

DNA as a Super-icon and Advertising Image:  
How Direct-to-Consumer Genetic Tests Contribute to Gene Fetishism

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## Abstract

Images and representations of DNA and genetic information have become some of the most widely recognized and well-established scientific images in the twenty-first century. This thesis explores the meanings that have become associated with DNA and the gene by using Charles Sanders Peirce's semiotic model to analyze images from *Time* magazine covers spanning the last 50 years, using Charles Sanders Peirce's semiotic model. An examination of DNA as a rhetorical object and cultural icon provides context to understand how Direct-to-Consumer (DTC) tests such as 23andMe's ancestry and health tests have become so popular and profitable. Due to the contemporary relevance of at-home genetic testing, the larger part of this thesis will examine the following two groups of images from 23andMe's website: the images on ancestry test results and the marketing images for their genetic health test. To ascertain how these images have reinforced the gene's cultural meaning in the last decade, I will analyze a second group of images from 23andMe's ancestry test results using Roland Barthes's "Myth Today" as a model for discussing images in the context of myth. I argue that the popularity of genetic ancestry tests reflects a cultural desire for understanding identity, and that visualizations of DNA and the gene have taken part in shaping contemporary American cultural identity by appealing to a sort of "genetic essentialism." A critical examination of the third group of images marketing 23andMe's health test using Michel Foucault's notions of biopower and biopolitics, as outlined in *The History of Sexuality*, also introduces current ethical questions regarding the new and rapidly growing market of DTC genetic tests.

Key terms: DNA, Direct-to-consumer genetic test, Biopolitics and biopower, gene fetishism, identity, semiotics, genetic essentialism

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## Chapter One

### Introduction

Through the pervasive use of iconic images of DNA in American popular culture, and their treatment as rhetorical objects, DNA and genes now carry the burden of answering existential questions surrounding identity, such as "Who am I?" and "Where do I come from?"<sup>1</sup> Appeals to genetic essentialism are evident in *Time* covers that feature the gene as far back as the 1970s, well before the human genome was sequenced. By this term "genetic essentialism," I am referring to "the view that our genomes do intrinsically define our personal identities, as secular substitutes for the 'soul.'"<sup>2</sup> It is also reasonable to assume that most people have limited knowledge regarding DNA in the context of molecular genetics, and this appeal to genetic essentialism effectively reduces the self to a molecular entity without regard to social and historical complexity. Yet there are millions of people using at-home genetic tests under the pretense that the tests can answer these questions. Moreover, this type of genetic information can be treated as a datapoint and is at risk of being used to fix dominant social categories relating to ethnicity, gender, and health. The gene's power to naturalize traditional, and often exclusionary, categories of social difference is particularly threatening for already marginalized populations. For this reason, it is worth looking at how a major direct-to-consumer (DTC) genetic testing company, 23andMe, manipulates expectations associated with DNA through their online marketing. My research questions are the following: (1) Precisely what cultural meanings have

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<sup>1</sup> In this chapter, I am using Merriam Webster's definition of *iconic* as opposed to the more specialized definition from semiotics, so I am referencing images of DNA and the gene that are "widely-recognized and well established" as scientific images.

<sup>2</sup> A. Nordgren and E.T. Juengst, "Can genomics tell me who I am? Essentialistic rhetoric in direct-to-consumer DNA testing," *New Genetics and Society* 28, no. 2 (June 2009): 157-172, <https://doi.org/10.1080/12636770902901595>.

become associated with visualizations of DNA and how do these images affect our sense of self? (2) Who stands to benefit from DNA direct-to-consumer tests? Regarding genetic testing and DTC tests, who are in positions of power? (3) How do images from the results pages of 23andMe reinforce these meanings and power structures?

### **DNA and The Gene: Scientific, Cultural and Rhetorical Objects**

The story of DNA's rise to iconic status in American culture really begins with the introduction of the gene in scientific discourse. In 1909, Wilhelm Johansen coined a new word to describe units of heredity, the *gene*, shortened from the word *pangene*.<sup>3</sup> From its conception the word was imprecise, and according to Siddhartha Mukherjee in *The Gene: An Intimate History*, "The word was created to mark a function; it was an abstraction. A gene was defined by what a gene *does*: it was a carrier of hereditary information."<sup>4</sup> Johansen and his contemporaries had no knowledge of its appearance, how it worked, or where it was in the body—the word was simply a hypothesis. Nonetheless, Mukherjee points out that this scientific hypothesis had a cascade effect by prompting exciting new research.<sup>5</sup> By 1914, genetics had become a sort of wild frontier, ripe for exploration.

Rhetorician Elizabeth Shea notes the considerable impact that the ambiguity of the word has had on the scientific community and popular culture. She contends that genes are biological, economic, political and scientific objects with complex histories, and that they have become "authoritative scientific and cultural icon[s]."<sup>6</sup> She also views the gene as a "semiotically tricky"

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<sup>3</sup> Siddhartha Mukherjee, *The Gene: An Intimate History*, (New York: Scribner, 2016), 47-55. Beginning in the late 1850s, Gregor Mendel's plant hybridization experiments led to a new idea in science, and his experiments suggested units of heredity that are passed down from parent to offspring.

<sup>4</sup> Siddhartha Mukherjee, *The Gene*, 71.

<sup>5</sup> Ibid.

<sup>6</sup> Elizabeth Parthenia Shea, *How the Gene Got Its Groove* (Albany: State University of New York Press, 2008), 9.

rhetorical object, which performs “the rhetorical work of laying claim to a material reality and opposing the ideological arguments of others.”<sup>7</sup> By the 1930s, genes were already being discussed in scientific articles, and by the 1940s, they were beginning to perform “iconographic cultural work” in the popular press, although the meaning of genes was no more settled in public or scientific discourse than it had been when Johansen conceived of the idea. As an example, Shea cites a *Time* story from 1949 titled “Cut to Pattern,” which she describes as a *genetics versus communism* article. Rather than simply discussing scientific breakthroughs and empirical results, the article positions the gene as a “rhetorical threat rising up on the outside of legitimate science.”<sup>8</sup>

Shea also cites visual examples of the gene entering popular discourse. She notes that in 1949, an electron microscope image of DNA was featured in the *Newsweek* article “Genes: Sliced and Pictured.” The image would eventually help researchers in discovering the structure of DNA, and it also served an ideological function, communicating that the gene was an important and powerful “icon that was on the verge of coming into view.”<sup>9</sup> Shea’s observations regarding the plasticity of the term “gene” are significant, because the notion of the gene precedes DNA, which has a similarly complex history and can also be thought of as an authoritative scientific and cultural icon that does rhetorical work. Furthermore, the gene was also seen as a driving force in the quest to identify the structure of DNA.

Drawn to the mystique of a molecule that was capable of carrying hereditary information, James Watson, Francis Crick, Maurice Wilkins and Rosalind Franklin<sup>10</sup> were the key players

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<sup>7</sup> Shea, *How the Gene*, 60.

<sup>8</sup> Shea, *How the Gene*, 54.

<sup>9</sup> Shea, *How the Gene*, 61.

<sup>10</sup> Siddhartha Mukherjee, *The Gene*, 159. Watson, Crick and Maurice Wilkins were awarded the Nobel Prize for their discovery in 1962. Franklin, who had died from ovarian cancer in 1958, was not included.

responsible for the discovery of DNA's 3-D structure.<sup>11</sup> Their discovery cast light on the mechanisms and functions of genes. Interestingly, both the discovery of the structure and Watson and Crick's model of the double helix relied on the use of visual images, and were both inspired by the design aesthetic of the time.<sup>12</sup> According to Mukherjee, Watson and Crick had taken an "intuitive scientific leap"—and rather than using complicated math equations and laborious experimental methods to illuminate the structure of DNA, they used a set of molecular models that resembled toys for preschool children.<sup>13</sup> They would use existing knowledge about the behavior of certain molecules along with X-Ray images, such as those they had seen from Maurice Wilkin's laboratory, to aid in building the model. Characterizing the creation of Watson and Crick's model, art historian Martin Kemp notes that there was a "strong element of toys for smart boys in their modelers' enterprise."<sup>14</sup>

James Watson and Francis Crick had failed at their first attempt of modelling DNA, and it wasn't until Maurice Wilkins shared Rosalind Franklin's image of DNA with James Watson that they succeeded.<sup>15</sup> Franklin, a highly regarded crystallographer, had captured an image of DNA's wet form using X-ray diffraction.<sup>16</sup> The famous photograph, titled "Photo 51" (figure 1), revealed DNA's possible helical structure and is regarded as one of the "most beautiful X-ray

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<sup>11</sup> Martin Kemp, *Christ to Coke: How Image Becomes Icon* (NY: Oxford University Press, 2012), 280.

<sup>12</sup> Martin Kemp, *Visualizations: The Nature Book of Art and Science* (Berkeley: Oxford University Press, 2000), 121. Kemp briefly suggests that the Watson-Crick DNA model— "linear, wiry, openly mechanical, unadorned, and rhetorically 'functional'"—embraced the modern design aesthetic and fit within the "design parameters of the 1951 Festival of Britain."

<sup>13</sup> Siddhartha Mukherjee, *The Gene: An Intimate History* (New York: Scribner, 2016), 148.

<sup>14</sup> Martin Kemp, *Christ to Coke*, 289.

<sup>15</sup> Siddhartha Mukherjee, *The Gene*, 153. There has been controversy regarding the sharing and ownership of this photograph. The photo was taken by Rosalind Franklin, Maurice Wilkin's assistant. She had discovered "the remarkable 'wetness' of DNA. She was also the only one capable of taking photographs of this quality and clarity, at the time. Wilkins had taken the photograph out of her drawer and revealed it without her knowledge or permission. He had acknowledged that he should have asked Rosalind's permission but "later maintained that the photograph had been given to him by Gosling, Franklin's student—and therefore it was his to do with what he desired."

<sup>16</sup> Crystallographers use X-ray diffraction to determine the internal structure and bonding arrangement in molecules such as DNA.

photographs of any substance ever taken.”<sup>17</sup> Despite the fact that information regarding the structure was still largely hypothetical, Watson and Crick went ahead and completed their model of DNA's structure, postulating that it was the iconic double helix that we now know (figure 2). With the publication of Watson and Crick's essay “Molecular Structure of Deoxyribose Nucleic Acids” in *Nature* on April 25th, 1953 complete with an illustration of the now-iconic double helix (figure 3) drawn by Crick's wife, Odile Crick, DNA made its first foray into the public sphere.<sup>18</sup>

The gene began as a “linguistic fiction” and prompted the search for DNA with the aid of persuasive rhetoric in Watson and Crick’s essay, which made sure to note the significance of the discovery.<sup>19</sup> From a rhetorical point of view, the impact of Watson and Crick’s initial essay in *Nature* (1953), and those that were published the following year, cannot be overstated. The first essay established the significance of their model of DNA with the closing line, “It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for genetic material.”<sup>20</sup> In their essay “Genetic Implications of the Structure of Deoxyribonucleic Acid,” published a year later in *Nature*, an explicit connection between genes and DNA was made.<sup>21</sup> Shea suggests that word *gene* was used in the essay for its epistemic value. It also “firmly affixed the concept of genes to the material of DNA,” again, without providing any clear definition of the gene or its function.<sup>22</sup> DNA legitimated the gene

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<sup>17</sup> J.D. Bernal, “Obituary” *Nature* 182 (1958), 154.

<sup>18</sup> Martin Kemp, *Christ to Coke*, 289.

<sup>19</sup> Dorothy Nelkin and M. Susan Lindee, *The DNA Mystique*, 3. Dorothy Nelkin was a New York University sociologist and expert on science and society and M. Susan Lindee is a professor of history and sociology of science at the University of Pennsylvania.

<sup>20</sup> Watson, James D. Watson and Francis H. C. Crick, “A Structure for Deoxyribose Nucleic Acid,” *Nature* 171, no. 4356 (1953), 737-738.

<sup>21</sup> Elizabeth Shea, *How the Gene*, 73-79.

<sup>22</sup> Elizabeth Shea, *How the Gene*, 79.

with “the most material definition it had yet to acquire,”<sup>23</sup> and at the same time, the gene remained a “flexible” and “robust” epistemic thing.<sup>24</sup> The discovery of the structure of DNA and Watson and Crick’s essays also prompted more genetic research that aimed to understand complex biological process through the study of genes.

The impact of genes and DNA as epistemic *things* and rhetorical objects reaches far beyond scientific discourse. Nelkin and Lindee place a reasonable amount of blame on the genomic scientific community for the proliferation of genetic essentialism and for the popular (mis)understanding of the genes and DNA:

Seeking to assure continued public funding of a long-term, costly project [The Human Genome Project], genome researchers have been writing for popular magazines, giving public talks, and promoting their research in media interviews. They contribute to popular imagery as they popularize their work in ways that resonate with larger social concerns.<sup>25</sup>

They argue that scientific illustrations glamorize DNA and that genomic scientists often use metaphors that suggest that predictive power of DNA or that is the “essence of identity.”<sup>26</sup> The intersection of images and words is vital to understand because they are inseparable, working together to form and reinforce public misconceptions of DNA and genes.

### **The Iconic Double Helix**

Today, the double helix is perhaps one of the most ubiquitous scientific images. While it is universally understood to be a biological image, many people do not understand what it technically means. For scientists, DNA is a biological entity, a complex molecule that contains

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<sup>23</sup> Ibid.

<sup>24</sup> Ibid., 73.

<sup>25</sup> Nelkin and Lindee, *The DNA Mystique*, 6.

<sup>26</sup> Ibid., 7.

genetic information, and the acronym D-N-A stands for deoxyribonucleic acid.<sup>27</sup> Images of DNA in scientific discourse are visualized in a number of ways—from familiar illustrations of the double helix to indexical photographs that bear no resemblance to the double helix, and these images are often accompanied by written descriptions. For instance, an electron microscope photograph of DNA's structure (figure 4) is black and white and might look more like a ball of yarn given that DNA is tightly coiled; however, the image that most people are familiar with is what DNA would look like if you took a strand of DNA, untangled and stretched it.

DNA's contemporary cultural meaning is quite different from its scientific, technical meaning. Many people have a deterministic view of genes, assuming a 1:1 correlation between DNA and physical traits or ancestry. Consequently, they conflate its meaning as also determining more cultural notions of identity such as gender, race, family and social proclivities. In *The Molecular Gaze* Suzanne Anker, a visual artist and theorist, and Dorothy Nelkin point out that images generated by scientists and those of artists are “based on quite different epistemologies” and that there is a disparity between how images are used.<sup>28</sup> Unlike images generated for science, images of DNA in art and popular contexts are highly aestheticized, what scientists might refer to as “pretty pictures.” These images are colorful, without the intention of being informational, flattened to resemble Odile Crick's drawing of the double helix, and they are often represented with images of people, suggesting a link to identity.

The discovery of DNA's structure eventually led to the Human Genome Project (HGP).<sup>29</sup> Nelkin and Lindee suggest that the HGP renewed public interest in DNA and the gene. The

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<sup>27</sup> Because its structure and function are known, it is less ambiguous and less “semiotically tricky” than the term *gene*.

<sup>28</sup> Suzanne Anker and Dorothy Nelkin, *The Molecular Gaze: Art in the Genetic Age* (NY: Cold Spring Harbor Laboratory Press, 2004), 189.

<sup>29</sup> The Human Genome Project, “What was the Human Genome Project?” U.S. National Library of Medicine, National Institute of Health, last modified May 11, 2016, <https://www.genome.gov/12011238/an->

ambitious genomics project began in 1990 and ended in 2003 with the first successfully sequenced human genome. In addition to the advances in the field of genomics, the early 2000s were marked by an emerging direct-to-consumer (DTC) genetic testing market.<sup>30</sup> The DTC market continues to grow, and global industry analysts project that it will be worth more than \$230 million by the end of 2018.<sup>31</sup> In fact, 23andMe, a leading company in the industry, estimates that they have more than five million genotyped customers worldwide.<sup>32</sup> This new wave of consumer genetic tests is accompanied by an overwhelming stream of television and online advertisements that have furthered these myths surrounding DNA and genes.

Despite the popular interchangeable use of the terms “DNA” and “gene,” they have quite different technical definitions. DNA is the smallest unit and forms a double helix. Genes are segments of DNA which code for certain proteins. Genes vary in size and can determine specific traits, such as eye color.<sup>33</sup> According to the National Institutes of Health (NIH), “a gene is the basic physical and functional unit of heredity . . . Every person has two copies of each gene, one inherited from each parent.”<sup>34</sup> The NIH notes that most genes are the same for people and less than 1% of genes are different between people, and yet the differences, rather than the similarities, are highlighted by DTC marketing.

Genes are located on chromosomes, which are made up of tightly coiled strands of DNA. Every person inherits 23 chromosomes from each parent and the two copies form the familiar x-

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overview-of-the-human-genome-project/. “The Human Genome Project (HGP) was the international, collaborative research program whose goal was the complete mapping and understanding of all the genes of human beings.”

<sup>30</sup> Direct-to-consumer (DTC) genetic tests are advertised directly to consumers and bought online or in stores. The consumer submits a DNA sample, usually via saliva, to the company and receives a report or analysis in return.

<sup>31</sup> Pascal Su, “Direct-to-Consumer Genetic Testing: A Comprehensive View,” *Yale Journal of Biology and Medicine* 86, no. 3 (2013): 359-65.

<sup>32</sup> “What is the history of the company?” 23andMe, last accessed November 23, 2018, <https://www.23andme.com>.

<sup>33</sup> Megan A. Allyse, “Direct-to-Consumer Testing 2.0: Emerging Models of Direct-to-Consumer Genetic Testing.” *Mayo Clinic Proceedings* 93, no. 1 (2018): 113-20.

<sup>34</sup> “What is a gene?” NIH, accessed March 28, 2018, <https://ghr.nlm.nih.gov/primer/basics/gene>.



shaped image of DNA. *Alleles* are variant forms of a gene, which often arise due to differences or mutations and are located at a specific place on the chromosome.<sup>35</sup> These small genetic differences carry the instructions that are, in part, responsible for our unique traits. Furthermore, genes can code for genetic disorders, and if a person carries a gene associated with a certain disorder, they are at risk of eventually having that disorder. However, carrying a certain gene does not guarantee that one will have the associated disorder, a point conveniently left out of advertisements for DTC tests, as it does not fit into the larger narrative, namely, that DNA provides *the* answers.

### **“The DNA Mystique”**

Presently, there is limited scholarship on visualizations of DNA used by DTC genetic testing companies in the context of critical theory. The literature that I was able to find regarding images of DNA focuses primarily on iconic images of DNA, such as the double helix, the concept of DNA and the cultural meanings that have become associated with DNA. There is also a fair amount of research surrounding DNA and the gene as rhetorical objects and the impact of the rhetoric of science on cultural conceptions of identity.<sup>36</sup>

Dorothy Nelkin and M. Susan Lindee devote *The DNA Mystique* (1995) entirely to the subject of the gene as a cultural icon, and their’s is the most comprehensive investigation of DNA as a cultural icon. Nelkin and Lindee discuss the ways in which the referent has become culturally embedded. Using a 2003 cover of *Time* as an example, Nelkin and Lindee argue that

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<sup>35</sup> “How genetic disorders are inherited,” Mayo Clinic, accessed May 28, 2014, <https://www.mayoclinic.org/tests-procedures/genetic-testing/multimedia/genetic-disorders/sls-20076216>. A gene mutation is defined as a change in or damage to a gene.

<sup>36</sup> Much of this writing began in the 1990s amidst growing fears regarding genetic essentialism.

iconic images of DNA are "easily adapted to address prevailing social issues and political perspectives."<sup>37</sup> They go on to say:

DNA's power and persistence as a cultural icon reflect its plasticity and openness to interpretation. In popular culture, DNA can play a role in many different stories and even can appear to solve difficult social problems. A symbolic icon that bears only a limited resemblance to the biological entity to which it refers, DNA in America popular culture changes with the times.<sup>38</sup>

Nelkin and Lindee argue that the gene—the concept and the image—is a powerful icon, by examining the various cultural meanings it has taken on, moving through issues surrounding spirituality, race and gender.

Not only is DNA treated as an entity that is universal to all living things, but mystical and God-like properties have also been ascribed to it. Consequently, DNA is thought to provide answers to existential questions.<sup>39</sup> DNA is also equivocated to the Christian soul, "relevant to concerns about morality, personhood, and social place."<sup>40</sup> As such, Lindee and Nelkin suggest that as an icon in contemporary American culture, DNA is treated as a powerful entity that is outside of the body, life-giving and that determines the true self. Nelkin and Lindee assert that it is particularly problematic to imbue DNA with such sacred power and to suggest that it is proof of good and evil, because it can also be used as a way of demarcating boundaries that can be harmful to already marginalized groups of people. They note that genome is a concrete thing that "can mark the borders and police the boundaries between humans and animals, man and machine, self and other, 'them' and 'us'"<sup>41</sup> They support this claim by examining ways in which DNA reifies biologically reductive notions of race, gender, and what they term as the "molecular

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<sup>37</sup> Nelkin and Lindee, *The DNA Mystique*, xi-xii. (from 2004 second edition preface.)

<sup>38</sup> *Ibid.*, xii.

<sup>39</sup> *Ibid.*, 40.

<sup>40</sup> *Ibid.*

<sup>41</sup> *Ibid.*, 43.

family.” Consequently, Nelkin and Lindee suggest that DNA can be used as an instrument of power over already marginalized groups.

In the final chapter of *The DNA Mystique*, Nelkin and Lindee briefly ruminate on the potential dangers of the commodification of DNA, such as direct-to-consumer tests. They argue that new applications of DNA, such as direct-to-consumer genetic tests, “are marketed directly to consumers, often in ways that reflect social anxieties.”<sup>42</sup> They warn that this type of advertising is exploitative and, even more alarming, that the new applications of DNA could “also facilitate a surveillance state.”<sup>43</sup> As *The DNA Mystique* was last revised in 2004 when DTC tests were just entering the market, Lindee and Nelkin did not provide an in-depth look at the DTC market or the impact of images used by these genetic testing companies. My research critically analyzes such images. Using images of DNA from 23andMe's website, I will be looking at issues surrounding the pervasive visual marketing of these new DNA applications and notions of biopower and surveillance. My thesis will serve as a continuation to Lindee's and Nelkin's comprehensive account of DNA as a cultural icon, although I will focus primarily on visualizations of DNA. The rapid growth of the DTC market in the 2010s, followed by the overabundance of images used by genetic testing companies, allows me to fill the gap for a topic Lindee and Nelkin anticipated in their last chapter.

Rather than examining how genetic tests utilize images in their marketing, most articles regarding DTC genetic tests are scientific and focus on the efficacy of the test. That said, there were a few articles that focused on the marketing of DTC genetic health and ancestry testing market or the impact of genetic ancestry testing in television programs on identity as it relates to race and postcolonial theory; these articles are quite broad and focus on social concepts rather

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<sup>42</sup> Nelkin and Lindee, *The DNA Mystique*, 192.

<sup>43</sup> *Ibid.*, 193.

than visual images themselves. My research suggests that there is a large gap in critical discourse regarding the deployment of images of DNA in the emerging DTC testing market, and my thesis is an attempt to fill this gap.

This research aims to examine the cultural meanings that have become associated with visual representations of DNA, such as the iconic image of the double helix. If, for instance, we consider the notion of self-regulation as having been embedded in culture for centuries, only to be followed by the emergence of DNA as a super-icon,<sup>44</sup> which has also become embedded in our cultural way of thinking, then it is no surprise that DTC genetic tests have become so popular. As the DTC market has grown in an alarming rate over the last decade, it is worth thinking about the ethical ramifications of these tests, particularly within the context of biopower and biopolitics. With all of this in mind, it is my assertion that 23andMe, a leading DTC company and “the *only* company authorized by the FDA to provide DTS Genetic Health Risk reports and carrier status reports” (figure 30), is aware of the conflation between identity and biology, and that images of DNA used in their web marketing and advertising reinforces these meanings and power structures.

## Chapter Overviews

Given the cultural power ascribed to the gene, the chapters that follow critically analyze three groups of images of DNA deployed in popular culture, beginning with iconic images of DNA on *Time* magazine covers. In this second chapter, I will provide an analysis of DNA using Peirce's semiotic model and briefly discuss the various ways of picturing DNA as indices, symbols, and icons in both science and culture. This chapter will focus primarily on the cultural

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<sup>44</sup> Super-Icon is a term that references W.J.T Mitchell's hyper-icon. This term will be discussed in greater detail in chapter 1.

meanings associated with visual images of DNA through the examination of a group of nine covers of *Time* magazine (fig. 1-9) that span over 50 years, beginning in 1971 and ending in 2012. The covers are examined in reverse chronological order and all feature DNA and genetics; this group of images forms a compelling timeline that illustrates how DNA has become culturally embedded and now carries the weight of signifying identity and life-itself.

Chapters Three and Four will focus on the marketing and design strategies of the company 23andMe. I will begin the third chapter by providing an overview of the company and its testing services. Following the overview, this chapter will extend the semiotic system discussed in Chapter Two to a second-order semiological system using Barthes's notion of myth, as described in "Myth Today."<sup>45</sup> Specifically, my objective is to analyze a group of images from an anonymous individual's online test results from 23andMe's genetic ancestry test (fig. 10-16) using Barthes's conception of myth in order to illuminate the way that DTC companies advertise and capitalize on the cultural misunderstanding of DNA, i.e. the myth of genetic essentialism. The online test result pages are part of an interactive web interface; there are numerous pages, and they are nonlinear. For instance, one of the results pages references the individual consumer's Neanderthal ancestry (fig. 23), while another provides information regarding the migration of that person's maternal line. Due to the number of images, it would be impossible to analyze each image in depth in this thesis. For this reason, I will be looking at the shared ways these images create meaning—and I will explore how images of genes and the human body are deployed, ultimately reifying cultural markers of identity, such as ethnicity and race. I argue that 23andMe is able to do this, in part, through a beautifully designed and unified design aesthetic

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<sup>45</sup> Charles Sanders Peirce, semiotics, Roland Barthes and myth will be discussed at greater length in the following two chapters.

that uses color and shared symbols such as chromosomes and genetic maps to exploit cultural conceptions of identity.

In Chapter Four, I will continue to examine the visual representation and marketing of 23andMe's genetic testing services, this time focusing on the health test. The objective of this chapter is to identify what images of DNA on 23andMe's website say about the power of knowing one's individual genetic information. Using Foucault's theories surrounding biopower and biopolitics, I examine a group of several images found on the 23andMe website (fig. 17-22), most located on the “How It Works” page. These images also support Foucault's notion of self-regulating populations and suggest a new form of surveillance via data collection. As in Chapter Three, there are too many images to discuss them all in depth, so I will again be focusing mostly on ways that DNA and human bodies are visually represented. My research suggests that these images reveal current ethical questions surrounding the new and rapidly growing market of DTC genetic tests.

If we consider the social origin of DNA, which began in the lab, simply as a biological object of scientific interest. In order to secure funding and garner public interest, scientists begin to use persuasive rhetoric and aestheticized scientific images. Thus, associated with the grand possibility of discovery, DNA enters popular discourse. Since its discovery in 1953, DNA takes a social life of its own. As “an object to think with,” DNA, and more specifically, the double helix has permeated society and connotes fears and anxieties about genetic manipulation and cloning, the commodification of genes, and identity politics.<sup>46</sup> As one of the most recognizable biological icons today, “the double-helix is etched upon the modern

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<sup>46</sup> Nelkin and Lindee, *DNA Mystique*, 16.

Western consciousness,” according to anthropologist Sarah Franklin.<sup>47</sup> Genetics themed *Time* magazine covers examined in Chapter Two serve as just one example of the ways in which persistent images of DNA deployed in media have cultivated shared cultural meanings associated with them.

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<sup>47</sup> Sarah Brooks Franklin, “Life Story: The Gene as Fetish Object on TV,” in *Science as Culture* 3, (London: Free Association Books, 1988), 93.

## Chapter Two

### The Double Helix on *Time* Magazine Covers: A Semiotic Analysis

To explore the cultural meanings that have become associated with images of genes and DNA in contemporary society, I've selected nine *Time* covers that visually and textually reference genetics. This collection of nine *Time* covers spans fifty years, forming a compelling illustrative timeline of the way in which DNA functions as a polysemic sign with multiple and preferred meanings. Drawing on Charles Peirce's semiotic models, my analysis examines images of genes and the double helix. My research indicates that the double helix has become a super-icon and is one of the most recognizable biological icons and symbols today—and that the meanings associated with DNA reflect social values and biologically reductive public expectations. Nelkin and Lindee argue that “Such exuberant texts, promoting the roles of genes in human personality, behavior, and identity and marketed widely to nonscientists, suggest that biology has replaced both religion and philosophy by providing explanations for the meaning of life.”<sup>48</sup> Representations of genes on the *Time* covers indicate that genes can indeed provide the profound insight that Nelkin and Lindee describe.

*Time* also claims that genes are responsible for producing human subjects, and beginning with the image on the 1971 issue of *Time*, titled “The New Genetics: Man Into Superman,” representations of the iconic double helix are super-imposed on human bodies. Here, the double helix signifies identity and reimagines techno scientific bodies; the double helix is similarly deployed throughout the collection of *Time* covers I analyze. Replacing human bodies with images of DNA is both biologically reductive and supportive of the problematic myth of genetic essentialism in our culture. Furthermore, supplanting human

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<sup>48</sup> Nelkin and Lindee, *The DNA Mystique*, xvii.



bodies with these technoscientific bodies that made up of information is also indicative of notion of gene fetishism; as such, my analysis indicates that the double helix has also become a powerful symbol, a sort of phallus-substitute, imbued with mystical powers and signifying life-itself.

Although I noted the separate histories and technical definitions of genes and DNA in the introduction, I will follow popular conventions when discussing the gene, genome, and DNA. They are regarded as cultural objects that essentially stake the same authoritative claim on reality.

### **Varying Visual Representations of DNA**

As the concept of DNA originates in and derives much of its power from science, I will briefly address images of DNA that are used within scientific discourse before discussing the ideological function of certain iconic images of DNA, such as the double helix. Images are the essential tools for understanding and interpreting scientific information and data, and images within scientific discourse must be clear and unambiguous. In *The Molecular Gaze: Art in the Genetic Age*, visual artist and theoretician, Suzanne Anker, and Dorothy Nelkin assert that “scientists visualize DNA exclusively through instrumentation—the medium of [. . .] crystallography, sequencing gels, magnetic imaging and digitized images.”<sup>49</sup> Therefore, within a research lab setting, it is essential that the image functions in a way that leaves the least amount of subjective interpretation.<sup>50</sup> While scientists may be uninterested in the “prettiness” of their images, as James Elkins argues, they are certainly interested in aesthetics.<sup>51</sup> They would not be able to effectively share findings if the data is unclear due to poor-quality images, because

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<sup>49</sup> Anker and Nelkin, *Molecular Gaze*, 37-41

<sup>50</sup> Anker and Nelkin, *Molecular Gaze*, 189.

<sup>51</sup> James Elkins, “Art,” 558.

interpretation relies on the integrity of the images. Rosalind Franklin, the scientist responsible for discovering the helical structure of DNA, for instance, was highly regarded in her field because of her ability to take beautifully clear photographs.

Presently there is a wide array of DNA images used in the context of scientific discourse. The variety of images is a result of the various ways in which data are collected, visualized, and analyzed. There are also images of DNA that rely on other images in order to be fully understood or interpreted and is not unusual for a scientific image with biochemistry involved. Per Elkins' observation, this level of complexity is not unusual for scientific images—as “images outside of art”—are “marked by unusually complex relations to one another.”<sup>52</sup> Images of DNA vary from graphical representations for data to educational diagrams of the double helix (figure 5). Some images are made up solely of symbols, while others are indexical photographs of molecules (figures 1, 4, and 7).

In order to discuss the multiple ways of picturing DNA, Suzanne Anker and Dorothy Nelkin adopt Charles Sander Peirce's semiotic model as a framework. They assert that there are three distinct ways in which DNA's molecules are represented: as index, symbol, or icon.<sup>53</sup> Peirce's model is commonly used in mainstream semiotics because it considers how different modes of signification work.<sup>54</sup> According to Peirce, “An *Index* is a sign which refers to the Object that it denotes merely by virtue of being really affected by that object.”<sup>55</sup> In other words, there is an inherent or culturally specific relationship between the signified and signifier. The photograph of DNA gel electrophoresis in figure seven is an example of

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<sup>52</sup> James Elkins, “Art,” 556.

<sup>53</sup> Anker and Nelkin, *Molecular Gaze*, 27.

Though Anker and Nelkin are concerned with images of DNA in contemporary art, their observations can be extended to images of DNA in contemporary visual culture. As with art, semiotics is also a “useful and revealing way to decode linguistic metaphors” in DNA-themed Magazine covers.

<sup>54</sup> Gillian Rose, “Semiology: Laying Bare the Prejudices,” in *Visual Methodologies*, (London: Sage, 2016), 118.

<sup>55</sup> Charles Sanders Peirce, *Philosophical Writings of Peirce*, (New York: Dover Publications, 1955), 102.

indexical image of DNA. In DNA gel electrophoresis, DNA is marked with fluorescent markers and is separated into bands as it moves down an agarose gel. The photograph is captured under a UV light so that the bands or traces of DNA are illuminated. Similarly, Rosalind Franklin's X-ray diffraction photograph (figure 1) is also an indexical image of DNA. According to Anker and Nelkin, they consist of patterns that "are unique for each individual."<sup>56</sup> They are essentially a genetic fingerprint used for identification in criminal investigations, paternity cases, or inheritance claims.<sup>57</sup> DNA gel photographs and DNA sequence images are often used by scientists who focus on the literal, denotative, function of these signs. Though they are not the most prevalent images of DNA in popular culture, such symbolic and indexical images of DNA have been represented in visual art, films and television shows, particularly those that are crime-based.

More prevalent in popular culture than indexical images are symbolic images of DNA. According to Peirce, "A symbol is a sign which refers to the Object that it denotes by virtue of a law, usually an association of general ideas, which operates to cause the Symbol to be interpreted as referring to that Object."<sup>58</sup> Essentially, a symbol carries a conventionalized meaning and the relationship between the signifier and signified is arbitrary. One way that DNA is visualized as a symbol is in the form of a DNA sequence (figure 6)—as a code-script or sequence of letters and information. The letters A, T, C, and G are shorthand symbols for the nitrogenous bases of the nucleotides in DNA: Adenine, Thymine, Guanine, and Cytosine. Moreover, Peirce asserts that a symbol "denotes a kind of thing. Not only that, but it is itself a kind and not a single thing."<sup>59</sup> In the case of DNA, there are many different types of symbolic

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<sup>56</sup> Anker and Nelkin, *Molecular Gaze*, 31.

<sup>57</sup> *Ibid.*

<sup>58</sup> Peirce, *Philosophical Writings of Peirce*, 102.

<sup>59</sup> *Ibid.*, 114.

images of DNA, from images of people to images of chromosome, that are used to connote a kind of thing—the scientific field of genetics, biotechnology, or individual identity.

The most commonly deployed images of DNA in popular culture are iconic representations, such as that of the chromosome (figure 8) and the double helix (figures 3 and 5).<sup>60</sup> These representations also have symbolic function, in that they are often used to connote genetics or biotechnology. Unlike indices and symbols, icons bear an immediate likeness to the thing they represent.<sup>61</sup> The images are simplified and stylized depending on the context in which they are used, so some of the images resemble actual DNA and chromosomes more than others. Though I will not be discussing images of chromosomes in this chapter, it is important to address these particular images because they are commonly deployed by direct-to-consumer genetic testing companies, such as 23andMe, which I will discuss in Chapters Three and Four. Per Elkins's article about non-art images, note that some of the images, such as the text book diagrams in figures 5 and 8, show relationships between pictorial and linguistic markings (shapes and letters); such pictorial and linguistic markings are a common feature of scientific diagrams, and key to understanding and interpreting them. Iconic images deployed in public discourse are rarely accompanied with identifying markings—their biological function is largely ignored— and the *Time* covers are a prime example of this denotative absence.

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<sup>60</sup> The relationship between DNA, genes and chromosomes is pictured in figure 5.

<sup>61</sup> Peirce, *Philosophical Writings of Peirce*, 102.

## The Double Helix: A Super-Icon

The iconic image of the double helix, universally understood to be a biological image, has become a super-icon in the twentieth-century. I use the term *super-icon*, first, as a way of addressing that it is a widely recognized and well-established image, without confusing it for the icon in Peirce's semiotic model, which I also discuss in this chapter. Secondly, I am using the term, super-icon, as a hybridization of the following two concepts: W.J.T. Mitchell's "hypericon" and Nelkin and Lindee's "Supergene." W.J.T. Mitchell, Professor of English and Art History at the University of Chicago, defines the term hypericon as a summary image "that encapsulates an entire epistemology, a theory of knowledge."<sup>62</sup> The double helix, which made its first public appearance in *Nature* magazine in 1953, commonly adorns covers of biology textbooks and biotech company and laboratory logos, and has become *the* image associated with genetics in science. When discussing the gene in popular culture, Nelkin and Lindee refer to the gene as the "Supergene," a cultural icon that "derives its power from science, [but] is not limited by scientific data."<sup>63</sup> Given Mitchell's definition and Nelkin and Lindee's observations regarding the gene, the double helix functions as a super-icon—as a widely recognized scientific image mostly understood for its cultural non-scientific meaning.

In *Christ to Coke: How Image Becomes Icon*, art historian Martin Kemp examines the ways in which images of the double helix came to be one of the most reproduced scientific images of any period. He provides a brief chronology of DNA and images of the double helix and discusses the rise of images of DNA to super-iconic status, which I have expanded on in the introduction. He suggests that DNA has been emptied of its scientific meaning, observing that many people use the term without knowing its factual meaning. For instance, many people make

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<sup>62</sup> W.J.T. Mitchell. *Picture Theory: Essays on Verbal and Visual Representation*, (Chicago: University of Chicago Press, 1994), 49.

<sup>63</sup> Nelkin and Lindee, *DNA Mystique*, 199.

statements like, “it's in our DNA,” reducing identity to their DNA or genetic code. Kemp notes that such statements suggest that a “certain proclivity is built in the very nature of a person at the deepest genetic level.”<sup>64</sup> In this chapter, Kemp is able to provide a useful foundation for referring to, not only the term D-N-A, but also images of DNA, as culturally embedded icons.

As I am concerned with the double helix as a culturally embedded icon, I focus here on its connotative function as a sign. In contrast to denotative signs, which describe literal meanings of the sign, connotative signs “carry a range of higher-level meanings,” i.e. secondary meaning.<sup>65</sup> Scholars writing on the topic of the social meaning of DNA argue that it is “independent of biological definitions” and connotes biologically reductive notions of identity and God, acting as a phallus-substitute. Nelkin and Lindee, argue that the social meaning attached to DNA and the double helix are a result of “persistent images” and “repeated metaphors [that] also serve to define experience, cultivate stereotypes, and construct shared meanings.”<sup>66</sup> They go on to say that persistent images that appear in commercial mass culture also reveal common beliefs and values. For instance, popular deployments of images of the double helix, such as those represented in *Time* magazine, reveal biologically reductive beliefs common in our culture.

The group of *Time* magazine covers discussed here (figures 9-17) reveals how persistent images of the double helix have been used in tandem with repeated metaphors to reinforce the social meanings of DNA. In these magazine covers the double helix can be categorized both as a metonymic and synecdochal sign. According to Gillian Rose, a metonymic sign is “something associated with something else, which then represents that

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<sup>64</sup> Kemp, *Christ*, 280.

<sup>65</sup> Gillian Rose, “Semiology: Laying Bare the Prejudices,” in *Visual Methodologies*, (London: Sage, 2016), 121.

<sup>66</sup> Nelkin and Lindee, *DNA Mystique*, 12.

something else.”<sup>67</sup> Following Rose’s definition, in some of the *Time* covers, DNA is associated with notions of the future, destiny, or God, as can be seen in figures 10-12. The visually represented social meaning is then reinforced with headings such as, “the God Gene,” the title of the October 2004 issue of *Time* magazine. The synecdochal deployment of the double helix is also evident in the *Time* covers represented in figures 9, 13, and 17, wherein images of genes and DNA are represented as the parts (i.e. building blocks or genetic information) that make up the whole human body. Rose defines a synecdochal sign as “either a part of something standing in for a whole, or a whole representing a part.”<sup>68</sup> In popular deployments of the double helix image, it often represents a whole person or there are allusions to genes as building blocks, entities in themselves that make up a whole you.

### **Biological Reductionism**

The most common and problematic popular deployment of the double helix connotes/promotes a biologically reductive view of identity. The *Oxford Dictionary of Sociology* defines biological reductionism as “a theoretical approach that aims to explain all social or cultural phenomena in biological terms, denying them any causal autonomy.”<sup>69</sup> In short, a biologically reductive point of views regards DNA as a sort of magic code to life. Moreover, knowing the code can unlock all of the secrets to who a person or animal is and why their body functions and appears the way it does. Mitchell warns against this problem, pointing out that a theoretical image can be taken at a glance too easily, which “may ‘hold’ the mind in the paralysis of a

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<sup>67</sup> Gillian Rose, “Semiology,” 121.

<sup>68</sup> Ibid.

<sup>69</sup> “biological reductionism,” *Oxford Reference*, last accessed April 24, 2019, <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095507137>.

misleading analogy.”<sup>70</sup> The DNA image is often misinterpreted, taken in at a glance and immediately connected to identity, and the false assumption becomes that people and organisms are simply a sum of their parts.

Biological reductionism is evident in a few of the *Time* magazine covers, beginning with the 1971 issue of *Time* that bears the title “The New Genetics: Man into Superman” (figure 17). On this cover, the double helix is literally super-imposed on an image of a man, and another onto an image of a woman. The image is colored in a warm red hue that mimics the red glow on their flesh, so that the double helix becomes indistinguishable from their bodies. In fact, their arms and legs disappear altogether, and each body has been transformed into a strand of DNA. The iconic double helix appears both scientific and futuristic for its time, less than 20 years after the publication of the double helix in *Nature*. This very literal conflation of human bodies and DNA is revisited again on the 2003 cover, with its accompanying title “Solving the Mysteries of DNA” (figure 14).<sup>71</sup> Paralleling the image from the 1971 cover, the layout features a man on the left and a woman to the right, each encased in a double helix. As on the 1971 cover, the helices run vertically to the edge of top and bottom plane, though in this more recent cover, they appear as stylized gold ribbons.<sup>72</sup> The helices transform into trees above the figures, referencing the biblical story of Adam and Eve, as well as alluding to DNA as a life-giving entity. As in the previous issue of *Time*, the title text is at the center. In bold red, “DNA” is the largest word, forming a sort of text-image that is more legible than the *Time* brand. If there was any confusion regarding the symbolic and iconic uses of the double helix, the text-image ensures the preferred reading that the man and woman

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<sup>70</sup> Mitchell, *Picture*, 49.

<sup>71</sup> Nelkin and Lindee briefly discuss the image on this cover in the DNA Mystique, though they do not analyze all of the *Time* covers that focus on genetics and genomics.

<sup>72</sup> In fact, the ribbon-like 3-dimensional shape of the helices resemble the double helix from Odile Crick’s drawing.



are made of DNA, and that DNA constitutes life. In this image, there is a clear reference to creation and the nude figures read as Adam and Eve, and DNA symbolically references the tree of life. Furthermore, within both of these *Time* covers, an equivalency is made between individuals and DNA; these individuals are their DNA, and that also goes for their identity.

*Time* magazine is also able to conflate DNA with identity without even deploying the image of the double helix. Instead, some of the *Time* covers address genetics-related topics with images of people serving as signs or symbols for genes. *Time* references genes by using symbolic images of babies in their June 2003 and December 2012 issues. In their 2003 issue, “What makes you special?” (figure 13), genes are visualized as children’s building blocks that when assembled complete the image of a baby’s smiling face. Here, DNA is literally visualized as the “building blocks of life.” Similarly, the 2012 cover “Want to Know My Future” (figure 9) uses the image of a baby to connote genetics. Against a stark black background, a baby in diapers sits at the center of the cover, staring at the viewer. Genetic traits, such as “Parkinson’s” and “cystic fibrosis,” are listed in text boxes that reference the baby’s body and create an image/word web. Again, genes are represented as parts (i.e. text boxes of genetic disease risks) that make up an individual. The color of the eyes, the font used to list genetic traits, and the title text are all the same brilliant blue, further reinforcing the connection between genes and the individual through transference. In both of these covers, DNA is represented as code-script that makes up a whole person.

Other covers approach more abstract notions of identity, such as social and behavioral traits or inclinations,<sup>73</sup> For instance, the September 1999 issue, “The I.Q. Gene?” (figure 15) immediately links an individual’s intelligence quotient (I.Q.) with DNA in the title in bold

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<sup>73</sup> Lindee and Nelkin, *DNA Mystique*, 2. Nelkin and Lindee argue that there are now “selfish genes, pleasure-seeking genes, violence genes, celebrity genes, couch-potato genes, depression genes...and even genes for sinning.”

(“The I.Q. Gene?”) in an image of a naked baby holding a double helix; this image reinforces the notion that high or low I.Q. is a heritable genetic trait. As with the 1974 issue, the iconic double helix resembles a computer-generated image of the molecular structure of DNA, much like those found in a scientific textbook, which acts to legitimate the claim with science. The baby on this cover symbolizes life, birth and DNA. *Time*'s August 1994 issue, “Infidelity: It may be in our genes,” (figure 16) forgoes the use of iconic genetic imagery. Again, this cover relies on the verbal text, which is symbolically reinforced by the image. Infidelity is pictured as a broken wedding band, which symbolizes broken vows. The wedding band might also symbolize broken or defective genes, if infidelity is in fact to be found in our genes.

The *Time* covers examined so far rely on culturally constructed notions about DNA that are biologically reductive. By repeatedly using images of the double helix in tandem with images of people, these covers all rely on the preferred reading that the relationship between identity and genetics is implicit. Those that do not employ iconic images of the DNA use babies to symbolize the whole that is made up of genes. Symbolically replacing the DNA image with an image of a baby also situates DNA at the beginning of life.

### **Super-Icon Becomes Symbol: Life Itself and The Phallus Substitute**

In addition to suggesting that DNA is fundamental to identity, images of the double helix on the *Time* covers also signify mystical power. The October 2004 issue, “The God Gene,” (figure 12) overtly links DNA with God and religion. The cover is a monochromatic blue illustration of a woman praying. The double helix is presented on the woman's forehead in place of the Hindu third eye Ajna symbol that signifies the subconscious mind and provides insights into the future. DNA is thought to hold the answers to existential questions, and, in

this way, it functions as an equivalent of the Christian soul, as Nelkin and Lindee argue in *The DNA Mystique*. The iconic image of the double helix on her forehead is also depicted in a way that suggests this woman *is* her DNA strands that have been transformed into two hands facing one another, almost mirroring the woman's praying hands.

In addition to using the double helix as a mystical symbol, *Time* makes other allusions to religion through their use of color and language. For instance, the word "TIME" appears in gold leaf at the top of the cover, as though it were part of a medieval Christian painting. Though they are not all gold-leafed, the title, "The God Gene," the double helix, and "TIME" are all gold. If we consider Williamson's notion of transference, which according to Gillian Rose, "suggests that one of the most subtle ways in which signifieds are transferred by images is in their use of colour," then the color gold on this *Time* cover is imbued with holy power, and by extension, so is the double helix.<sup>74</sup> The cover is also mostly blue, a historically symbolic color used in Christian art to denote the holy or those in positions of power. Text on the cover reads, "Does our DNA compel us to seek a higher power? Believe it or not, some scientists say yes." This language also suggests that DNA is equivalent to a soul; it speaks to our humanity, in that we are endlessly seeking answers to questions regarding our existence.

Popular images associated with DNA also suggest that science has replaced religion as a means of obtaining answers to such existential questions, as can be seen in the *Time* cover from 2006, "God Vs. Science," (figure 11). Again, the double helix is visualized as both icon and symbol. The iconic double helix is represented with color-coded base-pairs<sup>75</sup> whose helices transform into a rosary— a string of beads used for prayer in Catholicism. In this cover

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<sup>74</sup> Rose, 124.

<sup>75</sup> Base-pairs are the proteins Adenine, Guanine, Thymine, Cytosine, often characterized as the letter A-T-C-G in the genetic code. Base pairs are often color-coded in educational science texts, but also in science reports and in popular deployments.

the double helix acts as a symbol, representing both the tension between, and merging of, science and religion. Both the “God Gene,” and “God Vs. Science” *Time* covers use overtly religious symbolism in order to convey the notion of sacred DNA, that DNA is both godlike and responsible for life itself.

In “Deanimations: Maps and Portraits of Life Itself,” critical theorist Donna Haraway takes a cue from anthropologist Sarah Franklin, and names the gene as the chief actor in the drama of life.<sup>76</sup> She suggests that the gene is an “autotelic and self-referential” entity capable of offering “secular salvation” in the game of life.<sup>77</sup> Following Sarah Franklin’s discussions surrounding “life itself,” Haraway asserts that “‘Life,’ materialized as information and signified by the gene, displaces ‘Nature,’ preeminently embodied in and signified by old-fashioned organisms.”<sup>78</sup> Like Nelkin and Lindee, she is arguing that the gene, visualized as information, has come to signify life itself. Consequently, not only do genes play a dominant role in the secularized creation science of contemporary technoscience, they also produce maps and portraits of technoscientific bodies. These consequences are evident in the nine *Time* magazine covers which visualize the double helix in a way that places DNA at the center of life itself. On one hand, the double helix has a place in the biblical creation story of Adam and Eve, and on the other hand, genes produce the human subject, visualized as technoscientific bodies of genetic information. The semiotic substitutions that are occurring at various levels on the magazine covers are characteristic of Donna Haraway’s notion of gene fetishism,

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<sup>76</sup> Donna J. Haraway is an American Professor Emerita in the History of Consciousness Department and Feminist Studies Department at the University of California, Santa Cruz, United States.

<sup>77</sup> Haraway, “Deanimations,” 182-83. Haraway refers to the gene as an autotelic entity, which is a “self-replicating auto-generator.” She argues that from the point of view of the gene they are not really parts of a whole, that instead, they are a “thing-in-itself.” [Is this quote from the pages cited or another section of the article?

<sup>78</sup> Haraway, “Deanimations,” 183. According to Haraway, in “Life Itself,” from *Global Nature, Global Culture*, “Informed by Foucault on biopower and the history of the concept of life, Franklin analyzes how nature becomes biology, biology becomes genetics, and the whole is instrumentalized in particular forms.”

wherein genes and information are substituted for the human body.<sup>79</sup> In fact, Haraway explicitly states that fetishists are invested in these substitutions.<sup>80</sup>

Symptomatic of gene fetishism, images of the double helix on the *Time* covers demonstrate the transformation of DNA into a cultural “phallus-substitute.” Haraway invokes Freud, arguing that images of DNA, particularly the double helix, have replaced the phallus, becoming a phallus-substitute. She argues that the gene fetishist knows that DNA is just a symbol for life itself, and that there is more complexity, “or at best, a simplification that degenerates into a false idol.”<sup>81</sup> Haraway identifies scientists working in the field of technoscience, such as those who are involved in mapping the genome, as possible gene fetishists.<sup>82</sup> According to Haraway, gene fetishists are so taken with the phallus-substitute that they begin believing that it is the code for life, effectively adopting a biologically reductive point of view. Haraway suggests that this sort of fetishism is the result of the value placed on commodities. Furthermore, in “Deanimations: Maps and Portraits of Life Itself,” Haraway synthesizes an argument that not only acknowledges DNA as an icon, supporting Lindee’s and Nelkin’s claims that it has come to connote something god-like and sacred, but also addresses the commodification of DNA and its effect on the cultural perception of human bodies.

### **Socially and Scientifically Problematic Representations**

*Time* has certainly contributed to the proliferation of iconic and symbolic images of the double helix. The collection of *Time* covers discussed here chronicle scientific breakthroughs in

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<sup>79</sup> Haraway, “Deanimations,” 190.

<sup>80</sup> I will discuss gene fetishism at greater length in Chapter Three.

<sup>81</sup> Haraway, “Deanimations,” 189.

<sup>82</sup> This term can be extended to anyone that participates in gene fetishism, such as those genomic companies distributing genetic ancestry and health reports to consumers, as well as the consumers who see such reports as providing insight into their identities.

genetics, placing DNA at the center, as a super-icon. Images of the double helix on these covers suggest that DNA and the gene are biological entities as well as symbols for life-itself with the referent as the individual or God. By suggesting that DNA has an authoritative claim on reality and that it is solely responsible for personality traits, diseases, and intelligence, the images on covers are complicit in assigning biologically reductive meanings to DNA and the gene. Drawing on Donna Haraway's observations about the gene, my research suggests that biological reductionism is a form of gene fetishism, which "involves 'forgetting' that bodies are nodes in webs of interactions."<sup>83</sup> The objective simplicity of biological explanations to existential questions surrounding life make them both attractive and dangerous.<sup>84</sup>

Anker and Nelkin point not only to the rhetorical work of the gene, but also situate reductionism within the horrific history of human categorization in the sciences of Western culture. According the *Oxford Reference*, biologically reductive arguments have been used "to explain observed differences in group behavior—such as performance on intelligence tests, rates of mental illness, intergenerational poverty, male dominance or patriarchy, and propensity for crime—as being biologically determined, by claiming that groups have different biological capacities or evolutionary trajectories."<sup>85</sup> In her 1988 essay, "Life Story: The Gene as Fetish Object on TV," Sarah Franklin argues that though this sort of genetic essentialism is not new and was popular with the Eugenics movements of the past, "what is new is the amount of resources and interest being focused on the gene, and the new goal of corporate enterprise and techno-scientific discovery which is gene power."<sup>86</sup>

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<sup>83</sup> Donna Haraway, "Deanimations," 186.

<sup>84</sup> Nelkin and Lindee, *DNA Mystique*, 16.

<sup>85</sup> "biological reductionism," *Oxford Reference*, last accessed April 24, 2019, <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095507137>.

<sup>86</sup> Sarah Franklin, "Life Story: The Gene as Fetish Object," 97.

More than 30 years after Franklin's essay was written, we are in a much different techno-scientific landscape—one where the gene has been commodified to such an extent that any person can easily order an at home genetic health or ancestry test for \$99 with the click of a button. As consumers, we are encouraged to participate in the fun activity of genetic testing and are given the responsibility and burden of interpreting and understanding the results, which becomes a problem when most popular public understanding or knowledge of genetics is limited to the social meaning of DNA. From my perspective, it is irresponsible, at the very least, for *Time* to continue to deploy images of DNA in ways that support and perpetuate genetic essentialism, particularly in the face of new technologies such as direct-to-consumer genetic tests. In fact, genomic companies, like 23andMe, rely on genetic essentialism in the marketing of their genetic ancestry and health tests.

## Chapter Three

### 23andMe and the Myth of Genetic Essentialism

Having established DNA as a super-icon in the previous chapters, the next two chapters analyze both the verbal text and images of DNA that are commonly used by the direct-to-consumer genetic testing industry and, more specifically, by genomics company, 23andMe. My analysis looks directly at 23andMe's marketing strategies, as 23andMe is one of the most notable genetic testing companies on the market that offers both genetic ancestry and health testing services. This chapter analyzes images from genetic ancestry testing results and customer testimonials on 23andMe's website. Genetic ancestry testing looks at patterns of genetic variation that are shared among people of certain backgrounds.<sup>87</sup> According to The National Institute of Health (NIH), genetic ancestry testing enables people who are interested in genealogy and family history to learn more, supplementing the information they may have already gathered via historical documentation and conversations with relatives.<sup>88</sup> The popularity of genetic ancestry tests reflects a cultural desire for identity, seeing that the gene has become a cultural icon, symbolizing identity—as both the unique individual and the socially-connected self.

23andMe's results pages feature individualized genetic reports or portraits that are visualized as geographical and genetic maps and tie the consumer to broad and specific cultural groups. Such images fetishize the gene by substituting individual human bodies with representations of genomic and geographical maps. A critical analysis of these images in 23andMe's promotional materials reveals problematic and essentialist assumptions surrounding

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<sup>87</sup> "What is Genetic Ancestry Testing?" U.S. National Library of Medicine, National Institute of Health website, accessed April 1, 2019, <https://ghr.nlm.nih.gov/primer/dtcgeneticstesting/ancestrytesting>.

<sup>88</sup> "What was the Human Genome Project?" U.S. National Library of Medicine, National Institute of Health website, accessed May 28, 2018, <https://www.genome.gov/12011238/an-overview-of-the-human-genome-project/>.



the complex relationship between notions of identity, genetics, kinship, race, and ethnicity in the Euro-American West. In addition, by drawing on Roland Barthes's notion of myth, this chapter aims to show that 23andMe's genetic ancestry portraits function as a second order semiological system that deploys the myth of discoverable identity through genomic testing. In fact, drawing on Christine Hauskeller's argument in her article, "Genes, genomes and identity. Projections on matter," I argue that images deployed on the results pages of 23andMe's ancestry test also reference genetics in ways that reify cultural notions of individual and group identity. By providing some historical context, including an overview of Barthes's "Myth Today," and of genetic ancestry testing, I hope to expose the myth deployed by 23andMe's genetic ancestry testing services.

### **Direct-to-Consumer (DTC) Genetic Testing and 23andMe**

The rise of genetic ancestry testing, along with other forms of direct-to-consumer (DTC) genetic testing, was made possible by the work completed by the Human Genome Project (HGP). The HGP was a collaborative research program "whose goal was the complete mapping and understanding of all the genes of human being, [the human genome]." <sup>89</sup> The HGP successfully sequenced the first human genome in 2003. <sup>90</sup> In addition to the advances in the field of genomics, the early 2000s was also marked with an emerging direct-to-consumer genetic testing market that has culminated in the past few years with a burgeoning market—and 23andMe alone has over ten million customers. <sup>91</sup>

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<sup>89</sup> "What was the Human Genome Project?" U.S. National Library of Medicine, National Institute of Health, accessed May 28, 2018, <https://www.genome.gov/12011238/an-overview-of-the-human-genome-project/>.

<sup>90</sup> "What was the Human Genome Project?"

<sup>91</sup> "About Us," 23andMe website, last accessed April 24, 2019, <https://mediacenter.23andme.com/company/about-us/>.

The NIH, an agency of the United States Department of Health, defines direct-to-consumer genetic tests as “genetic tests that are marketed directly to consumers via television, print advertisements, or the internet.”<sup>92</sup> According to the NIH, genetic tests have traditionally been available “through healthcare providers such as physicians, nurse practitioners, and genetic counselors.”<sup>93</sup> DTC genetic testing offers an alternative to the traditional model and provides consumers access to their genetic information without involving healthcare providers. In an article regarding the commercial strategies of DTC genetic testing services, PD et al. argue that these “companies seem to be trying to define a new space between medicine and consumer culture.”<sup>94</sup> In fact, there are a wide array of genomic testing services available that are not limited to health-related testing.

Presently, online “consumer genomics” companies use genome-wide scanning and sequencing technologies to provide their customers with a variety of ‘personalized’ genetic profiles, offering genealogical and health testing services.<sup>95</sup> According to bioethicists, Anders Nordgren and E. T. Juengst, these services fit into one of three categories. The first category they describe is genealogical and non-health related, which provides information regarding ancestry, ethnicity, “paternity, extended relationships and individual uniqueness.”<sup>96</sup> The second category they identify aims to improve health, “in indirect ways, through nutrition and lifestyle.”<sup>97</sup> The final category of testing companies offers health-risk or disease-risk testing, which complements or informs medical care. Nordgren and Juengst note that many companies are blurring the lines between these categories; 23andMe is one such company, offering both health-related testing and

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<sup>92</sup> “What is direct-to-consumer genetic testing?” *NIH*, accessed March 28, 2018, <https://ghr.nih.gov/primer/testing/directtoconsumer>.

<sup>93</sup> *Ibid.*

<sup>94</sup> Pascal Ducournau et al., “Direct-to-Consumer Health Genetic Testing Services: What Commercial Strategies for Which Socio-ethical Issues?” *Health Sociology Review* 22, no. 1 (2013): 77.

<sup>95</sup> Nordgren and Juengst, 157.

<sup>96</sup> A. Nordgren and E. T. Juengst, 158.

<sup>97</sup> Nordgren and Juengst “Can genomics,” 158.

ancestry testing. For instance, their services test for wellness, offering lifestyle suggestions (i.e. providing diet and sleep suggestions for people “with your genetics”), and also test for carrier status, which identifies inherited disease-related genetic markers.<sup>98</sup>

The DTC market continues to grow and global industry analysts project that it will be worth more than \$230 million by the end of 2018.<sup>99</sup> Genome sequencing has become increasingly accessible and affordable, and “consumer genomics” tests have gained mainstream popularity.<sup>100</sup> 23andMe is one of the most notable genomics companies in the market—and the first to receive FDA authorization for a direct-to-consumer genetic test.<sup>101</sup> Founded in 2006, 23andMe launched its first product in 2007 for \$999. Since then the price of their testing services has dropped dramatically and consumers are now able to purchase the genetic ancestry test online for only \$99, and the package health and ancestry test for \$199.<sup>102</sup> In 2017, the popular genomics company hit a milestone, surpassing 2 million genotyped customers. It is evident that 23andMe has run a successful marketing campaign, having earned over 10 million customers to date.<sup>103</sup>

23andMe’s marketing and design strategy takes its cues from Swiss style graphic design, a style associated with corporate branding from the 1960s and 1970s. The style often utilized

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<sup>98</sup> [https://permalinks.23andme.com/pdf/samplerreport\\_wellness.pdf](https://permalinks.23andme.com/pdf/samplerreport_wellness.pdf)

<sup>99</sup> Pascal Su, “Direct-to-Consumer Genetic Testing: A Comprehensive View,” *Yale Journal of Biology and Medicine* 86, no. 3 (2013): 359-65.

<sup>100</sup> A. Nordgen and E.T. Juengst, “Can genomics tell me who I am? Essentialistic rhetoric in direct-to-consumer DNA testing,” 158. As a point of clarification, the terms “genomics” and “genetics” are often used interchangeably, and it’s worth noting that there is a distinction as I’ll be using both terms. The field of genetics tests specific heritable genes with the goal of understanding how they function. The field of genomics, on the other hand, looks at the entire genome, taking into account how genes interact with one another in the genome. 23andMe offers genome wide-scanning services and looks at the entire genome, but also utilizes genetic tests, as in the case with their ancestry test.

<sup>101</sup> “About Us,” 23andMe website. 23andMe received FDA authorization for the following genetic test in 2015: carrier status report for Boom’s syndrome. Furthermore, in 2017, they were “granted the first ever FDA authorization to market direct-to-consumer Genetic Health Risk reports, including tests for Alzheimer’s and Parkinson’s disease.”

<sup>102</sup> Ibid.

<sup>103</sup> Ibid. Of those customers, 23andMe has estimated that each individual contributes to an average of 200 different research studies.

large areas of blank space, is highly legible and functional; their design not only utilizes a sans serif typeface, but is also clean, organized, and readable. Their branding relies most heavily on aestheticized images of DNA as brightly colored and simplified chromosomes. In fact, their logo is an image of an x-shaped metaphase chromosome in magenta and lime green. 23andMe's design also organizes simplified images of chromosomes in a grid-like fashion. For example, chromosomes are arranged in a long line of pairs, with each chromosome donning colorful stripes that denote genes, on their packaging and web homepage. Their logo, branding and design are very much on message, both making sense for a company that analyzes the genome for specific genes, and one that is named for the 23 chromosomes that make up the human genome

### **Essentialist Rhetoric in DTC Genetic Tests**

Bioethicists Anders Nordgren and E.T. Juengst propose that if we consider genetic essentialism as an ideology that holds “the view that our genomes do intrinsically define our personal identities, as secular substitutes for the ‘soul,’” we can begin to understand why consumer genomics companies, such as 23andMe, are able to attract consumers.<sup>104</sup> In their article, “Can genomics tell me who I am? Essentialist rhetoric in direct-to-consumer DNA testing,” Nordgren and Juengst investigated “consumer genomics companies through the lens of identity.”<sup>105</sup> By analyzing the companies’ websites and online testimonials, Nordgren and Juengst found that many of these companies appealed to “a kind of ‘genetic essentialism.’”<sup>106</sup> One way that consumer genomics companies do this is through the use of personalized pronouns in their company names. For instance, “me” is used in 23andMe’s company name. Nordgren and

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<sup>104</sup> A. Nordgren and E.T. Juengst, “Can genomics tell me who I am?” 157.

<sup>105</sup> Nordgren and Juengst, “Can genomics,” 157.

<sup>106</sup> Nordgren and Juengst, “Can genomics,” 157.

Juengst also found that companies with broad testing services, such as 23andMe, perpetuate genetic essentialism in very explicit ways, suggesting that “personalized” results will provide clients with fundamental philosophical insights into their identities. 23andMe says that ‘By tapping into advances in DNA analysis and offering education, tools, and expertise, we at 23andMe want to help others take a bold, informed step toward self-knowledge.’<sup>107</sup>

These sorts of claims are pervasive in 23andMe’s web presence. For instance, the image on 23andMe’s box for their genetic ancestry testing services (fig. 18) includes text that says, “Discover where your DNA is from,”—and the results summary page for the ancestry test (figure 19) opens with the line, “Your DNA tells the story of who you are and how you’re connected to populations around the world.” 23andMe, like many genomics companies, explicitly and implicitly link genetics and various aspects in their advertising. Characteristic of many genetic ancestry companies, 23andMe also claims that it can provide a greater sense of belonging and connection in this individualistic society that we live in. Because there are “risks related to identity that arise in online DNA testing,”<sup>108</sup> as Nordgren and Juengst argue in their essay, it is important to expose the biologically reductive myth of genetic essentialism, which 23andMe relies on in order to sell and market their tests.

Roland Barthes’s “Myth Today,” which applies the concept of myth to advertising images, provides a clear method for examining and exposing genetic essentialism as a myth. In “Myth Today,” from *Mythologies*, Barthes discusses myth by way of “a kind of Marxian semiology of mass culture and everyday life.”<sup>109</sup> He begins the essay by defining myth as “a type

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<sup>107</sup> Nordgren and Juengst, “Can genomics,” 159.

<sup>108</sup> Nordgren and Juengst, “Can genomics,” 158.

<sup>109</sup> *Ibid.*, 1458.

of speech,”<sup>110</sup> that is, a system of communication. According to Barthes, myth is a kind of message, mostly defined by the way in which it is delivered rather than by its object. Myth can consist of “modes of writing or of representations,” including photography, cinema, and advertisements, in addition to oral speech.<sup>111</sup> In this way, myth is also not defined by its material. He makes these distinctions clear in order to point out that when talking about myth, “we are dealing with *this* particular image, which is given for *this* particular signification.”<sup>112</sup> Barthes notes that mythical speech is possible, and that pictures deploying myths are meaningful, because a system and history is already in place which allows the message to be understood and the ideology to become salient. In the case of images of genes, the history of the gene as a scientific, cultural and rhetorical object, enables its use as a symbol for life-itself. Barthes states that mythology studies “ideas-in-form,”<sup>113</sup> arguing that it can be studied as a historical science with an ideology or formal science, with a semiological system.

Barthes also recognizes that myths are pervasive in popular culture and that the messages deployed are often political in nature, designed to benefit the already powerful wealthy class and further reinforced by media.<sup>114</sup> Barthes regards myth as particularly threatening or dangerous due to its ability to naturalize the concept, or ideology.<sup>115</sup> He warns that the myth consumer reads myth as a factual system.<sup>116</sup> Additionally, according to political theorist, Andrew Robinson, “Barthes claims that dominant institutions lull us into believing that the current system is

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<sup>110</sup> Roland Barthes. “Myth Today.” In *Mythologies*, translated by Annette Lavers, 109-158. (New York: The Noonday Press, 2001), 109.

<sup>111</sup> Ibid, 110.

<sup>112</sup> Ibid.

<sup>113</sup> Ibid, 112.

<sup>114</sup> Richard Brody, “The Uses of ‘Mythologies’,” *The New Yorker*, accessed April 18, 2018, <https://www.newyorker.com/culture/richard-brody/the-uses-of-mythologies>

<sup>115</sup> Roland Barthes, 128-131.

<sup>116</sup> Ibid, 131.

natural."<sup>117</sup> In other words, myth disguises itself as "innocent speech," by portraying things as natural and eternal.<sup>118</sup> The essentialist rhetoric in 23andMe's website acts as mythical speech, naturalizing genetic essentialism with statements like the ones mentioned earlier, "Your DNA tells the story of who you are," "Learn about your relatives" and "Your DNA has more to say," (fig.22). These statements suggest that not only are you your DNA, but that it holds answers to certain existential questions, such as "where do I come from?" and "why am I here." The use of this rhetoric is effective due to the already existing *DNA Mystique*, which I discussed in the first two chapters—and following that logic, DNA fits within a system and history that places it at the center of life.

### ***Naturalizing Genetic Essentialism using Genetic Portraits***

The essentialistic rhetoric used in 23andMe's marketing is reinforced through their use of visual images. 23andMe is able to effectively conflate individual and group identity with genomic information by visualizing the body using geographical and genetic maps. In fact, as illustrated in figures 19 through 22, 23andMe uses images of chromosomes, genes, and maps as the predominant way of communicating ancestry results to their consumers.

In line with their branding and packaging, one way that 23andMe visualizes the human body as a genetic map is through the use of images of chromosomes. Figure 22 is an illustrative example of an anonymous individual's ancestry results; here, 23andMe has created an "Ancestry composition chromosome painting," made up of 23 pairs of chromosomes, using that individual's DNA. The colorful stripes on the chromosomes denote genes. Critical to Haraway's spliced argument in "Deanimations," is the idea that "Nature is known and remade as Life

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<sup>117</sup> Andrew Robinson, "Roland Barthes's Mythologies: Naturalisation, Politics and Everyday Life," *Ceasefire Magazine*, accessed May 29, 2018, <https://ceasefiremagazine.co.uk/in-theory-barthes-3/>.

<sup>118</sup> Roland Barthes, "Myth Today," 131.

through cultural practice figured as technique within specific proprietary circulation.”<sup>119</sup>

Similarly, life is known and remade as genes. Haraway’s essay illuminates a Barthesian mythical structure that displaces nature, organisms, humans and nonhumans with genes. By creating a genetic portrait of an individual using only images of chromosomes, 23andMe displaces people “as generators of liveliness,” with images of genes on chromosomes.<sup>120</sup> According to Haraway, fetishism is defined by these sorts of substitutions. Haraway asserts that “fetishes obscure the constitutive tropic nature of themselves and of worlds. Fetishes literalize and so induce an elementary material and cognitive error. Fetishes make things seem clear and under control.”<sup>121</sup> Haraway’s observation places fetish alongside Barthes’s notion of myth that naturalizes ideologies in similar ways.

Another way that 23andMe substitutes genes for humans is through visualizations of maps. In figures 19 -21, 23andMe provides results to the consumer in the form of geographical maps and timelines that trace ancestors across time and space. Haraway notes that that like the gene, which is a literal thing-in-itself that gets mistaken for the nonliteral world, maps can also be fetishized. Haraway considers geographical maps to be “embodiments of multifaceted historical practices among specific humans and nonhumans . . . [and] models of worlds crafted through and for specific practices of intervening ways of life.”<sup>122</sup> For Haraway, those maps that are fetishized appear to be literal “metaphor-free representations” of an existing world that has been quantitatively recorded with “‘absolute’ dimensions like space and time.”<sup>123</sup>

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<sup>119</sup> Donna Haraway, “Deanimations,” 183.

<sup>120</sup> Donna Haraway, “Deanimations,” 183.

<sup>121</sup> Donna Haraway, “Deanimations,” 184. Haraway’s use of the term trope refers to the “nonliteral quality of being and of language.”

<sup>122</sup> Donna Haraway, “Deanimations,” 184.

<sup>123</sup> Donna Haraway, “Deanimations,” 184.



In figure 19, 23andMe communicates “Ancestry Composition” with a world map. The map is a minimal gray and white, with color-coded regions corresponding to the consumer’s ancestry composition. In this image, ancestry composition is visualized in three distinct ways: as the geographical map, as a key or index with corresponding numerical percentages, as a pie-chart with the consumer’s initials at the center. Considering the text accompanying this image, “Your DNA tells the story of who you are and how you’re connected to populations around the world,” this image qualifies as a fetishized map, or mythical speech, with multiple substitutions occurring. 23andMe fetishizes by deploying images of maps and statistical charts and numbers alongside essentialistic rhetoric and suggesting that these images are factual and literal representations of reality—and these representations do not consider, for example, how the color-coded regions are determined or certain populations are disproportionately represented in the databases. The oversimplification and fetishization of maps has a powerful impact on the formation of subjects and objects, which is concerning when we consider that maps, and other modes of spatialization in general, are “power-laced” processes that are determined with certain purposes in mind by those in positions of power.<sup>124</sup>

In addition to geographical maps, which are a kind of spatialization of land, Haraway names gene mapping a kind of spatialization of the body, or “corporealization.”<sup>125</sup> Haraway defines corporealization as “the interaction of humans and nonhumans in the distributed, heterogonous work processes of technoscience.” Though geographic maps represent land, the maps in figures 19 and 20 are also function as examples of corporealization. The geographical maps are a means of representing the consumer’s body as a composite of thousands of years’ worth of ancestors. The geographical maps in these figures are a substitution for genetic maps

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<sup>124</sup> Donna Haraway, “Deanimations,” 184.

<sup>125</sup> Donna Haraway, “Deanimations,” 185.

obtained by analyzing consumers' DNA samples. Similarly, genetic maps are a reductive substitution for human bodies, which are in actuality, far more complex than gene fetishists would have us believe.

23andMe references genetic maps and appeals to gene fetishism more explicitly in figure 22, titled "Your Ancestry Composition Chromosome Painting." The figure illustrates a sort of gene map in the form of a column of 23 turquoise-colored chromosomes stacked on top of one another. In the chromosome painting, genes, or more specifically, genetic variants, are denoted by bands of varying blue color. Like figure 19, with the color-coded geographical map, this figure contains a key left of the image; the key identifies several ancestry groups or populations, each with a corresponding blue color. Despite their differing modes of representation, figures 19 and 22 illustrate essentially the same ancestry composition information. For example, in these two figures, the analyzed data determines the consumer to be 91.3% Eastern European and 0.6% Scandinavian. Images of chromosomes are deployed for their fetishized value. Genes, as phallus-substitutes and symbols of life-itself, are the ultimate fetishized objects. According to Haraway, this kind of gene fetishism rests on the denial of all the natural-social articulations and agentic relationships among researchers, farmers, factory workers, patients, policy makers, molecules, model organisms, machines, forests, seeds, financial instruments, computers, and much else that bring 'genes' into material-semiotic being.<sup>126</sup> Ultimately, substituting maps for human bodies communicates the myth of genetic essentialism by literally reducing the body to geographical information.

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<sup>126</sup> Donna Haraway, "Deanimations," 187.

## **Kinship, Ancestry, Race and Ethnicity**

The substitution of maps for human bodies in 23andMe’s personalized ancestry results, also reveals problematic assumptions surrounding the complex relationship between psychological notions of identity, specifically “the individual’s belonging to a family or group.”<sup>127</sup> For instance, in figure 18, some of the accompanying text states that the test can, “trace parts of your ancestry to a specific group of individuals,” and the map in figure 20 is titled, “Migrations of your maternal line.” In this example, 23andMe’s personalized maps and genetic portraits focus on uniqueness, offering an individualistic vision of personal identity, while the text addresses “communitarian visions of personal identity.”<sup>128</sup> Nordgren and Juengst note genomics companies “that use ancestry tracing” encourage “customers to frame their identity issues in terms of the question, ‘who is your tribe?’” They argue that this offsets the focus on individualism because “as the Existentialists pointed out, individualism can be alienating and uniqueness can be lonely. Here, genetic ancestry testing and social networking suggest a way out.”<sup>129</sup>

Consequently, 23andMe also encourages its customers to network using their ancestry results. In figure 18, 23andMe alludes to family connection and social networking with a column of three graphics to the left of the 23andMe box. The first graphic, labeled “Your DNA Family,” is an image of three people, identical in shape and linked at the arms, but differentiated with color. The second graphic, labeled “DNA Relative Finder” is an icon of a man with a word bubble. The word bubble has an ellipsis which resembles the ellipses when someone is in the process of responding to a text message. The accompanying text encourages users to “opt-in” and “connect with people who share DNA with you – and message them.” The third graphic is

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<sup>127</sup> Hauskeller, 287.

<sup>128</sup> Nordgren, 159.

<sup>129</sup> Nordgren, 160.

an icon of a family, presumably two parents and a child, with the text “share and compare.” All of these images highlight the implied social value of the ancestry test, in an increasingly pluralistic world where traditional notions of identity such as “family, ethnicity and religion” have been challenged.<sup>130</sup>

23andMe avoids culturally loaded terms like race and ethnicity and is careful to only reference consumers’ results as “ancestry” results providing insight regarding heritage and connected “populations.” Despite 23andMe’s explicit use of the term *ancestry*, the testimonials indicate that there is confusion among consumers regarding what sort of insight the test can really provide, and, more specifically, confusion about what ancestry and ethnicity are. This is not surprising as the terms *ancestry*, *race*, *ethnicity*, and *nationality* are culturally entangled with one another and one often brings another to mind. The conflation of such terms is problematic, because as Nordgren and Juengst point out, “Genetic evidence is used commonly to fix prevailing patterns of origin, race, ethnicity or disease. The reference to genes essentializes these traditional schemes of classification.”<sup>131</sup> Although the terms are often used interchangeably, it is important that consumer know they have distinct meanings.

### **Ethnicity and Nationality**

“Ethnicity” appears to be a relatively new term, first appearing in the *Oxford English Dictionary* in 1972. The term derives its meaning from the Greek word *ethnos*, meaning “people” or “tribe.”<sup>132</sup> In her essay on ethnicity, Vivian Ibrahim points out that the term is often associated with Edward Said's notion of the “other” and that the usage of the term “has been

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<sup>130</sup> Nordgren and Juengst, “Can genomics,” 161.

<sup>131</sup> Christine Hauskeller, “Genes, genomes and identity,” 291.

<sup>132</sup> Vivian Ibrahim, “Ethnicity,” in *The Routledge Companion to Race and Ethnicity*, ed. Caliendo and Mellwain (New York: Routledge, 2011), 12.

subject to much discussion and variation,” particularly because its usage has implications surrounding power dynamics between ethnic majority and minority communities, creating an “us” versus “them.”<sup>133</sup> She argues that from the viewpoint of the social sciences, which is concerned with how “ethnic attributes” become converted into “ethnic communities,” that sociologist Max Weber's definition is useful. According to Ibrahim, Weber suggested that ethnic groups were socially constructed, defining them as “human groups . . . who cherish a belief in the common origins of such a kind that it provides basis for creation of a community.”<sup>134</sup>

Despite this, Weber recognized that in addition to ethnic membership, historical circumstance was also "responsible for the mobilization of certain political and social movements" and the emergence of an ethnic community.<sup>135</sup> Consequently, Weber viewed “nationalism as an extension of the ethnic community as members and leaders searched for a unique political structure by establishing an independent state.”<sup>136</sup> Weber's idea of nationality is reflected in the dictionary definition, which defines it as either “State or quality of being a nation; racial, political, or institutional solidarity constituting a nation.”<sup>137</sup> By these definitions, 23andMe can hardly provide the answer regarding ethnicity. For one, the test provides information about “populations” which they have decided upon—and that vary depending on the brand of test being used. The populations 23andMe lists are “regional populations based on reference datasets representing 45 populations;” they are both regional (e.g. Eastern European) and country populations (e.g. Poland); it is worth noting that nation borders have not been historically static. Secondly, if the test provides the consumer with a result that their ancestry is,

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<sup>133</sup> Ibid.

<sup>134</sup> Ibid, 13.

<sup>135</sup> Ibid.

<sup>136</sup> Ibid.

<sup>137</sup> “Nationality,” in *Webster's New International Dictionary of the English Language*, ed. William Allan Neilson, Thomas A. Knott and Paul Carhart, 2nd ed. (Springfield, MA: G. & C. Merriam Company, Publishers, 1935), 1629.

for example, 80% Irish, it will not automatically result in inclusion in the Irish community, especially if that person has been born and raised in the United States and does not know anyone in that community.

## **Ancestry**

Though genetic ancestry testing is not an appropriate means for determining ethnic or national identity, according to the NIH, it can “provide clues about where a person's ancestors might have come from and about relationships between families. Certain patterns of genetic variation are offer shared among people of particular backgrounds. The more closely related two individuals, families, or populations are, the more patterns of variation they typically share.”<sup>138</sup> In short, genetic ancestry tests group people by shared differences. In “The politics of DNA: What if anything does genealogical history of our DNA reveal about our race and ancestry,” Christine Keneally argues that DNA studied by genetic historians are records only of ancestry and they do not provide us with information about what a person will look like or behave. Nor does DNA give us insight into a person’s life. Instead, Keneally states that segments of DNA “tell us that groups once existed that, for whatever reason, lived together long enough so that they ended up with genetic commonalities.”<sup>139</sup> This distinction is important in understanding what the results of ancestry tests actually convey.

23andMe does a poor job of maintaining the distinction between ethnicity, nationality, and ancestry, as evidenced in customer testimonials and the website’s use of geographical maps. First of all, the inclusion of testimonials works against the seemingly careful language that is used throughout most of 23andMe’s website regarding ancestry and its definition. The

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<sup>138</sup> “What is direct-to-consumer genetic testing?” NIH U.S. National Library of Medicine, last modified April 11, 2018. Accessed March 28, 2018. <https://ghr.nlm.nih.gov/primer/testing/directtoconsumer>

<sup>139</sup> Keneally, “The Politics of DNA,” 22.

testimonials and stories for the ancestry test use terms that refer to nationality, ethnicity, religion, and family when discussing the benefits of ancestry testing; those cultural descriptions are used interchangeably for ancestry. The testimonials are formatted with a small profile picture of the individual who is sharing their story, a headline, a large eye-catching quote, and a short story written in third person with quotes. The profile pictures are what you'd imagine would be used for a social media account, and they are of smiling and personable looking individuals. Next to the image is a small descriptor. For example, figure 24 is an image of a young woman with the textual label "adoptee finds answers." In this story, the adoptee, Megan, states that "everyone assumed I was Hispanic." The story in figure 24 describes an emotional experience of discovery for the adoptee. After receiving her results, the story states "now Megan knows she is part Irish, part Scandinavian, and part African. And she has some Native American ancestry as well." In this short testimonial, nationality, ethnicity, culture and ancestry are used in a way that implies they share the same meaning.

Similarly, in figure 25, the testimonial describes a man named Francisco who was raised Lutheran, though he never really felt a connection to Christianity. His DNA results revealed Jewish ancestry and after tracing his ancestors' migration, "he found his family escaped persecution by hiding their religion. 'I finally had evidence,' he said. Francisco celebrates his new-found cultural identity." In this story, 23andMe is making claims that family is discoverable via genetic tests, reinforcing the view that family is something that is biological, what Lindee and Nelkin refer to the "molecular family" in the DNA Mystique. Moreover, 23andMe suggests that ancestry can help inform the consumer of their true religion—and, in service to genetic essentialism and the sale of their tests, makes the false claim that cultural identity is discoverable by using their ancestry test. The confusion regarding the meaning of ancestry is unsurprising,

especially considering that the results are provided in the form of world maps, with ancestry populations defined by nation borders, or broad cultural regions.<sup>140</sup>

The testimonials and geographical maps also produce a leveling of cultural experience. Revealing that we all have a common place of origin strips people of their very rich histories and of their experiences, turning them from *sense* to *form*. In fact, it exemplifies the way in which myth is depoliticized speech. Barthes defines political as “describing the whole of human relations in their real, social structure, in their power of making the world.”<sup>141</sup> By depoliticizing notions surrounding nationality, ethnicity, and identity, myth is emptying the complexities from reality. This sort of leveling is done visually using timelines as in figure 21, and migration patterns over time in figure 20.

In “Recuperating Ethnic Identity through Critical Genealogy,” Christine Scodari critiques and examines genealogy-themed television through the lens of race, postcolonial and other critical theory. She argues that genetic ancestry tests produce a leveling effect, suggesting that we are all pilgrims.<sup>142</sup> It cannot be argued that the experience of a native American ancestor was the same as that of a slave ancestor or even an Anglo-Saxon ancestor. Scodari also cites a scholar who “maintains that genetic notions of kinship cannot appreciate how people 'understand their attachments to one another.’”<sup>143</sup>

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<sup>140</sup> Buried in multiple subpages of 23andMe’s “Customer Care,” is a page dedicated to “Understanding Your Ancestry Composition Results.” Here, 23andMe discusses the different regions and populations and how they are determined. According to their website, they reference 45 populations.

<sup>141</sup> Barthes, “Myth Today,” 143.

<sup>142</sup> Christine Scodari, “Recuperating Ethnic Identity through Critical Genealogy,” *Journal of Multi disciplinary Research* 8, no. 1 (2016): 47-62.

<sup>143</sup> *Ibid*, 55.



## Conclusion

It is apparent that the experience of learning about ancestral origins can be fun and feel significant to the consumer. However, the 23andMe makes irresponsible claims regarding the efficacy and social value of the test results, which geneticist David Reich cautions about, stating, "For those who assume that personal ancestry testing results have the authority of science, it is important to keep in mind that many of the results are easily misinterpreted and rarely include the warnings that scientists attach to tentative findings."<sup>144</sup> He also notes that data sets are still too incomplete for certain regions of the world to provide reliable results, although they do produce approximate results. 23andMe perpetuates and naturalizes the myth of genetic essentialism with customer testimonials and images of geographical and genetic maps supplanting human bodies. Though they seem aware that the term ancestry is conflated with cultural notions of identity such as ethnicity, family, and even race, 23andMe still names the populations using already established names of nations and broad ethnic and cultural groups.<sup>145</sup> By deploying images of maps, with clearly demarcated and labeled regions and populations, 23andMe encourages the consumer to identify with broad and separate cultural groups or populations that they have determined.

As a biotech company, 23andMe should exercise more caution and transparency regarding the results their genomic tests produce. According to Lindee and Nelkin, "With its emphasis on the natural origins of human difference, genetic essentialism can threaten marginal groups, with its focus on individual pathology, it seems to absolve society of responsibility for

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<sup>144</sup> Reich, *Who We are and How We Got Here*, 269.

<sup>145</sup> The issue of race and ancestry testing was not relevant to the images analyzed in this chapter, though it is incredibly relevant to the discussion of the ethical and social ramifications of ancestry testing in the direct-to-consumer genetic testing market, as ancestry and race are often confused for one another.

social problems.”<sup>146</sup> It is simply not enough to include the pertinent educational and disclaimer material in subpages that are difficult to navigate to, especially because the test results can seriously impact the way that consumers self-identify. As history has shown, biology has a way of illuminating differences and can be used to reify boundaries between various “ethnic” and “racial” groups. Powerful companies like 23andMe exploit our desire for community through what seems like deliberately manipulative marketing strategies that distort complex and nuanced scientific principles; this is all done in order to sell more tests and collect more sellable genetic data (i.e. our personal genetic information). Furthermore, by determining the population boundaries using already established social group names, 23andMe is in a great position of power.

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<sup>146</sup> Lindee and Nelkin, *The DNA Mystique*, 203.

## Chapter Four

### 23andMe and a New Biopolitics

As explored in the previous chapter, the visual marketing and rhetorical strategies of 23andMe's genetic tests on its website perpetuate the myth of genetic essentialism. This myth, coupled with the growing trend towards healthism, enables 23andMe to capitalize on consumers' curiosity about themselves. In fact, 23andMe has over 10,000,000 customers, with approximately 80 percent opting into research, and presumably voluntarily submitting their DNA; this is alarming given that many consumers are submitting their DNA as either a fun activity or to learn some larger truth about themselves.<sup>147</sup> This chapter explores how 23andMe's genetic health tests are being visually represented and marketed, and what they say about the power of knowing one's individual genetic information. I will be examining several images found on the 23andMe website, most located on the "How It Works" page, using Foucault's theories surrounding biopower and biopolitics. A critical examination of these images reveals current ethical questions regarding the new and rapidly growing market of DTC genetic tests.

#### Direct-to-Consumer (DTC) Health Testing

In 2016, 136 companies were identified as providing "some form of health related testing service."<sup>148</sup> Health testing includes health-risk or carrier testing and nutrigenic testing.<sup>149</sup>

23andMe provides the most comprehensive service and offers the following tests:<sup>150</sup> genetic

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<sup>147</sup> 23andMe, "About Us," accessed on March 25, 2019, <https://mediacenter.23andme.com/company/about-us/>.

<sup>148</sup> Philips, "'Only,'" 3.

<sup>149</sup> Ibid.

<sup>150</sup> Lu, Menfei, Cathryn M. Lewis, and Matthew Taylor, "Pharmacogenetic Testing Through the Direct-to-Consumer Genetic Testing Company 23andMe," *BMC Medical Genomics* 10, no.1 (2017): 2.

health risks, ancestry, wellness, carrier status and traits.<sup>151</sup> These tests are not diagnostic, and while the genetic health risks test and carrier status test both meet FDA requirements, the results only indicate potential risk of a certain disease or trait, indiscriminately, insufficiently weighing risk.

On their webpage regarding DTC genetic testing, the NIH makes sure to note that there are “significant” limitations and risks of at-home tests, stating “Consumers are vulnerable to being misled by the results of unproven or invalid tests.”<sup>152</sup> The NIH acknowledges that there are other factors, in addition to genetics, that affect a person’s risk of developing a disorder such as environmental factors and lifestyle choices.<sup>153</sup> They suggest that guidance from a healthcare provider is beneficial when making significant decisions regarding ones health, particularly when those decisions are “based on inaccurate, incomplete, or misunderstood decisions about their health.”<sup>154</sup> In fact, one of the criticisms surrounding the tests is their incompleteness. The genetic analysis is not comprehensive—many disorders have several associated markers, and current tests do not test for all of the markers. Another criticism is the “lack of weight of risk on the basis of strong-effect versus weak-effect genomic markers and odds ratios.”<sup>155</sup> Following FDA scrutiny in 2013, 23andMe has responded to some of these criticisms. For instance, in the “How it works” page under the *Our Science* heading on the website, 23andMe acknowledges that DNA can only give us partial insight regarding health risk and traits. Similarly, they respond to questions regarding consumer comprehension and appropriate intervention of medical

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<sup>151</sup> “DNA Genetic Testing & Analysis,” *23andMe*, accessed April 2, 2018, [www.23andme.com](http://www.23andme.com).

<sup>152</sup> “What is direct-to-consumer genetic testing?” accessed March 28, 2018, <https://ghr.nih.gov/primer/testing/directtoconsumer>.

<sup>153</sup> *Ibid.*

<sup>154</sup> *Ibid.*

<sup>155</sup> Baudhun, L. M., “The FDA and 23andMe: Violating the First Amendment or Protecting the Rights of the Consumers?” *Clinical Chemistry* 60, no.6 (2014): 835-37.

professionals and encourage users to talk to a healthcare professional to aid in making informed healthcare decisions.<sup>156</sup>

Despite the risks and limitations of at-home genetic tests like 23andMe, and the recent FDA intervention, DTCs continue to gain popularity and media is inundated with advertisements and commercials for these tests. According to Ducournau et al., there are several explanations for the popularity of DTC genetic tests, including but not limited to the following: DTC genetic tests respond to the postmodern quest for individual identity;<sup>157</sup> there is an overall cultural trend towards healthism; and the popularity is indicative of “a cultural motivation toward ‘do-it-yourself’ American ethic.”<sup>158</sup> It seems that DTC genetic testing companies have taken on the burden of answering complicated questions surrounding identity—and their marketing suggests that their test can provide consumers with the answer to the number one question of who we are.

Furthermore, DTC genetic testing companies also imply that the consumer is being responsible with their health by taking the test. 23andMe advertises with slogans such as “You have one body. Take care of it.”<sup>159</sup> That particular tactic is referred to by some scholars as a risk framing strategy, which is “used by companies to convince the consumer that it is important for them to know their genetic risk.”<sup>160</sup> According to the Mayo clinic, DTC genetic testing companies use marketing strategies that overstated the value of their products and “their potential to improve personal health.”<sup>161</sup> In a recent article regarding marketing strategies of these biotech companies, Pascal Ducournau et al insist that the proposed risk-framing strategy would not be possible without an already existing social concern for genetic risk— “these

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<sup>156</sup> “DNA Genetic Testing & Analysis,” *23andMe*, accessed April 2, 2018, [www.23andme.com](http://www.23andme.com).

<sup>157</sup> Ducournau, “Direct-to-Consumer,” 77.

<sup>158</sup> Allyse, “Direct-to-Consumer,” 115.

<sup>159</sup> “DNA Genetic Testing & Analysis,” *23andMe*, accessed April 2, 2018, [www.23andme.com](http://www.23andme.com).

<sup>160</sup> Ducournau, “Direct-to-Consumer,” 76.

<sup>161</sup> “How genetic disorders are inherited,” *Mayo Clinic*, accessed March 28, 2018, [web](http://www.mayoclinic.org).

rhetorics can be embedded in ‘social ways of thinking’ underlying their construction.”<sup>162</sup> In other words, the risk-framing strategy works because it exploits an existing cultural concern for health. As a result, it can be argued that DTC genetic companies are engaging in a new biopolitics. Through his genealogical examination of biopower and biopolitics, Foucault provides a historical account for the concern of societal health, or population health.

### **Foucault: biopower and a self-regulating society**

Foucault introduces the notion of biopower and biopolitics in “Right of Death and Power Over Life,” the last chapter of *The History of Sexuality*. Foucault begins discussing the technologies of power, biopower and biopolitics by examining sovereign power over individuals and society. He notes that monarchies exercised power using discipline and violence, sometimes sentencing individuals to death. In this sense, the *right of death* from the chapter title is as Foucault puts it, is “the ancient right to take life or let live.”<sup>163</sup>

Foucault notes that the *right of death* was eventually replaced with the concept of *power over life*, following the cultural adoption of capitalism. The *power over life* was the state’s power “to foster life or disallow it to the point of death.”<sup>164</sup> Foucault argues that people were not freed from oppressive power in this new system, rather the old form of power had just been replaced with a new one that was heavily invested in the lives of its citizens. He argues that the state “endeavors to administer, optimize, and multiply it [the population], subjecting it to precise controls and comprehensive regulations”<sup>165</sup>—and according to Foucault, doing so would also have beneficial consequence for the state. By ensuring the population’s health, the state would

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<sup>162</sup> Ducournau, “Direct-to-Consumer,” 77.

<sup>163</sup> Michel Foucault, *The History of Sexuality, Volume 1: An Introduction*. (NY: Vintage Books, 1990), 138.

<sup>164</sup> *Ibid.*, 138.

<sup>165</sup> *Ibid.*, 137.

prevent depopulation and provide a steady “supply of manpower for [the] military.”<sup>166</sup> He suggests this is evidenced by the correlation between decreasing number of death penalty cases and an increasing number of wars and war-related deaths.

Following the historical account provided by Foucault in “Right to Death and Power Over Life,” Foucault discusses biopolitics and biopower more explicitly—interestingly, *The History of Sexuality* is one of the only times he does so. Foucault notes that beginning in the seventeenth century, the *power over life* took one of two forms: (1) “disciplines: an anatomicopolitics of the human body” and (2) “regulatory control: a biopolitics of the population.”<sup>167</sup> The first form “centered on body as the machine: its disciplining, the optimization of its capabilities, the extortion of its forces,...its integration into systems of efficient and economic control.”<sup>168</sup> In contrast, biopolitics is concerned with the species body and the subsequent control and regulation of the population at the biological level (i.e. “health, hygiene, birthrate, life expectancy, race...”<sup>169</sup>).

In the *Birth of Biopolitics*, contrary to the title, Foucault focuses on the tangent of governmentality rather than biopolitics and biopower. He notes that population is at the core of all of the problems that he is trying to identify and that it forms the basis for biopolitics. In order to grasp the meaning of biopolitics, he suggests an examination of the “governmental regime called liberalism.”<sup>170</sup> Coined by Foucault, governmentality is the combination of the terms “government” and “rationality.” According to the *Encyclopedia Britannica*, “government in this sense refers to conduct”—taking form in leading, directing, and self-governance, or the “conduct

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<sup>166</sup> Mark Kelly, “Michel Foucault (1926-1984),” *Internet Encyclopedia of Philosophy*, accessed March 28, 2018, <http://www.iep.utm.edu/foucault/>.

<sup>167</sup> Foucault, *History*, 139.

<sup>168</sup> *ibid.*

<sup>169</sup> Michel Foucault, *The Birth of Biopolitics Lectures at the College De France, 1978-1979*, ed. Michel Senellart. (New York: Palgrave Macmillan, 2008), 317.

<sup>170</sup> Foucault, *Birth*, 22.

of oneself.”<sup>171</sup> Rationality is a form of thinking which strives to order and define systems. In the context of these definitions, governmentality is then the system by which government defines, categorizes, manages and controls populations.<sup>172</sup> It is worth noting that this system of governmentality includes a self-regulating element, wherein the population internalizes “the norms whereby they were controlled”<sup>173</sup> and begins monitoring, in the case of biopolitics, their own health.

### **DTC + Government**

Ducournau et al suggest that DTC testing signals a move toward individualized biopolitics and liberal governmentality. They argue that this new biopolitics is “a break from past forms of biopolitics that Foucault describes as being coercive,”<sup>174</sup> particularly because power is shifting from medical institutions to the individual. Contrary to this perspective, I suggest that DTC genetic testing today reinforces Foucault’s notion of biopolitics. First and foremost, while DTC tests can be completed at home by an individual without the direct intervention of a health professional or institution, DTC genetic tests are subject to government regulation, specifically the FDA. In fact, “in 2006, the US Government Accountability Office (GAO) launched an investigation into the practices of DTC genetic testing companies.”<sup>175</sup> Their reports found that the companies used deceptive marketing and “other questionable practices.”<sup>176</sup> The FDA responded accordingly, notifying DTC companies “that their products constituted medical

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<sup>171</sup> Richard Huff. “Governmentality,” *Encyclopædia Britannica*, last modified May 31, 2013 and accessed March 28, 2018. <https://www.britannica.com/topic/governmentality>.

<sup>172</sup> Ibid.

<sup>173</sup> Gutting, Gary Gutting. *Foucault: A Very Short Introduction*. (Oxford: Oxford University Press, 2005), 96.

<sup>174</sup> Ducournau, “Direct-to-Consumer,” 83.

<sup>175</sup> Allyse, “Direct-to-Consumer,” 116.

<sup>176</sup> Ibid., 117.



devices that had not been submitted to the FDA for approval”<sup>177</sup> in 2010 and sending cease and desist letters in 2013.<sup>178</sup> 23andMe was able to survive scrutiny from the FDA and was one of the first companies to embrace the new model of regulated DTC tests, which the Mayo Clinic refers to as *DTC 2.0*. Unlike the old DTC 1.0 model, this model required analytical validation and user comprehension. Furthermore, there was to be “greater separation between health and entertainment.”<sup>179</sup>

Not only is the government imposing new regulations on DTC genetic tests, it is also offering support in the form of grants. According to Reuters, in 2014, 23andMe “secured a \$1.4 million two-year grant from the National Institute of Health (NIH) to build survey tools and expand its gene database.”<sup>180</sup> 23andMe plans on using the genetic information from the database for additional research projects.<sup>181</sup> In *The History of Sexuality*, Foucault suggests that the recording and storing of data sets describing populations is a form of population control.<sup>182</sup> As evidenced by recent FDA involvement in the DTC genetic testing industry, simply shifting health testing to the private sector does not mean that it can function independently of the government or state. Moreover, the DTC industry is inextricably tied to capitalism and profits from their gene database, in addition to their test kits. Regarding capitalism, Foucault argues that bio-power is instrumental to the development of capitalism, which “would not have been possible without the controlled insertion of bodies into the machinery of production and the

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<sup>177</sup> Ibid.

<sup>178</sup> Ibid., 116-117.

<sup>179</sup> Ibid., 118.

<sup>180</sup> Christina Farr, “23andMe Lands \$1.4 Million Grant From NIH to Detect Genetic Roots for Disease,” *Reuters*, last modified July 29, 2014 and accessed March 28, 2018. <https://www.reuters.com/article/us-healthcare-23andme/23andme-lands-1-4-million-grant-from-nih-to-detect-genetic-roots-for-disease-idUSKBN0FY2IM20140729>.

<sup>181</sup> Ibid.

<sup>182</sup> Foucault, *History*, 140.

adjustment of phenomena of population to economic processes.”<sup>183</sup> In this view, the “insertion of bodies” is the genetic information of consumers.

### **23andMe and a New Biopolitics**

DTC genetic testing companies are not governmental institutions; they are, however, subject to government regulation, support and partnership. Therefore, it is appropriate to apply Foucault’s theories to these testing services. In “What commercial strategies for which socio-ethical issues,” Ducournau et al compared 42 DTC genetic testing companies, analyzing rhetorically the marketing language of these health tests. I would like to expand their analysis to cover the visual language of images used. I will be analyzing images, specifically those found on the “How It Works” page of the 23andMe website, scrolling from top to bottom and using the lens of biopolitics and biopower.

In the last chapter, I briefly analyzed the packaging for the 23andMe test in order to illustrate the various meanings tied to representations of DNA, noting the colorful, eye-catching representations of chromosomes and the biological reductionism of the statement, “welcome to you.” This statement can also be thought of in terms of genetic essentialism and, in this way, 23andMe is “claiming to provide knowledge about your essential self.”<sup>184</sup> The image in figure 27 pictures a half-opened 23andMe box supplemented with the text, “It’s just saliva. No blood. No needles.” Like the box in the first image, this box contains images of chromosomes, albeit a distinct style of chromosomes. The chromosomes here are arranged in an orderly and systematic way. They are paired (likely to suggest one chromosome from each parent) and they are striped—these stripes indicate alleles or genes, markers for genetic traits. These colorful images

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<sup>183</sup> Ibid., 141.

<sup>184</sup> Ducournau, “Direct-to-Consumer,” 82.

of chromosomes refer to someone's DNA in a scientific yet playful and visually attractive manner.

The text also suggests that the consumer does not need to go to the doctor, that they are qualified to run the test themselves. This statement empowers the user, who is left feeling like a scientist about to discover his or her genetic make-up. Ducournau et al. refers to this strategy in the context of a growing trend of *medicalization*. They state, "Not only do these tests provide a relatively novel 'geneticisation' of certain facets of social life, they also pursue the growing trend of social medicalization...causing biomedical competence to extend into multiple fields of the individual and collective arena it had never before invested."<sup>185</sup>

In addition to medicalization, these scholars suggest that DTC genetic testing companies are basing their services on the growing trend of *healthism*, "a major cultural, political and ideological evolution of modern-day societies enshrining health as one of our most treasured values."<sup>186</sup> Moreover, the authors note that testing services such as 23andMe have secured a niche market of "diseases of civilization" and "their marketing techniques are designed to intensify this sanitary concern through the skillful precepts of 'healthism; and the exploitation of ensuing fears."<sup>187</sup> This phenomenon is consistent with Foucault's notion of biopolitics and its emphasis on regulation of the species body or population, or, to put it another way, the emphasis on the health of the population. Furthermore, by encouraging ideologies and trends such as healthism and medicalization, the image in figure 29, encourages self-regulation of the population, a goal in technology of governmentalization described by Foucault. Similarly, the image at the bottom of figure 29 denotes a chromosome and connotes identity, while the text

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<sup>185</sup> Ibid., 80.

<sup>186</sup> Ibid., 81.

<sup>187</sup> Ibid.

encourages self-regulation- “It’s simple.” The text also suggests it is a more attractive and less invasive experience than one would have at the doctor’s office.

In fact, the thumbnail image for the instructional video on this same page shows just how easy and pain free it is. The image is of a woman holding the sample tube—this image uses a new approach compared to the previous image. First, it is indexical rather than iconic and contains a photograph of a person. The photograph only shows the woman’s face from the nose down, thus providing anonymity while still being very human and personal, suggesting reliability. Furthermore, although companies like 23andMe want to project images that connote scientific and medical legitimacy, these companies often use a type of marketing that focuses on the social cultural aspect of their test to avoid or escape scrutiny from the FDA by not marketing their products as medical devices. An avoidance of the scientific aspect of the test is more prevalent in commercials advertising DTC genetic tests like 23andMe or AncestryDNA.

An opposite strategy is utilized in figure 28, which appeals to the scientific validity of the test. This image uses a few legitimacy or trust markers: including biohazard bag and sticker, the image of the collection tube disassembled as parts, and a set of instructions. The biohazard symbol is a very common trust marker or symbol—it is used to designate dangerous materials and used by research and medical institutions, including the CDC. The collection tube and bar code suggest the empirical nature of the test. And finally, the instructions include diagrams and drawings of people and the product which are depersonalized and very clinical in appearance—this strategy appeals to a population, or individuals, in general rather than a specific individual.

23andMe continues to make reference to population in the next image (fig.31). The image contains a circle filled with identical green icons of individuals and units. Among the many green figures, is one that is striped and blue, still identical in shape—signifying the *unique*

*you*. The text says, “Accelerating research. Making an impact.” In this way, 23andMe is appealing to consumers with the promise of “co-production.”<sup>188</sup> With images and rhetoric such as this, the HSR article points out that, “at the risk of genetic ‘reductionism’—companies highlight the capacity for innovation and self-determination that individuals gain as a result of using their services.”<sup>189</sup> DTC companies, such as 23andMe are substituting “a vision of genetics mostly dominated by biological determinism [...] with the concept of indeterminism indeterminism and individual control over our sanitary destiny.”<sup>190</sup> Users are encouraged “to become actors in human genetic research,”<sup>191</sup> rather than simply being data providers. In fact, users are told that they can make an impact on research with their genetic data. Again, from a Foucauldian perspective, the recording and use of genetic data from individuals willingly supplying their own biological material to private companies constitutes an oddly consensual form of population control.

### **A Brief Note Regarding Ethics**

In addition to the risk of naturalizing identity, one of the ethical issues that physicians shared dealt with the responsibility of companies to provide valid tests that are not misleading and that patients can understand. This makes sense as a concern, since physicians have an ethical responsibility to their patients. Prior to FDA intervention, DTC companies did not have any explicitly stated responsibility towards the users of their tests, which were likely defined as customers rather than patients. However, the image in figure 32 addresses the issue of accountability and responsibility that 23andMe has towards the user of their testing services.

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<sup>188</sup> Ibid., 83.

<sup>189</sup> Ibid., 81.

<sup>190</sup> Ibid.

<sup>191</sup> Ibid., 83.

A list of assurances for the user or consumer is featured in the image in figure 32. 23andMe identifies its accreditations and insist that their reports are “based on well-established scientific and medical research.”<sup>192</sup> They also make sure to point out that their Genetic Health Risk and Carrier status reports meet FDA requirements (i.e. the reports are scientifically and clinically valid). Following the cease and desist order in 2013, 23andMe has made sure to comply with FDA regulations, and this image not only provides trust markers for the consumer, it also demonstrates 23andMe’s cooperation with the FDA. Physicians were also concerned about the lack of counseling offered by DTC genetic testing services. 23andMe seems to have responded to this criticism as well by encouraging and suggesting counseling services.

Privacy and security are discussed in the final two images (figures 33 and 34). Again, these topics seem to be in response the ethical issues and concerns that come along with the responsibility of storing and having access to private individual data. The inappropriate disclosure or use of individual data, specifically genetic information, was in fact one of the concerns that prompted the GAO investigation. In a related image (figure 15) 23andMe contends that privacy is their priority, that they will not share “individual data without your explicit consent,”<sup>193</sup> and in the last image (figure 34) they assure us that their databases are encrypted for the protection of your identity. Privacy, however. is a much more complicated issue than they lead you to believe in this image. The website includes a lengthy “terms of service” section that contains additional links to additional information regarding your privacy. In short, it seems that they will provide companies, such as genomic research laboratories, with access to their database regardless of user consent if the identifying information such as name and address have been removed, making the data anonymous. Having read through the terms, I am still not certain if I

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<sup>192</sup> “DNA Genetic Testing & Analysis,” *23andMe*, accessed April 2, 2018, [www.23andme.com](http://www.23andme.com).

<sup>193</sup> *Ibid.*

understood them fully, and my experience is not unusual; overcomplicated and lengthy terms of service can be easily glossed over or misunderstood by consumers. Most often, terms of service are not read. Despite this, it seems that 23andMe is trying to be responsible and transparent.

## Conclusion

In *The History of Sexuality*, Foucault introduced new technologies of power to his scholarship, biopower and biopolitics. Through his genealogical examination of biopolitics, Foucault was able to identify a potential starting point for the governmental concern for public or population health at the beginning in the seventeenth century, wherein the *right of death was with the power over life*, or as Foucault puts it, “the function of administering life.”<sup>194</sup> He notes that the new *power over life* was organized around “the disciplines of the body and the regulations of the population,”<sup>195</sup> and this became the basis for what he later would term biopower and biopolitics. By biopolitics, Foucault was referring to the regulation of the population via government institutions, such as medical institutions, and he suggests that biopower can manifest in the self-regulation of the population, by which the population normalizes and then implements the measures of control upon themselves.

If we consider the notion of self-regulation as having been embedded in culture for centuries, only to be followed by the emergence of DNA as a super-icon, which has also become embedded in our cultural way of thinking, then it is no surprise that DTC genetic tests have become so popular. However, this form of genetic testing is still in its infancy and it is worth thinking about the ethical ramifications of these tests, particularly within the context of biopower and biopolitics.

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<sup>194</sup> Foucault, *History*, 138.

<sup>195</sup> *Ibid.*, 139.

## Chapter 5

### Conclusion

Since its inception, the concept of the gene has operated as an exemplar of mythical speech—both as a persuasive and “authoritative” scientific figure, pushing research forward, and as a powerful cultural icon, connoting identity.<sup>196</sup> It began as a concept and symbol for life without material form and then the discovery of the structure of DNA gave the concept of the gene a material form to grasp. According to Elizabeth Shea, “The double-helix model of DNA was able to provide mechanistic applications for functions ascribed to the concept of the gene.”<sup>197</sup> Consequently, DNA, the biological entity and cultural icon, is now tied to the concept of the gene. Furthermore, like the gene, DNA can be thought of as a material-semiotic object, or boundary object.<sup>198</sup> Shea argues that the gene can be more easily understood as a flexibly defined thing, with an imprecise definition and multiple meanings. Though DNA is a materially defined biological entity, it still carries multiple meanings, particularly outside of scientific discourse.

Similarly, meanings associated with images of DNA are not limited to scientific discourse. The image of the double helix, for instance, is one of the most well-recognized biological images, and understood for its cultural meaning—identity, life-itself, and God. For this reason, I believe that the double helix functions as a Super-icon, a term that loosely references Mitchell’s hypericon and Lindee and Nelkin’s notion of the supergene. Terming the

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<sup>196</sup> Elizabeth Shea, *How the Gene Got Its Groove*.

<sup>197</sup> Elizabeth Shea, *How the Gene Got Its Groove*, 69.

<sup>198</sup> Elizabeth Shea, *How the Gene Got Its Groove*, 69-70. Shea describes boundary objects as: “those things (sometimes material, sometimes abstract, sometimes both) that allow for cooperation among diverse groups without necessitating consensus about meanings, viewpoints, or goals. The notion of boundary object (along with similar theoretical concepts in social studies of science, such as Haraway’s material-semiotic objects [1997] . . . has become very important and influential in social and cultural studies of science, for it allows for understanding the production of knowledge without assuming a community of homogenous interests.



double helix a Super-icon is also a way of differentiating it from Peirce's notion of the icon, which references its visual likeness to the molecule it represents.

We see that as early as 1971, just three years after James Watson's book *The Double Helix: A Personal Account of the Discovery of the Structure of DNA* was published, the cultural meanings associated with DNA had already taken hold—and that DNA and the gene had become well-established symbols for life and identity.<sup>199</sup> These covers are just one group of visual examples illustrating ways in which genes have become part of our everyday vocabulary. Since beginning this research a couple of years ago, I've noticed just how common comments like "it's in our DNA," are. These comments are frequently made by educated politicians in nuanced arguments, by companies trying to sell a product, in movies having nothing to do with science, by technology companies, etc; the scope of DNA's and the gene's cultural (mis)understanding is extensive. This is all to say that the *DNA Mystique* is quite pervasive and that images of the gene and DNA in the *Time* covers illustrate ways that DNA's cultural meaning has solidified over time, as concept that is imprecise, yet all-encompassing. The discovery of the DNA structure, the double helix, not only legitimated the gene but also become one of the most widely recognized biological images.

The most commonly deployed images of the gene and DNA are of the double helix and chromosomes. Images of chromosomes and the double helix tend to be iconic in the Peircian sense, resembling the thing which they stand for, but also iconic in that they are widely recognized as scientific and biological images. If we consider Peirce's semiotic system, visualizations of the double helix are often deployed as symbols, either replacing human bodies or being replaced by images of human bodies; this allows for connotations associated with the

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<sup>199</sup> James D. Watson, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*, (New York: Touchstone, 1968). A scientific drama, Watson's book characterized not only the excitement of the discovery of the structure of DNA, but also the complex personal relationships at play and the conflicts that arose.

double helix, such as personal identity, to be easily communicated. Many scholars, including Lindee and Nelkin, argue that such images and understandings of DNA are biologically reductive—and in images where the double helix forms bodies, such as the earliest *Time* cover (1971), wherein the man and woman appear out of the double helix, which intertwines with their bodies. In that cover, the human body is literally reduced to a biological concept, DNA in the form of the double helix. This is done even more literally in an image taken from 23andMe’s ancestry results (figure 22), wherein the body is visualized solely as 23 chromosomes.

### **Genetic Essentialism and Gene Fetishism**

The sort of biological reductionism that appears in the *Time* magazine covers and accompanies 23andMe’s marketing is symptomatic of the myth of genetic essentialism prevalent in our culture. Genetic essentialism is an ideology that equates our personal identities with our genomes i.e. our genetic composition. 23andMe relies on this myth of genetic essentialism in order to exploit consumer’s fears, anxieties, and hopes regarding their identity in this rapidly changing world. According to Nordgren and Juengst, there are multiple ways that DTC companies deploy genetic essentialism. The first is through the use of personal pronouns in company names such as 23and(Me). Nordgren and Juengst argue that companies with broad testing services, like 23andMe, suggest that the personalized information from their reports “will provide clients with fundamental philosophical insights into their identities. 23andMe says that ‘By tapping into advances in DNA analysis and offering education, tools, and expertise, we at 23andMe want to help others take a bold, informed step toward self-knowledge.’”<sup>200</sup> Nordgren and Juengst note that DTC companies take varied philosophical approaches when answering how

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<sup>200</sup> Nordgren and Juengst, “Can genomics tell me who I am?” 159. Furthermore, the statement that Nordgren and Juengst quote suggests that it is responsible for clients to take their test.

their test can provide insight into their identities—and 23andMe focuses on both “uniqueness of each individual’s genome and highlight the social connections at networking possibilities that their genetic testing enables. Through their ancestry testing services, 23andMe is able to solve the problem of alienation that uniqueness and individualism can bring.

23andMe, whose logo is comprised of an image of two chromosomes, employs many reductive and *essentialistic* rhetorical strategies in the advertising of their genetic ancestry test; these strategies are visually apparent and made much more salient through the use of genetic imagery and geographical maps. For instance, in figures 19-22, human bodies are replaced with geographical and genomic maps; these maps define a new type of body made up of information, referred to by Haraway as the technoscientific body. Ancestry results and genetic data are represented as a genomic map in figure 22, which supplants the consumer’s body with an illustration of 23 monochromatic chromosomes. The “Ancestry Composition” illustrated in figure 22 does not present any new information from the geographical map in figure 19. In fact, it is simply a repackaging of the same information, a new way to visually substitute human bodies. If we consider Haraway’s arguments in “Deanimations: Maps and Portraits of Life-itself,” these sorts of substitution are symptomatic of gene fetishism. In this instance, 23andMe acts as a gene fetishist, knowing that genes are just symbols for life itself and that actual genes and human bodies are formed through complex interactions.

These sorts of substitutions are biologically reductive and troublesome for a number of reasons. With regards to ancestry tests, there is a risk of distorting the consumers’ “subjective experience of their identities, by providing inadequate or incomplete information.”<sup>201</sup> Moreover, consumer genomics tests can also reinforce existing social boundaries. The ancestry results from figure 19, for instance, represented in the form of a world map, both reinforces cultural

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<sup>201</sup> Nordgren and Juengst, “Can genomics tell me who I am?” 166.

boundaries by naming and color-coding regions and populations. At the same time they are also visually producing a cultural leveling effect with this graphic, suggesting that we are all “pilgrims.”<sup>202</sup> My research indicates that the gene is often deployed by DTC companies for its ability to reduce cultural identity to biology, including complex social relationships such as family, ethnicity, and nationality. However, as these are socially constructed categories, a biological test is absolutely not a guarantor of group membership, nor should it be. Yet, 23andMe continues to suggest that biology can provide the consumer with a new family using misleading testimonials and visual representations of DNA in their advertising.

## **Biopolitics**

23andMe places the individual within a population, by claiming to provide the consumer with a community through their ancestry test. Chapter Four addresses 23andMe’s health test and a new biopolitics, concerned with the health of the population. By examining images from 23andMe’s health test through a Foucauldian lens. I look at the power dynamics between companies like 23andMe, the scientific community, and the consumer. Though it appears that DTC testing is a move toward individualized biopolitics and that power might be shifting from medical institutions to the individual, I argue that power is shifting to corporations and large companies—and in the specific case of my research, to 23andMe<sup>203</sup>. This shift in power is especially problematic considering that as a consumer, responsibility is placed on the individual to monitor and understand their own health results, regardless of their knowledge on the topic.

Another concern that arises is the consumer is not afforded with the same privacy guarantees that is required from a healthcare provider to a patient. The goals of the medical

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<sup>202</sup> Christine Scodari, “Recuperating Ethnic Identity through Critical Genealogy,” *Journal of Multidisciplinary Research* 8, no. 1 (2016): 47-62.

<sup>203</sup> 23andMe is also regulated by the FDA, a governmental institution.

institution are not the same as those of private companies or corporations, whose ultimate goal is profit. In fact, as biopower is instrumental to capitalism, DTC genetic testing is just another means of inserting bodies (i.e. technoscientific bodies and private genetic information from consumers) into the machinery of economic processes.

With DTC tests, biopower has manifested in a way that population is self-regulating for the financial benefit of genomics companies. As with their ancestry tests, 23andMe's health tests rely on essentialistic and manipulative rhetoric and genetic images in order to sell more tests. Genetic images and rhetoric featured on 23andMe's website promote the growing trend of healthism. The strategies used by 23andMe with regards to their health test begins with the deployment of science-related images, such as scientists, biohazard symbols, and the double helix, and a clinical aesthetic, which work together as legitimacy markers to build the company's ethos. In this way, 23andMe is reassuring the customer that their test is scientifically sound. Secondly, they promote healthism by suggesting that it is responsible for the customer to take a health test, asserting that it is empowering and that we should all take our health into our own hands. In this way, they are also promoting self-regulation, a concept Foucault discusses with regards to biopower. That is, there are millions of customers that are voluntarily submitting their DNA to 23andMe, and monitoring their own health.

23andMe also suggests that the consumer is not only being personally responsible but that they are contributing to the greater good by participating in the genetic health test. A graphic used on their website promotes this sort of group mentality very explicitly in figure 31, which pictures an individual in a group or population of similarly shaped non-descript people. The graphic in figure 31 goes a step further with the inclusion of text, which states "Accelerating research. Making an impact." This rhetoric is manipulative, claim that submitting genetic

information is meaningful for the advancement of medicine, and suggesting that the consumer can potentially help the population by contributing to research that could save lives. It is misleading for 23andMe to highlight the idea that private genetic data is going toward important medical research, when in reality it is also being sold to or shared with pharmaceutical, insurance, and other for-profit companies. This data, consisting of DNA fingerprints, is all used at the discretion of the companies and not necessarily for the benefit of the consumer or the larger population.

Not only are there privacy concerns with DTC genetic tests, but there are also ethical concerns regarding the social impact of these tests. With poorly understood DTC genetic results, such as those from 23andMe's ancestry test, comes the possibility of reifying social categories, such as ethnicity and race, harmful to already marginalized groups. Though, I've highlighted only specific visual and rhetorical advertising strategies that 23andMe's uses, my research indicates that these strategies are common for other DTC companies too. In fact, DTC companies rely on the gene's cultural meaning in order to perpetuate the myth of genetic essentialism—and they often exploit consumers' desire for self-knowledge, self-improvement, and community, much like 23andMe.

It is troubling that 23andMe is able to make biologically reductive and essentialistic claims, despite being an FDA regulated testing company. Critics agree that biological explanations for complex existential question can be attractive, not only for their simplicity but also for their seeming definitiveness. But seeing as DTC genetic health tests are not as definitive as they may appear and that we are living in an era where data is a new form of currency, we must be more critical of genetic testing companies, the visual and rhetorical strategies they use in

the marketing of their products, and their overall influence on culture. There is a lot at stake with DTC genetic testing; after all, the gene is a powerful cultural icon.

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## Appendix: Figures

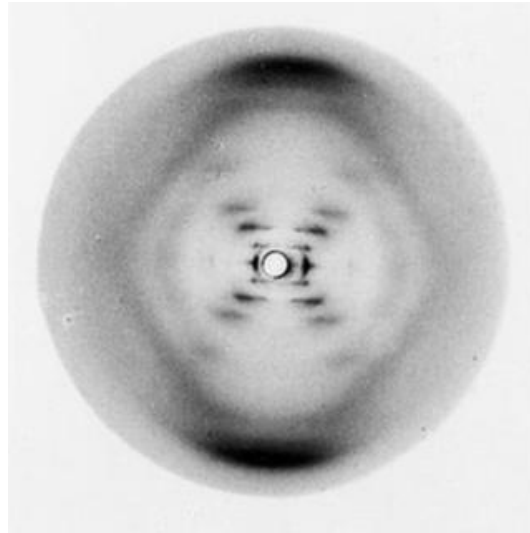


Figure 1. Rosalind Franklin, Photo 51: DNA X-ray diffraction image, 1952. Kings College London. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 02/02/19, <https://www.bbc.com/news/health-18041884>.



Figure 2. A. Barrington Brown, James Watson and Francis Crick with their DNA model at the Cavendish Laboratories in 1953. A. Barrington Brown, Science Photo Library. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 02/06/19, <https://www.sciencehistory.org/historical-profile/james-watson-francis-crick-maurice-wilkins-and-rosalind-franklin>.

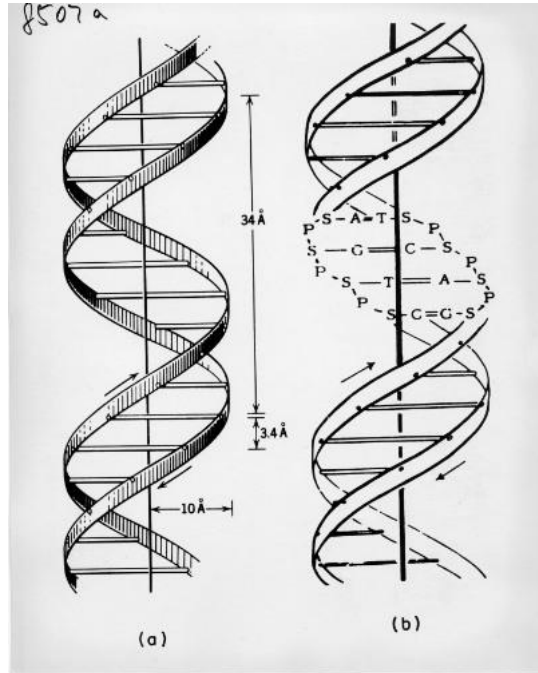


Figure 3. Odile Crick, Untitled (diagrammatic figure of DNA's double helix), 1953; published in *Nature*.  
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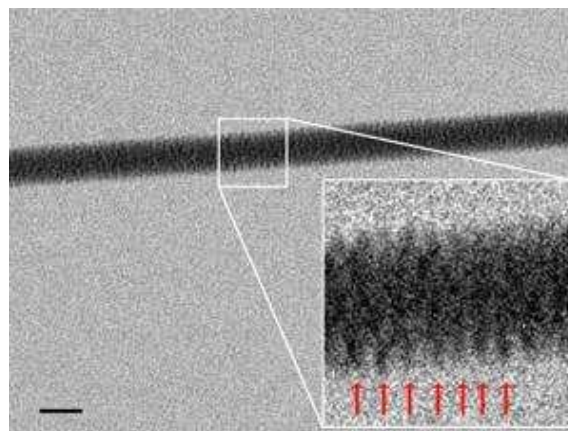


Figure 4. Direct Imaging of DNA Fibers: The Visage of Double Helix, 2012. American Chemical Society.  
 Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 02/06/19,  
<https://www.newscientist.com/article/dn22545-dna-imaged-with-electron-microscope-for-the-first-time/>.

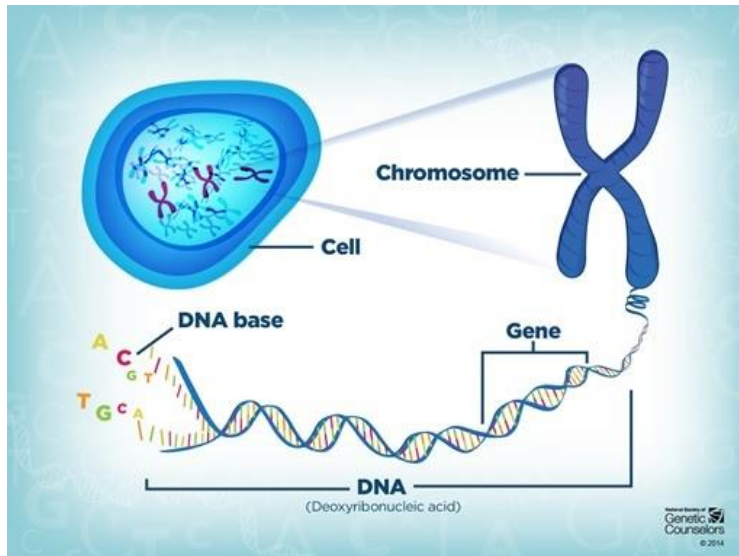


Figure 5. Untitled (Relationship between chromosomes, genes, and DNA), 2014. National Society of Genetic Counselors. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.melbournegenomics.org.au/our-work/about-genomics/what-genomics>.

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ATCCAGGAATTTTCGC
CATAAACCAGGTTTCT
CTCCGCTATTCAGGCA
TAACTACCGTAACATA
AACTTTCCAAATAGCA
TACAGATTTACCCGGA
TACATTTAGGAAAATC
CCAGTACCAGGTTAAA

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Figure 6. Angelica Hay, DNA Sequence Example, 2018.

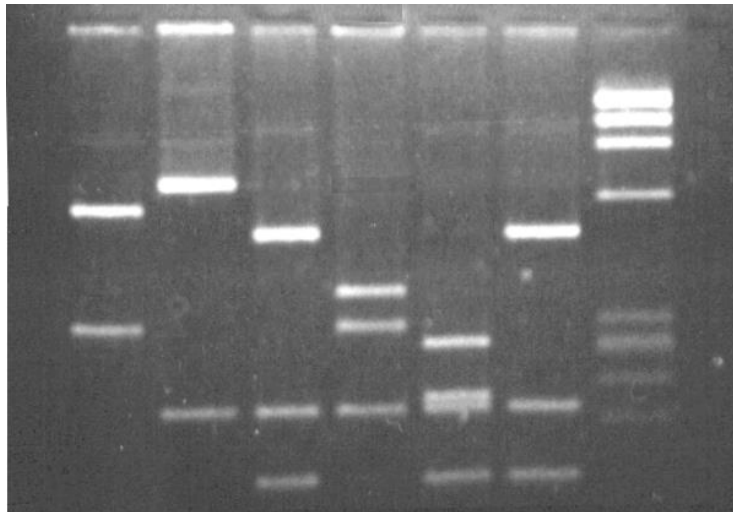


Figure 7. Untitled (DNA gel electrophoresis image), 2012. Steven M. Carr, reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, [https://www.mun.ca/biology/scarr/Gel\\_Electrophoresis.html](https://www.mun.ca/biology/scarr/Gel_Electrophoresis.html).

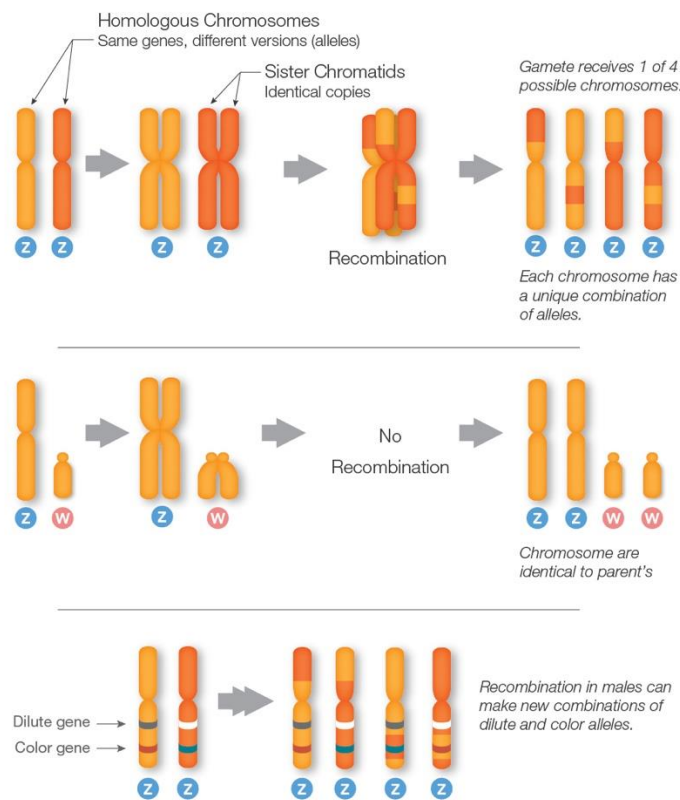


Figure 8. *Untitled* (Chromosome and Chromatids). Genetic Science Learning Center, University of Utah, reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://learn.genetics.utah.edu/content/pigeons/sexlinkage/>.





Figure 9. Cover of *Time* magazine, v. 180, no. 26 (Dec. 24, 2012). Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/23/19, <http://content.time.com/time/magazine/0,9263,7601121224,00.html>



Figure 10. Cover of *Time* magazine, v. 175, no. 2 (Jan. 18, 2010). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/covers/0,16641,20100118,00.html>



Figure 11. Cover of *Time* magazine, v. 168, no. 20 (Nov. 13, 2006). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601061113,00.html>

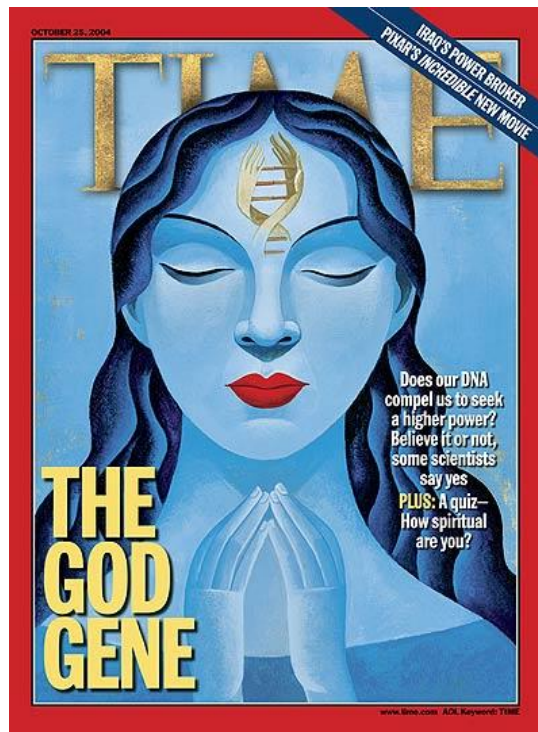


Figure 12. Cover of *Time* magazine, v. 164, no. 17, (Oct. 25, 2004). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601041025,00.html>



Figure 13. Cover of *Time* magazine, v. 161, no. 22 (Jun. 2, 2003). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601030602,00.html>

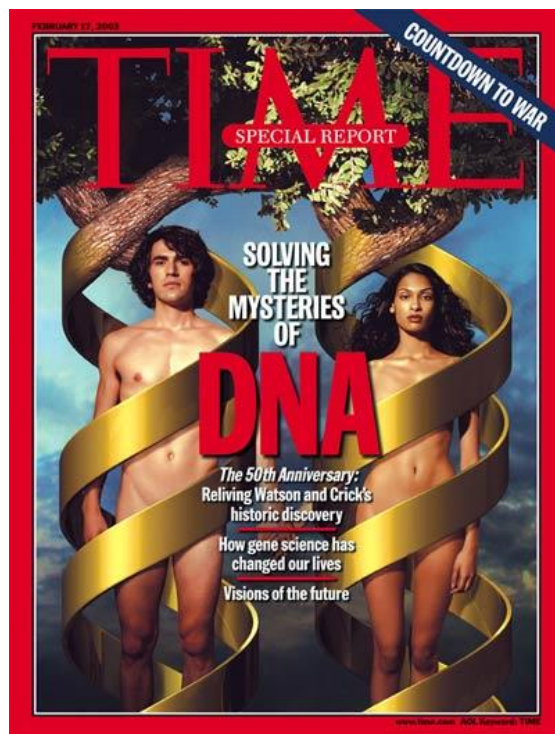


Figure 14. Cover of *Time* magazine, v. 16, no. 7 (Feb 17, 2003). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601030602,00.html>



Figure 15. Cover of *Time* magazine, v. 154, no. 11 (Sept. 13, 1999). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601990913,00.html>

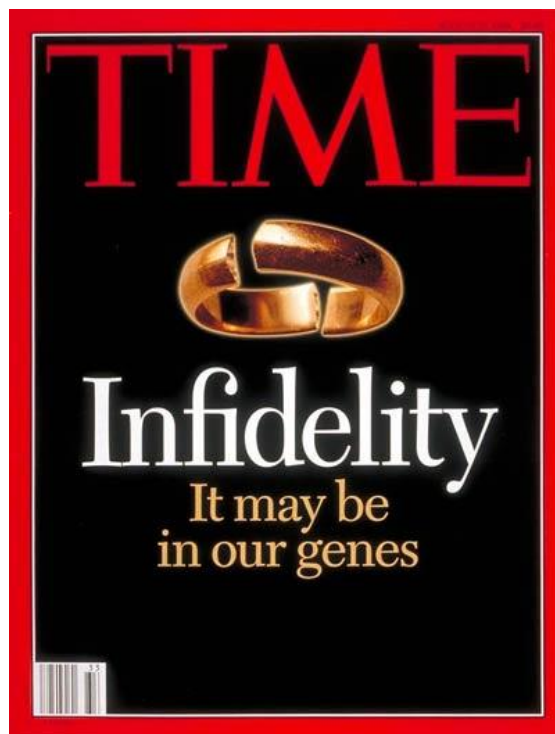


Figure 16. Cover of *Time* magazine, v. 144, no. 7 (Aug 15, 1994). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601940815,00.html>

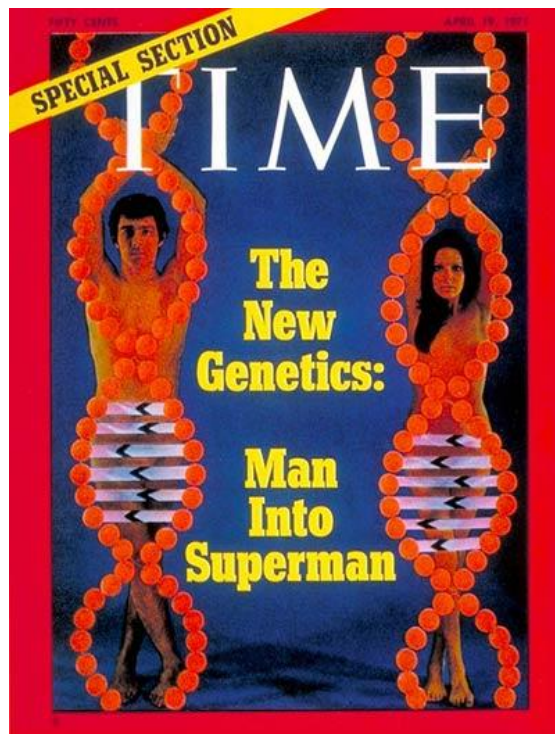


Figure 17. Cover of *Time* magazine, v. 97, no. 16 (19 Apr 1971). Reproduced under *fair-use* (Section 107 of Copyright Act). <http://content.time.com/time/magazine/0,9263,7601710419,00.html>





Figure 18. Packaging of 23andMe ancestry test kit. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com/dna-ancestry/>.

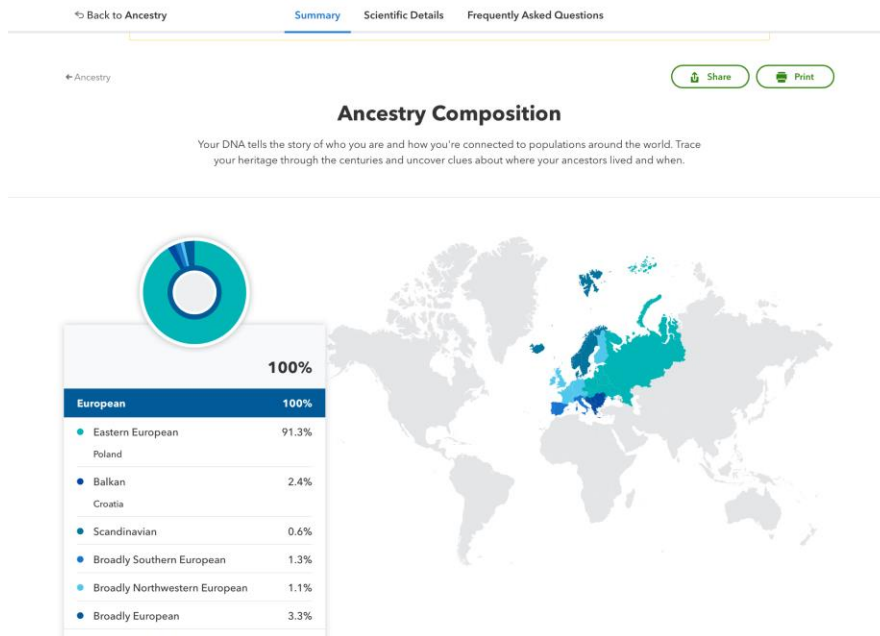
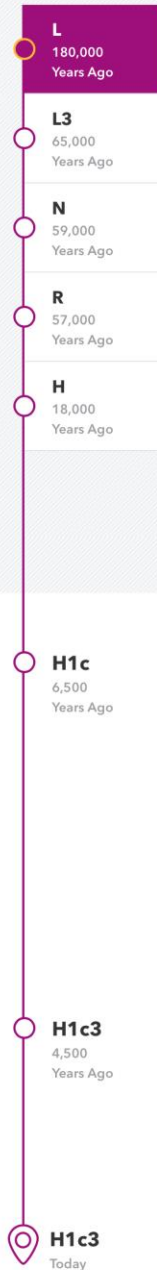


Figure 19. “Anonymous” individual ancestry test results for 23andMe Ancestry direct-to-consumer genetic test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com>.

## Migrations of Your Maternal Line



### Haplogroup L

If every person living today could trace his or her maternal line back over thousands of generations, all of our lines would meet at a single woman who lived in eastern Africa between 150,000 and 200,000 years ago. Though she was one of perhaps thousands of women alive at the time, only the diverse branches of her haplogroup have survived to today. The story of your maternal line begins with her.



### Origin and Migrations of Haplogroup H1c

Your maternal line stems from a branch of H1 called H1c. The common ancestor of haplogroup H1c lived approximately 6,500 years ago in southwestern Europe, where her ancestors had sheltered from the last great cold peak of the Ice Age thousands of years earlier. While she probably lived in southern France or the Iberian Peninsula, her descendants are most frequently found among eastern Europeans. Women carrying H1c journeyed eastward from southwestern Europe, passed north of the Italian Alps and entered present-day Slovakia. From there, H1c spread north throughout the region surrounding the Baltic Sea and the Volga-Ural area of Russia. Members of H1c also moved into southeastern Europe to Ukraine, the Balkans, and the Caucasus Mountains. Today, H1c can be found at low levels throughout Europe.

**Your maternal haplogroup, H1c3, traces back to a woman who lived approximately 4,500 years ago.**

That's nearly 180 generations ago! What happened between then and now? As researchers and citizen scientists discover more about your haplogroup, new details may be added to the story of your maternal line.

**H1c3 is frequent among 23andMe customers.**

**1 in 260**

Today, you share your haplogroup with all the maternal-line

23andMe customers

Figure 20. “Anonymous” individual ancestry test results for 23andMe Ancestry direct-to-consumer genetic test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com>.

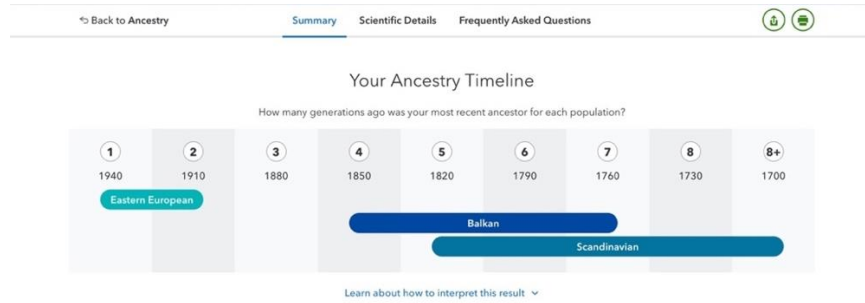


Figure 21. “Anonymous” individual ancestry test results for 23andMe Ancestry direct-to-consumer genetic test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com>.

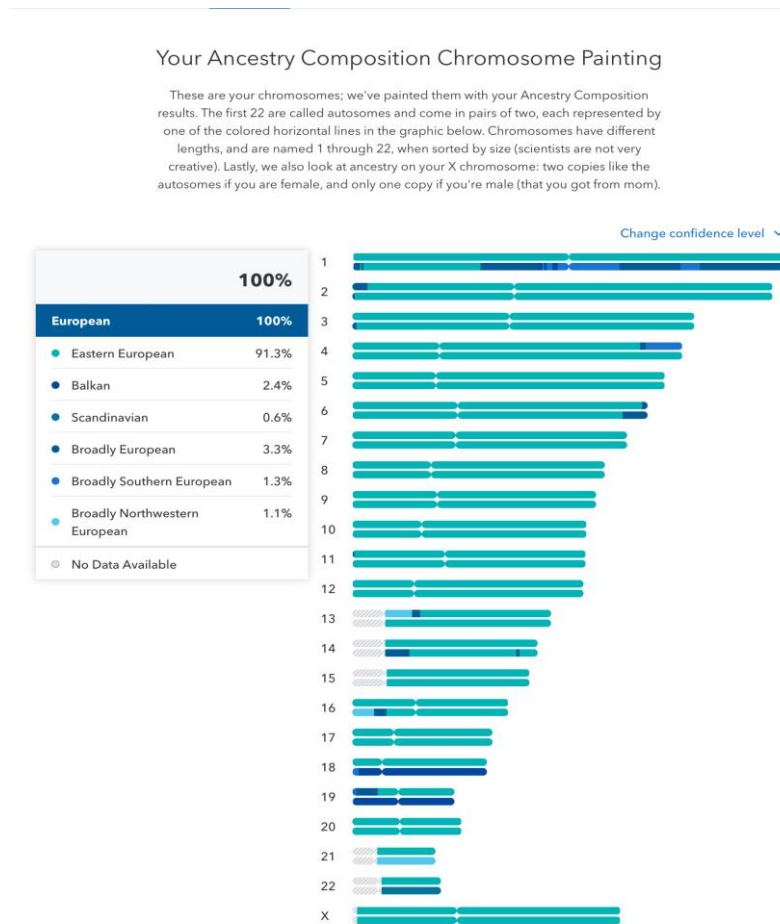


Figure 22. “Anonymous” individual ancestry test results for 23andMe Ancestry direct-to-consumer genetic test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com>.



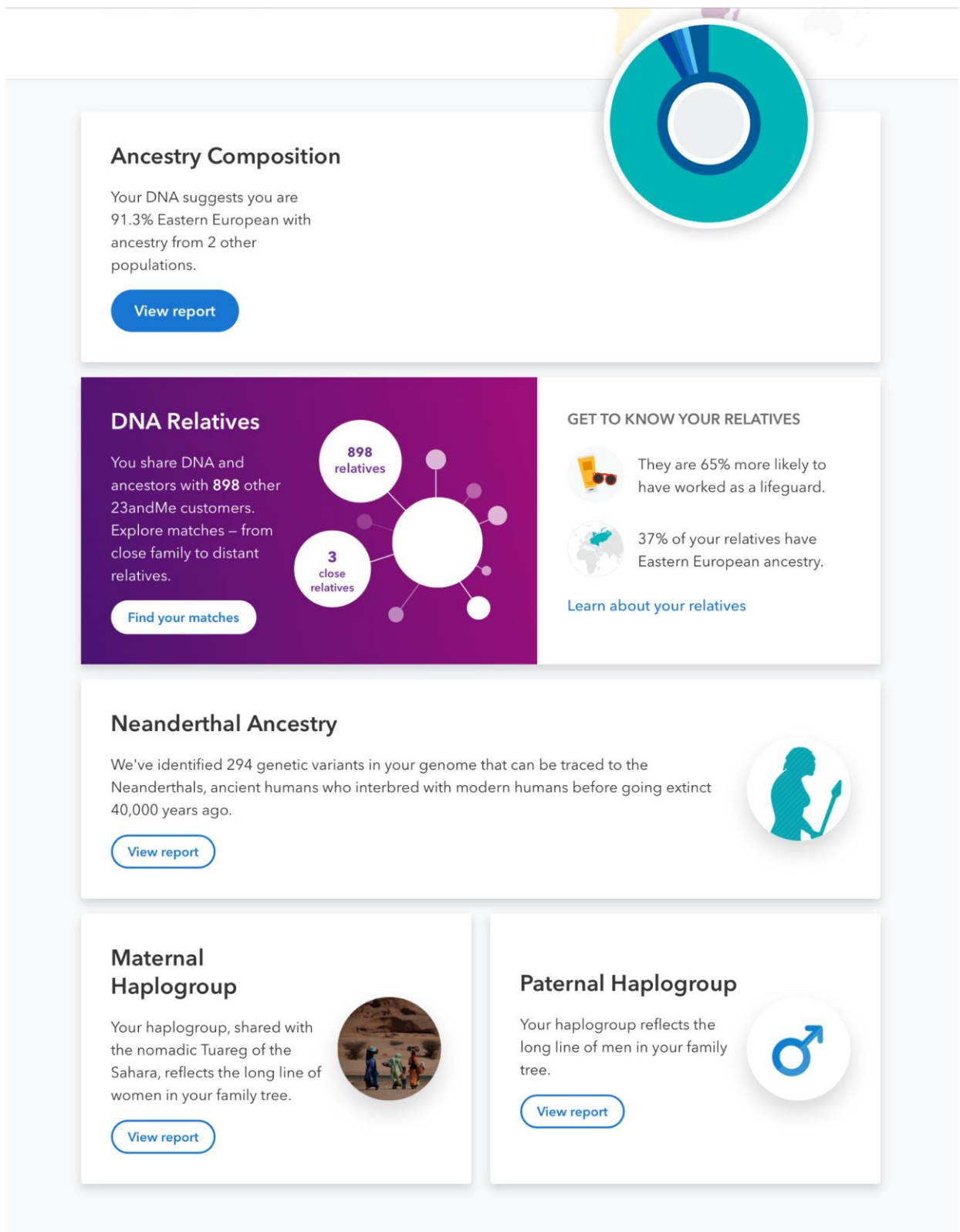




Figure 23. “Anonymous” individual ancestry test results for 23andMe Ancestry direct-to-consumer genetic test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com>.

OUR SERVICES ▾ HOW IT WORKS ▾ REPORTS STORIES SHOP  SIGN IN REGISTER KIT HELP ▾


## Genetics just got personal.\*

These are the stories of 23andMe customers. Your experience may be different since everybody's DNA is unique.


^




**ANCESTRY**  
Adoptee finds answers



**ANCESTRY**  
DNA reveals Jewish ancestry



**ANCESTRY**  
DNA strengthens her bond with Dad



**ANCESTRY**  
83-year-old reunited with family

∨

**"When I was younger, everyone just assumed I was Hispanic."**


As an adoptee, Megan didn't know anything about her biological parents or family history. For years she would get questions about her background—questions she couldn't answer. "I wanted to know about ME." So Megan ordered a 23andMe kit.

"I counted down the days until the reports came in, and when they did I almost cried," said Megan. "After 19 years of not knowing anything, and then just from spitting in a tube, I have a pile of information all about me."


In the beginning, she would look at her reports every day, multiple times a day. "When I was younger everyone just assumed I was Hispanic." But now Megan knows she is part Irish, part Scandinavian and part African. And she has some Native American ancestry as well. When asked how she felt about finding out her genetic makeup, she said, "I thought it was so cool."

Figure 24. Testimonial found on “Stories” page of 23andMe’s website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com/stories/>.


^




**ANCESTRY**  
DNA reveals Jewish ancestry



**ANCESTRY**  
DNA strengthens her bond with Dad



**ANCESTRY**  
83-year-old reunited with family



**GENERAL DNA**  
A shared interest in genetics

∨

**"I am so grateful for the opportunity to finally have confirmation of my history."**

Francisco grew up in a Latino neighborhood. His family was Portuguese and attended a Lutheran church, but something about his culture never felt quite right to him. His grandmother lit candles on Friday nights, she told him that dairy and meat didn't mix, and she told him to avoid shellfish. Christian holidays like Easter and Christmas were not celebrated with joy, but with obligation. Even when his father passed away, there were no clergy present at the burial, and no Christian iconography was put on the tombstone.

In college, Francisco had a discussion with a Portuguese professor about his last name. His surname was taken by Portuguese Jews, many of whom had been forced to convert to Catholicism during the Inquisition.

With 23andMe, Francisco found his paternal haplogroup was shared with 20 to 30% of Sephardic Jews. He traced his ancestors' migration, and he found his family escaped persecution by hiding their religion.


"I finally had evidence," he said. Francisco celebrates his new-found cultural identity.

Figure 25. Testimonial found on “Stories” page of 23andMe’s website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last Accessed 04/24/19, <https://www.23andme.com/stories/>.

Your DNA has more to say.




Upgrade to Health *instantly*.  
No waiting. No spitting.  
\$125

**Upgrade me!**



**Get the rest of your DNA story.**  
Upgrade your account today with 85+ more genetic reports, *instantly*.

What reports will be added to your account today?

<p><b>Genetic Health Risks*</b> (5+ Reports) MEETS FDA REQUIREMENTS</p> <p>Learn how your genetics can influence your risk for certain health conditions like <b>Age-Related Macular Degeneration</b> or <b>Hereditary Thrombophilia</b>.</p>	<p><b>Wellness</b> (5+ Reports)</p> <p>Know how your genetics could play a role in your well-being and lifestyle choices, from <b>Deep Sleep</b> to <b>Lactose Intolerance</b> and <b>Genetic Weight</b>.</p>	
<p><b>Carrier Status</b> (40+ Reports) MEETS FDA REQUIREMENTS</p> <p>Being a "carrier" means you "carry" one genetic variant for a condition. Carriers do not typically have the genetic condition, but they can pass a genetic variant down to their children. Find out if you are a carrier for certain inherited conditions like <b>Cystic Fibrosis</b> or <b>Hereditary Hearing Loss</b>.</p>	<p><b>Traits</b> (25+ Reports)</p> <p>See how your DNA affects your hair color, taste preferences and more! You can also choose to compare your results to other 23andMe customers. From <b>Earwax Type</b> to <b>Hair Loss</b> to <b>Finger Length Ratio</b> – find out what makes you, you!</p>	
		

\* Viewing Genetic Health Reports is strictly optional. Customers decide for themselves whether they want to know about their genetic health risk for serious conditions.

Figure 26. Screenshot from 23andMe website re: 23andMe Health Test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.

It's just saliva.  
No blood. No needles.

Our home-based saliva collection kit is all you need to send your DNA to the lab. We have made the process as simple as possible.

**shop now**



Figure 27. Screenshot from 23andMe website re: 23andMe Health Test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.

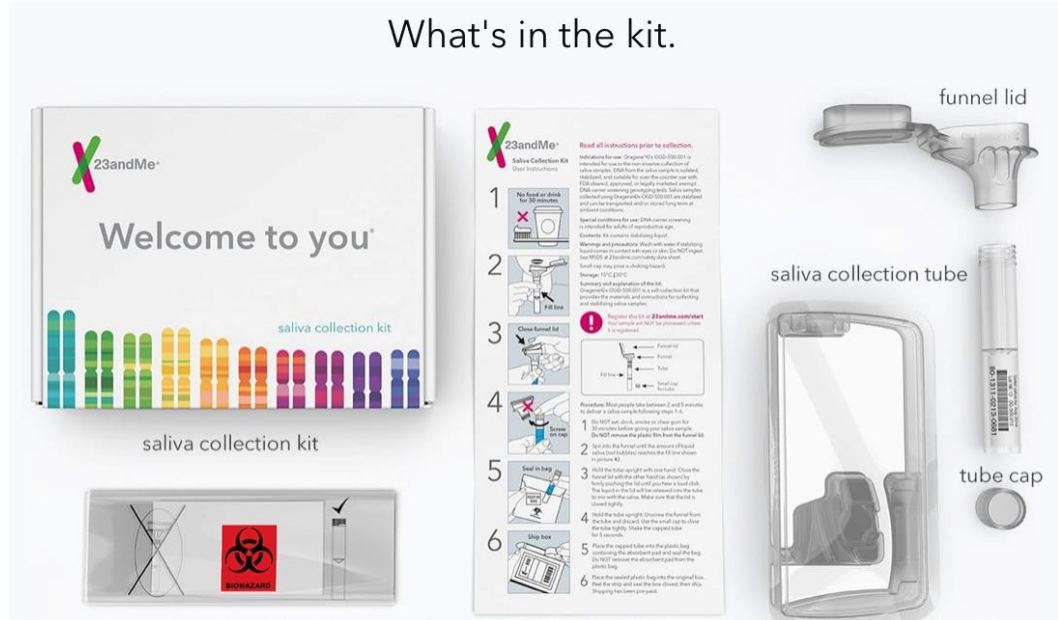


Figure 28. Screenshot from 23andMe website re: 23andMe Health Test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.

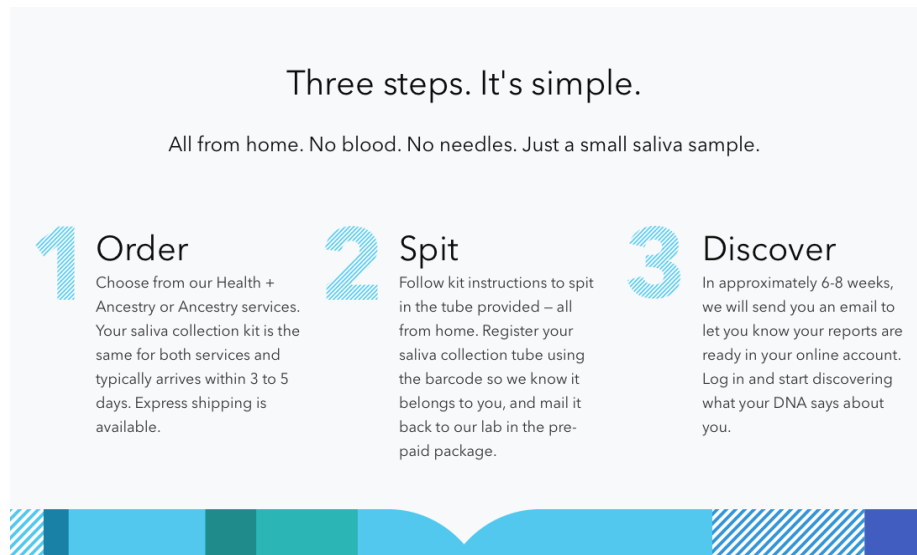


Figure 29. Screenshot from 23andMe website re: 23andMe Health Test. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.

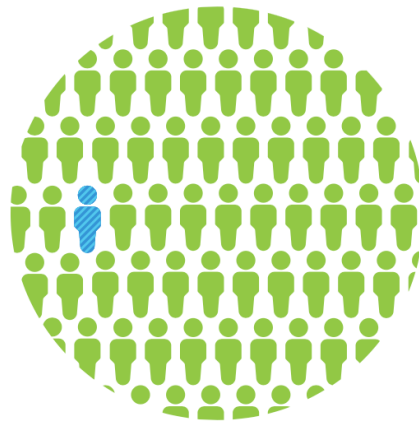
Meets FDA  
Requirements. What  
this means.

23andMe is the *only* company authorized by the FDA to provide direct-to-consumer (DTC) personal Genetic Health Risk reports and Carrier Status reports.

Our Genetic Health Risk and Carrier Status Reports meet FDA criteria for being scientifically and clinically valid.



Figure 30. Screenshot from 23andMe website (Legitimacy marker). 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com>.




Accelerating research.  
Making an impact.

On average, a customer who chooses to opt into research contributes to over 230 studies on topics that range from Parkinson's disease to lupus to asthma and more.

With the help of our 23andMe community we believe we can accelerate research and make an impact with our genetic data.

Figure 31. Screenshot from 23andMe website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/research/>.

Genetic reports.  
Backed by science.




**Our rigorous quality standards:**

- ✓ Our Genetic Health Risk\* and Carrier Status\* reports meet FDA criteria for being scientifically and clinically valid
- ✓ All saliva samples are processed in CLIA-certified and CAP-accredited labs
- ✓ Our DNA collection kit is FDA-cleared for use with our Genetic Health Risk and Carrier Status reports
- ✓ Genotyping is a well-established and reliable platform for analyzing DNA
- ✓ Our scientists and medical experts use a rigorous process to develop the reports
- ✓ Your personalized reports are based on well-established scientific and medical research
- ✓ Ancestry percentages are derived from our powerful, well-tested system that provides you with ancestry estimates down to the 0.1%

[Learn more.](#)

Figure 32. Screenshot from 23andMe website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.



Your privacy is our priority.

You are in control. You choose how your personal genetic information is used and shared.

- We will not share your individual data without your explicit consent
- A federal law (GINA) provides protection from employer and health insurance discrimination based on your genetics
- We do not provide information to law enforcement unless we are required to comply with a valid subpoena or court order

[Learn more details about our \*privacy practices\*.](#)

Figure 33. Screenshot from 23andMe website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.

## Security matters.

We have measures in place to prevent unauthorized access and ensure appropriate use of your genetic information.

- Separate databases keep your genetic information decoupled from your personally identifiable information, protecting your identity
- External firewalls restrict unauthorized connections to our databases
- All connections to our website are encrypted using SSL (Secure Sockets Layer) technology



Figure 34. Screenshot from 23andMe website. 23andMe website. Reproduced under *fair-use* (Section 107 of Copyright Act). Last accessed 04/24/19, <https://www.23andme.com/howitworks/>.