstein Myth: The Mad Scientist and Dangerous Science

The story always goes as follows: an ambitious scholar, blessed with superior intelligence, dedicates himself to an unrestricted pursuit of knowledge. As is so typical in stories about scientific experiments, Victor zealously believes that his work is performed in the service of the greater good. Following the footsteps of alchemists, who were obsessed with the idea of creating homunculi,[2] he desires to unlock the secrets of life. Driven by a passion to accomplish a significant breakthrough, Victor creates an unprecedented composite being. He soon realizes, however, that his science has produced something different than what he expected: a deformed and hideous entity that turns against him. Since Victor has no control over the creature, his life becomes dominated by a violent battle of wills with his monstrous invention (Franco 1998).

Although Victor Frankenstein achieves a remarkable scientific breakthrough, he fails morally—his creation becomes a mockery of life, an abomination with a burning desire to take revenge on the scientist who brought him to life and abandoned him (Adams 2001). Building on the tone of the German doppelgänger genre, Mary Shelley portrays the creature as the external reflection of the scientist, an existential mirror, which forces Victor to face the consequences of his scientific agenda (Heffernan 2003). In the Gothic literary tradition and later in popular media depictions, the doppelgänger is a mysterious character that provokes fear and anxiety. The doubling also reveals people's most intimate secrets, fears, and desires (Webber 2003). In *Frankenstein*, the creature serves as an existential mirror because it is a symbolic representation of the hidden, nefarious nature of Victor's scientific curiosity, which motivates him to steal body parts from cemeteries, commit hubristic overreach, and deny responsibility.

In addition to illustrating how scientists' beliefs affect their theories and practices, Mary Shelley's novel tells the story of the scientist who is willing to sacrifice his sanity for success. Like Victor, scientists sometimes are perceived as the archetypal "mad scientist who likes to play God", heightening fears about the imagined dangers of new discoveries and the difficulty of regulating emerging scientific practices (Petersen 2002). The idea of the mad scientist can be seen as a comment on people's relationship with science at any given historical period. As Gerlach and Hamilton (2005) put it, "the mad scientist as a cultural figure marks the boundaries of legitimate and illegitimate science" (p. 83), and these boundaries shift across different cultural and historical contexts The various literary and cinematic versions of *Frankenstein* contribute to the familiar negative image of the scientist, the madman with a God complex who loses control over his own experiment and creates a monster. Often paranoid, he wishes to unlock the secrets of the divine, and therefore exhibits strong narcissistic tendencies, or even a God complex. He is not interested in the social consequences of his actions, thinking that the conventional moral standards do not apply to him.

[2] Originating from alchemy and nineteenth-century fiction, a homunculus refers to an artificially created miniature human being (Newman 2004).

Similarly to Victor Frankenstein and the mad scientist archetype, the stereotypical caricature of the scientist is as an eccentric man who works alone in his laboratory, completely absorbed in secret, controversial projects (e.g., Chambers 1983; Tan et al. 2015). Authors such as Flores (2002) or Crichton (1999) stress that scientists are often depicted in the popular media as egotistical, uncaring, and unethical people, a pattern that creates false expectations among the public. Similarly, although previous research shows that science as an institution is trusted highly by society (Losh 2010), scientists are still frequently perceived as naive individuals who cannot deal with powerful interests, and/or who are willing to violate ethical principles for the sake of gaining new knowledge, which leads to catastrophic or horrific consequences (Weingart et al. 2003). Analyzing how the popular media depicts scientists, Haynes (2016) argues that recent TV shows and movies tend to portray scientists in a more favorable and positive way than they did in the past. However, even with this positive shift in presenting scientists to the public, people have great difficulty in separating fiction and reality, assimilating inaccurate ideas about scientists' work (Reis and Galvão 2004). People have a tendency to project their own cultural meanings onto science, and they seem to appreciate science to the degree that it confirms their own values (Gauchat 2011). This projective mechanism stems from people's inherent tendency to use cognitive shortcuts to construe new information in ways that support what they already believe (Gauchat 2015). These shortcuts often originate from stories, rumors, and myths that help people make sense of the world around them (Lewandowsky et al. 2012). Fictional texts like science fiction novels and movies serve as culturally ubiquitous sources for understanding and imagining technologic and scientific work (Marsh et al. 2003). Even when people know that these stories are products of fantasy, they still have a remarkably strong effect on judgments and attitudes (Marsh and Fazio 2006). The reason why these stories have such a powerful influence on the public imagination is rooted in the nature of narrative. As Dahlstrom (2014) notes,

> Narratives are intrinsically persuasive. Because they describe a particular experience rather than general truths, narratives have no need to justify the accuracy of their claims; the story itself demonstrates the claim. (p. 13616)

Culturally accepted and popular narratives are trusted to such an extent that people are apt to neglect evidence that contradicts them; or even worse, people may cognitively alter new evidence so it better supports their existing understanding (Dahlstrom and Ho 2012). This human tendency to use narratives to understand the world may lead to the acceptance of false scientific information and the formation of negative attitudes towards the scientist, especially when powerful stigmatizing narratives like Frankenstein are widespread in the popular culture (Barriga et al. 2010). While people imagine science as a potent driving force of history and human development, this belief is often combined with a profound distrust of scientists and their moral and ethical codes (Mulkay 1996). As a result, the public is likely to think that scientists are socially incompetent and boring (Reed 2001), not interested in what is happening outside of their own world (Evans 2010), and often dangerous and unpredictable (Finson 2002).

When confronted with sciences that are viewed as "Frankenstein things," people may apply the Frankenstein myth to imagine and explain them. New emerging scientific practices and technological advancements are likely to fuel debates on the potential risks and dangers as well as the ethical implications of science. In this sense, the Frankenstein narrative is applied particularly often, and with particular force, in specific social contexts to conceptualize "bad science." Consequently, certain scientific practices are more likely to invoke the Frankenstein stigma. For instance, technological artifacts, such as AI and robots, are frequently imagined to disrupt existing social order and transform into something beyond our comprehension (Friedman and Kavey 2016), while anti-GMO discourses tend to rely on popular images such as Frankenstein to undermine scientific explanations (Clancy and Clancy 2016). Similarly, public discourse about cloning invokes Frankensteinian images to dramatize prevalent fears and anxieties about emerging scientific practices. The announcement of the birth of Dolly, a clone of an adult sheep, captivated the imagination of laypeople and scientists alike. News articles and op-eds discussed the potential implications of cloning for human race and reinforced negative stereotypes about scientific experiments (van Dijck 1999). Perhaps not surprisingly, the "de-extinction movement," referring to scientific attempts to revive organisms of extinct species, was viewed as the continuation of the Frankenstein story and the pursuit of dangerous knowledge (Swart 2014).

In addition to these ambitious scientific projects, medical discussions, especially those related to transplant surgery or gene therapy, also invoke the Frankenstein myth (Bishop 1994). The magazine *Popular Science* recently released an open letter by prominent neuroscientists about the potential risks that brain stimulation raises for people wishing to improve their brain functions without medical supervision. Interestingly, although the open letter did not contain any reference to Frankenstein (see Wurzman et al. 2016), the magazine explicitly framed the story as a Frankensteinian phenomenon by writing, "Dr. Frankenstein played with electrodes. Don't be that guy." (Cole 2016). Another recent example shows a more concrete application of the Frankenstein stigma. When the media covered and sensationalized the news about human-animal hybrids in 2016, the group People for the Ethical Treatment of Animals (PETA) issued a statement accusing scientists of engaging in monstrous "Frankenscience," causing unnecessary suffering to animals, practically torturing them, causing harm to humanity, and as a result finding themselves lagging behind their forward-thinking counterparts, the ethically progressive scientists (PETA UK 2016). According to Julia Baines, a science policy advisor for PETA, human-animal hybrids are the products of ethically questionable scientific practices. She also added that "creating human-animal hybrids is a really shocking and crude use of animals which belongs in fictional horror books" (Dolan 2016). The *Speaking of Research* (2016) blog, which covers the scientific and ethical dimensions of animal testing, tried to debunk the comments by saying that PETA's descriptions rashly evoked the Frankenstein image which may lead to confusion among the public and to the spread of misinformation. The way PETA framed the human-animal hybrid research shows that the Frankenstein narrative can be deployed to encourage people to view scientists pursuing certain types of projects as irresponsible individuals who are ready to unleash horror on the world.

We suggest that the social construct of stigma can help make sense of the controversies surrounding science and scientists. In the following sections, by building on relevant sociological and psychological theories, we illustrate the underlying mechanisms of stereotype formation and its effects on scientists' public image as well as the public reactions to scientists.

The Frankenstein Stigma and System-Justification

Dating back to the Ancient Greeks, who marked people's skin in order to identify them as outcasts and lawbreakers, stigma has been used to show how some people are inferior to others. More than a 100 years ago, Durkheim ([1895] 1982) documented the effect of stigma on groups like the mentally and the physically ill, who were labeled as deviants by society and treated negatively. For Goffman (1963) a stigma is "an attribute that is deeply discrediting" (p. 3). More concretely, Link and Phelan (2001) argue that stigma "exists when elements of labeling, stereotyping, separating, status loss, and discrimination co-occur in a power situation" (p. 382). Stigma may refer to a wide range of characteristics that are considered culturally undesirable—physical or mental shortcomings (e.g., body deformities or mental illnesses), negative demographic features (e.g., being poor) and social factors (e.g., being unemployed) (Arkin 1980). When someone becomes stigmatized, people start to think about them in terms of negative evaluations and stereotypes (Major and O'Brien 2005). As such, stigma is a social construct that is always embedded in a specific social context, meaning that what is stigmatizing in one context may not be stigmatizing in another (Bos et al. 2013).

Stigma has direct and detrimental effects on the stigmatized through discrimination and negative stereotyping (Pryor et al. 2004). Stigmatized people tend to consistently devalue themselves because society does not accept them for who they are. Feeling detached from "normal people," stigmatized individuals are likely to avoid social groups other than their own, seeing others as sources of various unpleasant and painful experiences (Blascovich et al. 2001). According to Goffman (1963), the discrepancy between how a stigmatized person sees himself and how others see him "spoils his social identity; it has the effect of cutting him off from society and from himself so that he stands a discredited person facing an unaccepting world" (p. 19). By incorporating the public's negative perceptions into their own selves, people internalize their stigma, which in turn has detrimental effects on their self-worth and self-image (Herek 2007). To put it in a different way, stigmatization acts as a significant threat to a person's identity, which leads to a wide range of stress responses such as fear and anxiety, as well as the application of various coping mechanisms (Pescosolido et al. 2008). These involuntary stress responses and coping efforts, however, actually serve to undermine stigmatized people's self-esteem, performance, and health (Major and O'Brien 2005).

Like scientists who find discussing controversial issues with the public challenging, stigmatized people often find themselves in a difficult spot when they seek to change how others see them. When stigmatized group members provide evidence that challenges negative stereotypes, the public tends to experience a

heightened sense of fear, anxiety, and threat–which in turn motivates them to punish the source of the threat: the stigmatized group (Kaiser 2006). Stigmatized people are often identified as a source of societal threat because they question the assumptions and values underlying the existing social order. For instance, gay couples are often viewed as radicals seeking to challenge and weaken traditional family values (Goldberg and Smith 2011). Similarly, people suffering from mental disorders are treated as dangerous and harmful individuals who should be kept apart from society (Corrigan 2004). One way to punish dangerous members of society and keep them separated from "normal people" is to constantly remind them of their proper place in the social order. In social psychology, this is called system-justification, a process through which "existing social arrangements are legitimized, even at the expense of personal and group interest" (Jost and Banaji 1994, p. 2). Although it entails significant psychological and material harm to stigmatized groups, system-justification helps to reinforce and preserve existing social arrangements. As such, system-justification serves a purely ideological function, demonstrating that people are driven to accept and justify existing social, political or economic conditions simply because they exist (Jost et al. 2004). It is well-documented in the social psychological literature that people tend to think about themselves and other people in ways that justify the prevailing social structure and values, as well as the status that they occupy within that structure (e.g. Jost et al. 2003, 2010; Zhu et al. 2013).

We believe that system-justification theory is able to explain why people have ambivalent feelings about the figure of the scientist, despite the fact that science itself is a highly trusted institution. A recent study assessing public and scientists' view on science and society found that laypeople have strong anti-science attitudes towards bioscientific practices in the U.S. (Funk et al. 2015). More specifically, this research found that 67 percent of the people think that scientists do not have a clear understanding of how certain scientific advancements, such as GMOs, actually work. As the columnist Julia Beck (2015) notes, "Americans believe in science, just not its findings," implying that people tend to see certain groups of scientists as untrustworthy and their work dangerous. As a result, scientists may feel that they need to be cautious about how and when they interact with the public, and develop strategies to control their stigmatized status (Arluke 1991). It is well-documented in the stigma literature that these strategies serve as adaptive mechanisms to cope with negative reactions and rejection (Pachankis 2007). As a result, scientists may feel that they should stop interacting with laypeople in order to avoid public scrutiny and negative reactions to their work.

System justification conclusions are built around selective and biased information processes (Jost et al. 2010). When people try to make sense of an event, they tend to interpret it as a collection of interconnected and coherent episodes, resulting in oversimplified and biased perceptions (Roese and Vohs 2012). When people are trying to make sense of scientific artifacts they tend to use various cognitive shortcuts, mental images, and subjective impressions about science (Bozeman and Sarewitz 2005). More specifically, when people try to understand emerging scientific practices, they face a lot of uncertainty because they often lack the knowledge to interpret complex theories and concepts. Despite the case that scientific concepts and theories are extremely complex and (thought to be) hard to

comprehend, people are increasingly exposed to situations in which they are often asked to express their opinions and make decisions (electoral decisions, consumer decisions, etc.) associated with controversial issues, such as GMO, cloning, and gene therapy (Nadelson et al. 2014). This represents a difficult double-bind: on the one hand, the ideals of rationalism and objectivity are widely associated with scientific process, and so members of the public are primed to embrace these principles in discussing scientific issues. On the other hand, the Frankenstein stigma offers a "sentimental" set of cognitive tools in system-justification, focusing on fears and anxieties about science. People experience negative emotions when they cannot anticipate what will happen in the future (Whitson et al. 2015). Emerging science and technology developments create precisely this uncertainty about what the future will be like. For instance, biologically enhanced organisms that once belonged to the realm of science fiction, such as designer babies and genetically modified humans, are now real things and are expected to change how we think about our bodies and identities (Parrington 2016). Similarly, artificial agents and robots are predicted to completely transform and redefine how we live and work in the upcoming decades (Peláez and Kyriakou 2008).

The Frankenstein stigma shows two opposed but simultaneously existing attitudes working at cross-purposes. While echoing a centuries-old sentiment about the dangers scientists may pose to society, the Frankenstein label also suggests that it is the inherent nature of science to push boundaries, discover new things, and commit overreach. For instance, a recent large-scale study found that U.S. adults have ambivalent feelings about scientists: while they are mostly trusted and often liked, they are also pictured as immoral and unpredictable figures who can easily become dangerous when they engage in acts of misconduct (Rutjens and Heine 2016). These problems become more acute as scientists play a more active role in public debate, shifting the focus from science to scientist, creating a second dilemma. If the scientist is not there to effectively and actively represent her research, she may simply be ceding the battle to the established stigma, but if she does engage, she runs the risk of reinforcing that stigma. As a result, scientists may isolate themselves from society by limiting communication with people outside of their existing social circles (i.e., other scientists), which may actually justify people's negative expectations and reactions. For instance, observing animal experimenters' work, Arluke (1991) found that these scientists often feel isolated and rejected because of the public's hostility towards their research practices. As a result, scientists may conceal their occupation and develop a wide range of self-defensive mechanisms to avoid confrontation. People may see scientists' retreat and social isolation as a confirmation of their initial suspicion. They might falsely assume that scientists avoid people because they have something to hide—and that something has to do with dangerous and harmful scientific practices and artifacts. Previous research has already demonstrated the potential negative effects of occupational stigmas across a variety of professions, such as low job commitment or loss of motivation (e.g. Ashforth and Kreiner 1999). Therefore, it might be useful for scientists to learn ways to cope with the Frankenstein stigma.

Counteracting the Frankenstein Stigma: The Role of Empowerment

Since stigma is the result of human perception, it might be important for scientists to investigate how the Frankenstein stigma is perceived by the public, by their communities, and by themselves. Acquiring an explicit understanding of these perceptions may help the stigmatized group—in this case, scientists—learn valuable lessons about the images and expectations of themselves and their peers in contemporary society. In this sense, exploring the different ways the Frankenstein stigma affects people may create space for talking directly and constructively, rather than fearfully and vaguely, about Frankenstein. By interpreting Frankenstein as a stigma, scientists are able to revisit their own beliefs, opinions, biases, and stereotypes that shape how they think and feel about their role in the society as a scientist. Realizing the potential effects of the Frankenstein stigma on their work is a necessary first step for scientists to redefine, reposition, and adjust their professional identities so they can better show the public the ethical and moral values that govern their research practices and procedures.

In order to overcome the negative effects of the Frankenstein stigma, we argue that scientists should view their stigma as an empowering process and define science as an integral part of people's lives. From a clinical psychology standpoint, empowerment can be best understood as "a corrective for the lack of control, sense of helplessness, and dependency" (p. 483) that people develop after being treated negatively (Jacobson and Greenley 2001). Successful individuals adopt an "empowerment" model as opposed to a "coping" model when dealing with stigma (Shih 2004). Whereas coping strategies focus on prevention and avoiding negative consequences rather than creating positive ones, the empowerment model positions stigmatized individuals as active participants in dialogues and encourages them to gain a better understanding of the social world around them, to talk with other people, and to create positive outcomes (Oyserman and Swim 2001). When engaging in empowerment practices, Shih (2004) argues that "many stigmatized individuals cite that they gain strength and learn valuable life lessons in confronting adversities caused by stigma" (p. 181). The empowerment model encourages scientists to overcome their "Frankenstein identities" and move beyond the stigma experience to replace the Frankenstein myth and misinformation and mistrust with accurate scientific conceptions, thereby improving scientific knowledge and overall scientific literacy.

Drawing on two case studies of the mentally ill and disabled people, Kirkwood and Stamm (2006) argue that social marketing can be used as an effective empowering tool to catalyze social change. Their model suggests that stigmatized groups should identify how their target audiences stigmatize them, what messages they want to convey to counter the stigma, and what behavior and attitude change they want to accomplish. To create an effective and sound message to enhance public image as well as shape popular perceptions, stigmatized people are encouraged to openly discuss their life experiences, share their personal stories, frustrations and fears. These stories can serve as materials for creating effective and convincing empowerment campaigns. Science organizations, such as The Royal

Society in the United Kingdom or The National Academies of Sciences in the United States, have already engaged in well-organized efforts to improve science communication. For instance, The National Academies of Sciences recently published a book entitled *Communicating Science Effectively: A Research Agenda* (2017), which synthesized a wide range of research for scientists wishing to become more empowered when dealing with public mistrust and misinformation about science. To change how people perceive science, the authors argue, scientists should do three things: warn the public about potential misinformation and manipulation, repeat scientifically accurate information, and perhaps most importantly, "tell coherent, plausible alternative stories, explaining the source and motivation behind the misinformation" (p. 65).

The stigma management literature suggests that telling personal stories—helping people understand issues the stigmatized individuals need to face on a daily basis—may allow stigmatized people to counterbalance misinformation and undermine the negative effects of stigma and system-justification processes (e.g. Creed and Scully 2000). For instance, the gay rights movement in the U.S. and other parts of the world have used a wide range of communication and political strategies very successfully (van Dyke and Cress 2006). Similarly to other civil rights organizations, gay rights advocates have emphasized their similarities with other people to shape the social imagination in a positive way (Bernstein 1997). By going public and sharing their personal stories, gay people were able to create a more favorable public image eventually (Hart-Brinson 2016). Telling personal stories is an effective tool because it allows the public to reconsider their former assumptions and stereotypes particularly because they gain a unique opportunity to "imaginatively identify with the states of others" (Fligstein 1997). Similarly, Abraham and Dessler (2013) also argue that if scientists want people to believe them, they need to share their personal stories to illustrate that they are also human beings and their identities are only partially defined by their profession. This could lead to a positive shift in the public and professional discourses about scientists. In her thorough review of the existing literature, Meisenbach (2010) showed that effective stigma management practices are revealed and elaborated through frequent public engagement, allowing the stigmatized group to create more accurate and favorable public perceptions about themselves.

Besides personal stories, scientists can also use science fiction stories or science novels as tools to facilitate dialogue with the public, and to change the way people imagine the scientist's work (Kitzinger 2010). In this sense, using science fiction stories to replace the Frankenstein narrative with more constructive alternatives could allow scientists to better clarify and disentangle science and technology issues, to clear up potential misunderstandings, and to provide more information about their ethical and moral scientific considerations (Link 2013). For instance, the recent book *Science Fiction by Scientists: An Anthology of Short Stories*, edited by Michael Brotherton (2016), offers a wide range of speculative stories to challenge former stereotypes and facilitate discussion about the role of science and scientists. Featuring afterwords and commentaries by the authors, this collection also allows readers to learn more about how scientists think and create. Additionally, *The Science & Entertainment Exchange Program*, funded by the National Academy of

Sciences, connects filmmakers with real scientists and engineers to create more powerful and entertaining messages about science. Similarly, *The Sloan Film Program* intends to support filmmakers wishing to present science and engineering characters and themes in a more authentic way, and thus improve public understanding of science and technology. Their website also offers a wide range of teaching materials for formal as well as informal science education purposes. And lastly, popular TV shows, such as *Star Trek*, *Black Mirror*, *Humans* or *Fringe* also present a plethora of ethical dilemmas scientists can use to engage the public in conversation about the roles and responsibilities of science.

In conclusion, rejecting people's reactions to controversial emerging scientific practices, classifying them as "irrational" or "unscientific," inhibits scientists' capacity to overcome the stigma of Frankenstein. Scientists should view the Frankenstein myth as an opportunity to imagine more accurately how and why people are concerned about certain scientific practices. Defining science as part of people's lives may allow scientists to explain issues in ways that help laypeople imagine and understand science more easily, with particular attention to the personal benefits of emerging scientific practices (Feygina et al. 2010). Perhaps more importantly, acknowledging the social aspects of scientific work, and using the Frankenstein myth as a lens for mapping the effects of stigma, scientists may gain a better understanding of why people develop negative attitudes towards science and the scientist. As a result, the scientific community can change existing social norms and develop new ways to communicate with the public more effectively.

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