Chapter 1: Introduction

On Machinic Ways of Seeing the Face: Aim and Background

While passing through border control at Helsinki airport on a flight to Seoul, I walked through a biometric turnstile. On a small screen by the entrance to the turnstile were instructions to scan my passport. Once my passport had been scanned, I was then allowed to enter a small cubicle space between two panes of glass. I stood facing an empty screen that moved vertically, adjusting automatically to my height. A sensor took my picture, which then appeared before me on the screen. I waited a moment while the machine verified my identity by checking the facial image it had just captured against the image scanned from my passport. Then one of the glass panes opened, and I was released from the turnstile. I was then confronted with a border control guard – a man who sat behind a desk and whose face was shielded by a dark pane of glass. I only saw his hands, which grasped my documents. He did not seem to look at my face, but rather only examined my plane ticket and passport, which he eventually stamped with approval. My identity had been successfully recognized, and I was allowed to move on.

Automated facial recognition (AFR) has increasingly become a filter through which access to the world is granted. The ritual to which I was subjected at Helsinki airport, a ritual I also experienced in a slightly altered form at the Swedish immigration office, as part of the process of registering for permanent residency, is a familiar one. Beyond its most conspicuous uses in border control and immigration services, AFR is now increasingly being implemented in more mundane and everyday scenarios. For example, AFR systems

are used in our phones, at ATM machines, in office security systems, for the manning of cash registers in convenience stores and inside toilet-paper dispensers in public bathrooms. They are also used covertly, in CCTV and police cameras. In these new contexts, successful recognition by AFR is increasingly intervening in a complex negotiation between recognition, identity and access. Alongside this expansion of AFR into everyday contexts, there is a growing realization that we are becoming reliant on machines looking at us – and, most importantly, perceiving and interpreting us – and making decisions that, ultimately, govern our existence.

Although AFR systems rely on a form of visual recognition, something about their processes is also paradoxically opposed to forms of looking, as is apparent in the example of the biometric turnstile at Helsinki airport given above. Often the operations of biometric scanning and identity verification occur within an invisible field and through processes that the human subject does not see. As a result, algorithmic processes of biometric recognition remain difficult to define, analyze and critique. A close analysis of the technology itself is necessary in order to understand how and by what means biometric identification occurs. Kelly Gates explains that the facial recognition technologies used in biometric identification "are being developed to address a fundamental concern of modern societies: the problem of 'disembodied identities' […] the existence of visual and textual representations of individuals that circulate independent of the physical bodies."[1] Yet this re-embodying of identities that occurs through a facial recognition operation occurs through a *disembodied* form of visual perception.

This book investigates AFR technology through an inquiry into its visuality, that is, into how an AFR process encultures a way of seeing and, as such, can be understood as a contemporary mode of perception by machine. It focuses on the 'recognition' part of automated facial recognition. Facial recognition through an AFR system contains three inherent tensions, which structure the following discussion. The first tension is that AFR technology is a form

1 Kelly A. Gates, *Our Biometric Future: Facial Recognition Technology and the Culture of Surveillance* (New York: New York University Press, 2011), 12.

of machinic vision that is used to recognize us and yet, as I have mentioned, operates unseen and is, indeed, *unrecognizable* to those within its scope. In this way, AFR technology involves an invisible operation; its processes of recognition are inaccessible to us. Yet this operation increasingly governs people's lives within various institutional contexts. The second tension has to do with the question of the continuities and discontinuities between machinic visual perception and human visual perception. Many methods of AFR are designed and inspired by human processes of cognition and recognition, but to what extent do automated recognition processes replicate our own perceptual processes? To the extent that they do replicate these processes, in what ways does this replication relate, in turn, to a discourse of visuality? A third tension involves the relationship between the processes of recognition in an AFR system and the kinds of knowledge it may produce. A successful operation of automated recognition results in the production of (often actionable) information about the identity of a subject. An understanding of these processes of recognition may afford us a broader understanding of contemporary forms of identity production, and understanding these forms of identity production may allow us, in turn, to construct alternatives to the AFR process.

These tensions also suggest a critique of the notion of recognition inherent in AFR systems. In critically examining the notion of recognition, I intend to operationalize the term and use it as a tool to analyze AFR systems. These three tensions prompt a discussion of what recognition does and can possibly mean, and they problematize this notion. They lay out a general problematic of AFR technology as it relates to the context of its implementation and explored through the specificities of its technical processes. These tensions relate to broader issues of how machinic processes define visual perception as recognition. These tensions also provide an outline a line of inquiry into the relationship, in an AFR process, between seeing and knowing, that is, between how this process comes to produce not only the filtered data of information but also the knowledge that is accrued through the process of algorithmic learning in relation to the recognized subject.

AFR technology is an example of the automatization of the labor of looking, which is taking place in a variety of contexts in the Information Age. The production of massive amounts of data from digital surveillance networks has made it that the ability to perform this labor of looking sometimes outstrips human capacities. AFR technology is utilized as a way of interpreting data and deriving meaning from it in order to produce "information," the primary product of this technology. Machine vision, or the automation of visual sense perception, has its origins in the controlled environment of the industrial factory, where it is used as a means of sorting and inspecting industrial parts and manufacturing flows. In the Information Age, machine vision technology has developed to be able to read measurable and quantifiable objects outside of the factory setting. In conjunction with the increasing use of surveillance systems, machine vision comes to focus on the processes and transactions relating to the flows of people in society. Similar to its use within the factory, biometrics, as one form of machine vision, functions in operations of inspection, that is, the sorting, selecting and surveilling of individuals in society. The biometric gaze turns toward the shifting, unstable and unruly forms of the body and reads these as if they were quantifiable industrial objects.

Facial recognition technology calls our attention to the site of the face not only as a means of identification but as a marker of identity. Inherent in the distinction between identity and identification is a politics of the face. In describing the site of the face as a particular mechanism of the political imaginary, Jenny Edkins writes, "the face in itself *is* a politics […] that reflects and inscribes a particular intersection of two regimes of signs: the signifying and subjecting regimes."[2] While the face can be measured, scanned and read like a sign, it is also expressive of the malleability and shape-shifting nature of the subjective experience of self. Faces are everywhere these days. In the so-called Age of the Selfie, one's self-portrait temporally and spatially situates oneself within the channels of various social networks. The selfie is an expression of the face as an embodiment of the self, depicting one's experience at a particular place and time.

2 Jenny Edkins, *Face Politics* (London: Routledge, 2015), 4.

This may be why David Lyon calls on the face as an ethical starting point for a critical analysis of biometrics.[3] He describes the site of the face as "resisting mere categorization" and claims its treatment is central to understanding how "one perceives the issues surrounding the appropriate conditions of self-disclosure."[4] While the face is, as Lyon argues, expressive of an embodied social person and as such resists simple categorization, it is also a site of the body that is easily accessed, without consent, by biometric technologies. The prevalence of AFR technology is in part due to the fact that the face is a part of the body that tends to be visible in daily life and so is easily captured by surveillance mechanisms and CCTV.[5] For example, in the arguments made in favor of AFR use in the ongoing "War on Terror," it has been stated that the only biometric data available on terrorists is their facial images.[6]

It has been noted by many programmers and developers of AFR technology that it confronts its own special challenges when it comes to both the detection and the recognition of human faces. The face is quite unlike the sorts of things typically the subjects of machine vision – subjects that are usually finite, measurable and geometrically fixed. As Lyon suggests, the face resists mere categorization not only through its expression of a subjective and embodied sense of identity but also physically, in its variability, multilayered forms of expression and constantly changing form, which resists the reductive methods of recognition used in AFR systems. In short, the face is a part of the body that escapes singular recognition. As such, the face as an object (and subject) of AFR technol-

3 David Lyon, "Surveillance as Social Sorting: Computer Codes and Mobile Bodies," in *Surveillance as Social Sorting: Privacy, Risk and Digital Discrimination*, ed. David Lyon (London: Routledge, 2003), 27–28.

4 Lyon, "Surveillance as Social Sorting," 27.

5 AFR is also in high demand because the use of facial images for identification purposes has a long history, and so there is a pre-existing infrastructure on which AFR can draw. Passport photos and criminal portraiture are examples of the use of the face and facial images as means of identification.

6 John D. Woodward Jr., *Biometrics: Facing Up To Terrorism* (Santa Monica, CA: Rand Corporation, 2001), 8, https://www.rand.org/pubs/issue_papers/IP218.html.

ogy provides a fascinating case study of machine vision, because it challenges the mechanisms of this technology both technically and theoretically.

A growing number of artists are working with facial recognition technologies in order to explore, confront and articulate sociopolitical issues raised by the use of these technologies. Artists engaging with facial recognition technology are uniquely positioned to articulate the visuality of this technology, and as such their works figure centrally in this study as objects of theoretical examination. Much of the development of AFR systems, and the surrounding discourse, has been guided by the aims of this technology in policing, military and market contexts. These artworks fill in a gap by providing a cultural translation of the technology, a translation that is often not discussed or explored by developers or programmers. Artistic engagements with facial recognition technology are able to articulate complex issues that AFR processes give rise to at the intersection of recognition, identity and representation. The strategies of artists engaging with facial recognition technology include appropriating the technology and decontextualizing its processes; in these ways, these artists allow for an engagement with this technology that not only problematizes its use but also imagines alternative outcomes of the technology and its processes.

There are three primary research questions that guide this study:

1) What is the process through which recognition is defined in the machinic form of vision used in an AFR method?
2) What historical continuities (and discontinuities) can we identify in these processes of recognition?
3) How do artistic interventions with facial recognition technology respond to, articulate and confront the implications of the use of this technology?

The general purpose of these questions is to achieve a broader understanding of AFR technology within the sociopolitical and cultural contexts in which it is used. These questions focus on the general problematic and central principle of AFR technology by asking how

recognition can be defined through a technical process. Although these questions approach a general problematic of recognition in AFR technology, they also get at the specificities of how this technology operates. These questions reflect on the technology itself, on how a technical process encultures a way of seeing through recognition. These questions also relate the ways in which the face is represented through an AFR method to a discourse of visuality, namely, historical practices of facial representation and portraiture. This line of inquiry acknowledges that the forms of visuality involved in an automated recognition process are a central source of the knowledge this technology produces. The ways in which the face is represented in this process of recognition are how an AFR method itself comes to know a face. In addition, through a process of successful recognition, an AFR method produces knowledge in the form of the identity and identification of the person being recognized. In referring to examples of artistic interventions by contemporary artists, this analysis presents an inquiry into the visuality of automated facial recognition and the ways in which meaning is both produced and made malleable by AFR technology.

Cultural Analyses of Biometrics: Previous Scholarship

Biometrics and, in particular, AFR technology have increasingly come to be applied within the contexts of risk mitigation and security practices for the identification and recognition of individuals. Biometrics utilizes advanced visual technologies, such as digital sensors, to scan, measure and capture parts of the body, their forms and surface patterns. The uniqueness of body parts, such as finger prints, an iris or a person's face, allow these technologies to ascertain an individual's identity. The practice of using the body as a sign of identity has a long history that dates back to the mid-1800s, beginning with the practice of using a hand imprint to seal a contract, a practice that has a more recent analogue version in the collection of the fingerprints of grade-school students. In the 1980s, the term "biometrics" began to be used to describe the automated systems of human recognition then being developed; in the 1970s, the field

had been known as "automated personal identification."[7] What has changed with more recent developments in biometrics is that these practices are now being digitized, which includes the use of algorithms to read collected bodily data and the use of biometric technologies in conjunction with growing and widespread networks of surveillance. Alongside the increasing use and continued development of contemporary biometrics, there has been a corresponding increase in critical academic scholarship in the humanities that has studied biometric and AFR technology through a cultural lens. In the last ten years, scholars from the fields of sociology, surveillance studies and media and communications have produced work that articulates the social, political and cultural implications of society's increasing dependence on biometrics. The scholars included in this brief overview of previous literature for the most part critically approach the use of biometric and AFR technology through analyses of their technological development and the systemic contexts and implications of their implementation. They have analyzed the technology through theoretical frameworks that draw on a range of discourses, including sociology, surveillance studies, science and technology studies, post-colonial theory and gender and feminist theory.

One of the first scholars to adopt a sociological approach to biometric technologies was David Lyon, who in 2001 described biometrics as one aspect of the growing ubiquity of widespread surveillance practices that function as a method of "social sorting," that is, as a way of "categorizing populations and persons for risk assessment […] [in] attempts to minimize risk, by discovering – preferably in advance – who is likely to break the law, buy the product, or seek the service."[8] Lyon's use of the term "social sorting" highlights the "classifying drive" as a central function of surveillance and biomet-

7 James L. Wayman, "The Scientific Development of Biometrics over the Last 40 Years," in *The History of Information Security: A Comprehensive Handbook*, ed. Karl de Leeuw and Jan Bergstra (Amsterdam: Elsevier, 2007), 263–74.

8 David Lyon, "Facing the Future: Seeking Ethics for Everyday Surveillance," *Ethics and Information Technology* 3, no. 3 (2001): 172, https://doi.org/10.1023/A:1012227629496.

ric technologies.[9] Rather than raising issues of privacy concerning the individual, Lyon brings the discussion of biometric and surveillance practices into the social realm, examining their use as mechanisms of neoliberal policy that enforce social division and categorization and imply unequal access and distribution. Lyon's analyses of biometrics establish a framework through which to approach the social power of its information production.

Lyon's critique of biometrics as a surveillance practice highlights its unequal implementation and effects on vulnerable and marginalized parts of the population. This topic is expanded on in the work of Simone Browne and Shoshana Magnet, both of whom analyze the dialectics of recognition in biometric technology and the ways it is directed by normative categories of identity. Both scholars the ways in which applications of biometric technology deny a subjectivity, and they associate the limitations of the technology with a limit to notions of identity. Biometric technologies thus enact a negation of certain individuals based on their race, gender and/or economic status while verifying the identities of certain others. Through the use of different theoretical frameworks and discourses, both Browne and Magnet recognize that there is a cultural logic embedded in biometric technology, and their works actively critique this logic.

In her book *Dark Matters: On the Surveillance of Blackness*, Browne draws on the discourse of post-colonial theory, referencing the work of Franz Fanon and his concept of "epidermalization" to approach the power dynamics of a biometric, disembodied gaze. She defines the concept of "digital epidermalization" as "the exercise of power cast by the disembodied gaze of certain surveillance technologies [...] that can be employed to do the work of alienating the subject by producing a truth about the racial body and one's identity (or identities) despite the subject's claims."[10] Browne's analysis outlines historical continuities that can be found within biometric and surveillance practices by placing these in direct dialogue with an archive

9 Lyon, "Surveillance as Social Sorting," 13.

10 Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham, NC: Duke University Press, 2015) 110.

of transatlantic slavery and the history of the control, regulation and surveillance of black bodies. Through her analysis, Browne describes the inherent violence that occurs through the enactment of institutional recognition by the state.

Magnet's book *When Biometrics Fail: Gender, Race and the Technology of Identity* adopts a feminist theoretical framework.[11] The point of departure for her study is a call for a broader and more precise vocabulary for defining a notion of failure in relation to biometric technology. In this way, Magnet aims to counter an acceptance of failure as technically productive: technical failures are usually accepted as means to an end, leading to further developments and eventual success. Instead, Magnet defines a sociological framework of failure according to which, when biometrics technologies "over target" and "fail to identify," these failures are defined as sociologically counterproductive, as excluding certain communities and resulting in the inaccessibility of resources for certain segments of the population. Magnet argues that the failure of the science of biometrics lies in the fact that it is a technological implementation of gendered and racialized norms, essentially codifying "existing forms of discrimination"[12] and thereby failing to recognize the complexity of bodily identity.

Magnet's analysis may be seen alongside the work of other scholars who focus on the technical limitations of biometric technologies. Kelly Gates's book *Our Biometric Future: Facial Recognition Technology and the Culture of Surveillance*, in particular, challenges the legitimacy of AFR technologies by examining the gap between the claims made about their viability and their actual capabilities.[13] Drawing on communications theory, Gates gives an in-depth account of the political and economic constellation of influences governing the development and implementation of AFR technology. Gates argues that the claims of technical precision made on behalf of AFR technology by the biometrics industry and government

11 Shoshana Magnet, *When Biometrics Fail: Gender, Race and the Technology of Identity* (Durham, NC: Duke University Press, 2011).

12 Ibid., 9.

13 Gates, *Our Biometric Future*, 98.

officials make its implementation appear inevitable. Furthermore, these claims mean that AFR technology is often given precedence over other forms of intelligence gathering. In examining the actualities and limitations of the technology, Gates's study aims to disrupt this trajectory and to provide a more down-to-earth account of its advanced capabilities.

Gates explores how AFR technology was framed as the solution to the particular challenges of the post-9/11 period. She describes the narrative advanced by the research agency of the US Department of Defense (DARPA): that the war on terror involved a new kind of enemy, an "unidentifiable" enemy who thus implied a new form of national vulnerability.[14] Gates explains that, in virtue of AFR technology's ability to produce a kind of identifiability for these enemies, and thereby provide a sense of certainty in the post-9/11 geopolitical landscape, the need to deploy this "expensive, new, high-tech surveillance technology […] seemed self-evident."[15] Gates's study shows how the development of AFR is based on the fact that this technology has been framed as a solution to the political and military challenges faced within the contemporary geopolitical landscape.

Numerous scholars have approached an analysis of biometrics through the lens of geopolitics. One example is Btihaj Ajana, a scholar working in the area of digital cultures who approaches an study of biometrics through the theoretical discourse of biopolitics, drawing on the work of Michel Foucault, Giorgio Agamben and Nikolas Rose.[16] Ajana argues that biometric technologies enact a form of biopolitics and result in the construction of politicized identities along geopolitical lines. For example, Ajana examines the binary of the "asylum seeker" and the "neoliberal citizen," which in turn comprises a whole set of practices that govern the individual: hierarchical power relations marginalize asylum seekers, trampling their basic rights, especially their rights to move freely, and also empower the neoliberal citizen, at the opposite end of the geopolitical spec-

14 Ibid.

15 Ibid.

16 Btihaj Ajana, *Governing through Biometrics: The Biopolitics of Identity* (Basingstoke: Palgrave Macmillan, 2013), 34–44.

trum, with a "surplus of rights."[17] Louise Amoore, a scholar in the field of political geography, also approaches an analysis of biometric technology within the context of geopolitics. She does so by drawing on a conceptual framework from the field of geography. In her concept of the "biometric border," she casts biometrics as a way of constructing a new kind of geopolitical border, which is made manifest through the mapping and measuring of the body.[18] Biometrics does not analyze abstractions but maps the actual biophysical patterns of the body and, by doing so, inscribes the body with institutional divisions and demarcations. As Amoore writes, "In effect, the biometric border is the portable border par excellence, carried by mobile bodies at the very same time as it is deployed to divide bodies at international boundaries, airports, railway stations, on subways or city streets, in the office or the neighbourhood."[19]

The work of these scholars presents a range of diverse approaches to the cultural, social and political implications of biometrics and AFR technology. These scholars articulate some of the most pertinent and salient conclusions of the cultural and social critique of these technologies. They explore how the development and implementation of these technologies depends on a certain way of framing both the solution and the problem. Overall, these scholars' works undermine the claims of neutrality and precision so often made on behalf of biometric and AFR technologies. These scholars recognize that biometrics and AFR technology directly participate in decision making, with wide-ranging social and political implications. They look into the social and economic interests behind the development of the technologies as well as the results in terms of contemporary constructions of institutional identities. These cultural analyses of biometric technologies recognize that the implementation of these technologies brings about not only a technological but a cultural shift. By bringing to bear a diverse range of theoretical discourses

17 Ibid., 2.

18 Louise Amoore, "Biometric Borders: Governing Mobilities in the War on Terror," *Political Geography* 25, no.3 (March 2006): 336–51, https://doi.org/10.1016/j.polgeo.2006.02.001.

19 Ibid., 338.

in their discussions of biometric technology, these scholars articulate some of the cultural implications of the implementation of this technology. A central critique of biometric technologies advanced by these scholars is that these technologies draw their notions of identity from the agendas of the institutions that implement them, and force subjects to accord with these notions. My own analysis takes this central critique as its point of departure. But, in contrast to the works discussed above, which examine the dominant social and political narratives that surround the development of biometric technology and its present application, I look at the empirical material of the technology and the technical processes themselves as a window into a cultural logic of visuality. This, in turn, may provide us with a source of critique and further insight into the limitations of this technology with regard to notions of identity and knowledge formation.

Language and Visual Artifacts: Empirical Material

As I have explained, previous cultural analyses of biometrics and AFR technology have focused on the contexts of their development and implementation. And while this is necessary in order to problematize the use of these technologies, these studies tend to overlook the specificities of AFR technology. There has been little scholarship from within cultural studies and the humanities more broadly on the ways in which AFR actually performs recognition and how this may constitute and enculture a mode of perception. More often, the specificities of the technical processes of recognition are discussed and debated within the field of the computer and cognitive sciences, separated from any cultural investigation. When AFR technology has been discussed within cultural studies, it is for the most part treated as a monolithic method rather than as a variety of different methods that have evolved in specific ways. When the topic is scrutinized in this way, individual AFR methods are largely ignored. In contrast to this approach, I choose to focus my own analysis on a specific AFR method.

My interest in examining the visuality of AFR has led me to focus on a method that uses an eigenface approach to recognition, an approach that was developed in the early 1990s and is considered the first successful method in AFR technology. Many AFR systems are difficult to scrutinize because the technology is usually considered proprietary software.[20] The eigenface approach, now considered a dated method, was open source from its inception. Because of its simplicity, it is often still used as a training tool by computer science students, so examples of its use are widely available on the internet. There are two primary reasons for my interest in this method. Firstly, the eigenface approach is considered a holistic method: that is, it takes into account the entire face, rather than isolated features of the face, and is, as such, designed to emulate human facilities of facial recognition. Secondly, as a part of its algorithmic processes of recognition, the eigenface approach was designed to produce an image, a visual artifact through which it is possible to enter into a visual analysis of its processes of recognition. The success of the eigenface approach to recognition made it a benchmark for the AFR methods that developed subsequently. And although it is now considered a somewhat dated method, its creation still remains an inflection point in the history of the development of AFR, shifting, for a moment, the direction of the technology toward holistic and pictorial processes of facial recognition. The eigenface approach is a simple method. In its simplicity, it reveals the technical processes that structure a successful AFR recognition operation. This basic structure can still be found in the more sophisticated AFR methods that have since been developed.

My investigation into biometric facial recognition technology differs from the theoretical frameworks outlined in the previous section in that it analyzes AFR technology in relation to discourses of visuality and machinic vision. Nevertheless, this investigation does draw on the conclusions and some of the central conceptualizations of previous cultural analyses. These conceptualizations act

20 Lucas Introna and David Wood, "Picturing Algorithmic Surveillance: The Politics of Facial Recognition Systems," *Surveillance and Society* 2, no. 2/3 (2004): 185, https://doi.org/10.24908/ss.v2i2/3.3373.

as useful prompts, providing inroads into the analysis of the visuality of an AFR recognition process. For example, drawing on Lyon's aforementioned critique of biometrics and surveillance practices as enacting a form of "social sorting," I ask what technical means AFR methods employ in this sorting process. How does this sorting equate to a form of vision? How are contemporary modes of perception reduced to a sorting mechanism? As this line of questioning makes clear, this analysis approaches AFR technology by specifically problematizing a visuality found in its processes, a visuality that has social and political implications.

As I have mentioned, the eigenface approach is an earlier, "pictorial" algorithmic method that reads the face holistically (rather than a feature extraction method that measures the distances between features of the face). What sets the eigenface approach apart from other methods is that, as I mentioned above, it produces an image as a part of its algorithmic processes. The eigenface image and, importantly, the algorithmic recognition processes that produce it, constitute the central departure point of this study. The production of this image was originally a way of providing the programmer with a way to fix bugs in the algorithm. This image appears as a phantom-like blur of multiple overlapped faces, which, to human eyes, lingers on the threshold of recognition. While the eigenface image remains blurry to human vision, it contains a wealth of information that, for the processes of perception by the machine, equates to a form of clarity. The image provides a visual artifact that allows me to bring AFR processes into discussion with visual and cultural theory and discourses on machinic vision. I do this in two ways. Firstly, as I will explain in more depth in the theoretical section of the introduction, I present this image as an example of the changes in the role of the image as information brought about by the advent of digital networks. Secondly, I positioned the eigenface image within a discourse of facial representation in the art historical genre of portraiture. Taken out of its original context of production, that is, as a tool for programmers, I understand the eigenface image to be a machinic production of a portrait, depicting the human face from the perspective of machine. I investigate this in depth in the first part of this book, which relates the eigenface

image to a historical antecedent: the composite portrait. This line of analysis continues in the second part of the book, which looks at artistic interventions and discusses portraiture in the age of AFR technology.

Another, related source of empirical material is provided by the scientific texts that describe the eigenface method. I was first introduced to the eigenface method by reviewing scientific journal articles that outline the development of and experimentation with AFR methods by programmers and students in the field of computer sciences. The central texts for the analysis of the eigenface method are two articles written by its developers, Matthew Turk and Alex Pentland. Aside from the articles written by Turk and Pentland, which record the initial findings of experiments using the eigenface method, Turk later wrote another article, "Twenty Years of Eigenface," which provides further insight into the impetus behind its original development and its relationship with other methods of AFR technology.[21] I have also drawn on the work of the computer scientists Lawrence Sirovich and Michael Kirby, whose work preceded that of Turk and Pentland. Sirovich and Kirby applied the primary representational mechanism used in eigenface, Principal Component Analysis, to facial images, which influenced Turk and Pentland's work.[22] These works are the primary scientific texts concerning the eigenface method. The method has become a popular algorithmic training tool for students of computer science, and there are numerous published scientific journal articles and blogs by computer science students and programmers that build on the method. These provide an endless source of information about eigenface images and a wealth of examples of such images. I have made use of some of these texts and images; because many of the blogs were written in such a way as to be accessible to laymen such as myself, these proved to be particularly useful.

21 Matthew Turk, "Over Twenty Years of Eigenface," *ACM Transactions on Multimedia Computing Communications and Applications* 9, no. 1 (October 2013): 1-5, http://dx.doi.org/10.1145/2490824.

22 Lawrence Sirovich and Michael Kirby, "Low-dimensional Procedure for the Characterization of Human Faces," *Journal of the Optical Society of America* 4, no. 3 (April 1987): 519-24.

A central challenge I confronted in seeking to understand the eigenface method through relevant scientific texts was that I had to understand specialist language from outside of my own field of expertise. Not only is there an abstraction of the image that occurs through the eigenface process; in analyzing the texts that outline this method, I also confronted an abstraction in the language used to describe it. These scientific journal articles communicate the method in four different forms: text, mathematical equations, photographic and video images and graphs. In the course of my analysis, I found the images to be most relevant. The images corresponded to specific equations that explained more fully, for a specialized computer-science audience, the underlying procedures. Mathematical equations relating to the method and its processes figure prominently in the texts: for example, 27 times in the primary text by Turk and Pentland on the eigenface method.[23] It is important to note here that I do not include any mathematical equations in my own research; I lack knowledge of programming, and I am writing a cultural analysis within a field of the humanities for an audience within this discipline. Instead, I have focused on the language and the words chosen to describe the process and, of course, the eigenface images themselves. The captions written by the authors of the scientific articles, which at times take into account the aesthetic aspect of the images, were also of importance for this study, for they express what was considered important in the image and supplement an explanation of the algorithmic process. Inevitably, the language as well as the images used by the developers became a central part of the empirical material.

I have tried to bring to bear a cultural theoretical framework and concepts on a technical phenomenon that has predominantly been described in a specialist language and through mathematical equations. I have thus faced a challenge in attempting to communicate the central mechanisms behind this process, as I understand them, without parroting the specialist language of the original sources and while also being careful not to oversimplify this explanation.

23 Matthew Turk and Alex Pentland, "Eigenfaces for Recognition," *Journal of Cognitive Neuroscience* 3, no. 1 (Winter 1991): 71–86.

The language used in the humanities contrasts with that in the so-called "hard sciences," such as the fields of applied mathematics and computational sciences, specifically when it comes to the site of knowledge production. Scientific literature often describes phenomena from an assumed objective and distanced standpoint of observation, while, in contrast, as a humanities scholar, my own approach is explicitly interpretative, and it often requires an explanation of my own and others' specific historical, cultural and socially situated vantage points. In short, in my observations, the site of knowledge production includes an "I," and I freely admit my own limitations in confronting the specialist language used in these scientific texts, which make up a large part of the empirical material for this study.[24]

I refer to in what follows include "The Scientific Development of Biometrics over the Last 40 Years," by James L. Wayman, from *The History of Information: A Comprehensive Handbook*, and the recently declassified reports by computer scientist Woodrow Wilson Bledsoe, which concern some of the first attempts to develop AFR technology, funded by the CIA.[25] These supplemental texts have helped me to explore further the broader contexts in which AFR technology has been used and developed. They also provide further information that situates the success of the eigenface method within the developmental trajectory of AFR technology.

Another primary source of empirical material in this study is the collection of artists' works explored in the second part of the book. The examples of artistic interventions included in this part bring out particular issues to do with the implementation of facial recognition technology in society. Each artist relates the technology of facial recognition to specific discourses. Thomas Ruff's study of the identification portrait as an artistic object creates a bridge between

24 Thank you to Anthony Paré and his "Anatomy of a Genre" course for insight into this difference between academic perspectives with regard to situatedness. For more info, see Anthony Paré, "Rhetorical Genre Theory and Academic Literacy," *Journal of Academic Language & Learning* 8, no. 1 (2014): A83–A94.

25 See footnote 7 in chapter 2 for more details about how these reports became declassified.

AFR technology and a discourse on photographic portraiture. AFR technology still relies on photographs or video-still captures of the face and as such on a form of representation that connects back to the indexical relationship between identity and portraiture and the use of the photograph as a scientific document. Ruff's work with the construction of faces in his series *andere Portraits* situates the composite portrait into the realm of art. As such, his work serves to connect the analysis of the eigenface method with the themes of the second part of the book. Zach Blas's work brings AFR technology into a discussion with discourses of identity politics. His work confronts the gaze of AFR technology, and his sculptures materialize a contemporary strategy of activism through collectivism. Blas's artwork highlights the social and political contexts in which AFR technology is implemented and the enmeshment of automated recognition practices in the construction of contemporary identities. Trevor Paglen's work is a study of visuality in light of discourses concerning the growing ubiquity and invisibility of algorithms in society. Paglen's work not only disrupts how contemporary meaning is produced through algorithmic recognition processes but also explores the role of imagination. This collection of artworks explores three essential aspects of the influence and role of contemporary AFR technology: representation, identity and knowledge production. With the inclusion of these artworks, I hope to show that art has an important role to play as a source of theoretical reflection on contemporary technologies, as well as offering a means of exposing their dangers and exploring the possible alternative futures resulting from these technologies.

Temporalities — History as Critical Inquiry: Methodology

A primary method of historicization guides the critical analysis of the eigenface algorithm in the first part of this study. Eigenface is related to a historical antecedent, composite portraiture, which was invented by the anthropologist, statistician and founder of eugenics Francis Galton in the 1880s. These two methods are connected by the idea of merging vision with statistics in order to provide a

mechanism of recognition. The method of historicization as a tool for critically analyzing AFR technology relies on a concept proposed by African studies and surveillance scholar Simone Browne. Browne calls for a "critical biometric consciousness," which includes ways of developing critical strategies that can reveal and allow us to scrutinize the technical development and socio-cultural implications of biometric technologies.[26] Central to this call is an approach to biometric technologies that contrasts with its treatment as objective and without history. This approach is directly opposed to the widely held belief that algorithms and biometric scanning exist as privileged, ahistorical practices of information technology that are objective and precise, a belief that validates the continued development and use of these technologies. Browne describes one method of developing a "critical biometric consciousness": tracing historical practices and antecedents that inform the social dynamics and technical development of contemporary biometric technologies.[27] In tracing the socio-historical lineage of the facial representation processes found in the eigenface method, this analysis answers Browne's call. By linking the eigenface image with the historical antecedent of composite portraiture, we are able to reveal the cultural dynamics of facial representation that inform automated processes of recognition. In historicizing the eigenface image in this way, this study reveals not only a logic of recognition based on the merging of statistics with vision but also an embedded and situated cultural logic of facial representation within the eigenface's algorithmic processes.

The method of historicization in this analysis is inspired by recent scholarly work that has critically engaged with overarching, general terms by tracing the histories behind their meanings. Two key texts that have influenced this study are the book *Objectivity*, by Lorraine Daston and Peter Galison, and John Durham Peters's work on the term *information*, specifically in his article "Information:

26 Browne, *Dark Matters*, 116.

27 Ibid., 116-18.

Notes Toward a Critical History."[28] Both of these works pursue a method of historicization, tracing the cultural meaning behind the practice-based terms "objectivity" and "information" as a means of demystifying their contemporary position as transparent and "omnipresent idols"[29] and grounding their meaning in actual use and in modes of discourse. Like the scientific illustrations that appeared at the turn of the last century, recent technological developments and processes of information production are often, in the fields of cultural or aesthetic inquiry, treated as possessing a kind of objectivity. Often it is only the distance of history that allows us to engage in a more critical way with a scientific production that had been accepted as neutral in its own time. In tracing the historical continuities of the culturally embedded recognition practices found in an AFR method, I argue that we may contest the assumed scientific objectivity of the technological present.

By relating the eigenface algorithm to a historical antecedent, the composite portrait, I put two sets of images into dialogue with one another: one the result of the representational mechanisms of the eigenface algorithm, and the other Galton's historical, photographic composite portraits. The relationship between these two sets of images involves a history of what I consider a way of seeing – a mode of perception that is based on statistical logic. In relating these two images, I am not trying to trace the origins of eigenface but rather relating it to a particular historical instance in order to reveal how its mode of perception is embedded within a specific cultural ethos. One thought that is central to my own approach to relating these two images comes from Walter Benjamin's "Theses on the Philosophy of History" (the last text he wrote before his premature death). Benjamin writes: "The past can be seized only as an image which flashes up at the instant when it can be recognized and is never seen again […] For every image of the past that is not recognized by the present as one of its own concerns threatens to

28 John Durham Peters, "Information: Notes Toward a Critical History," *Journal of Communication Inquiry* 12, no. 2 (1988): 9-29, https://doi.org/10.1177/019685998801200202.

29 Ibid., 19.

disappear irretrievably."[30] In my analysis, the composite portrait appears as a pictorial reference to a cultural ethos of social classification from the past that, through contemporary practices of biometrics, finds a foothold in the present. The composite portrait is a contextually loaded image; embedded within it is an impulse to construct a social taxonomy, as part of Galton's broader project of eugenics. This particular history is recalled by the classifying impulse of contemporary AFR technologies and is visualized through the eigenface image. In relating these two images, I do not mean to suggest that the historical relationship between them is self-evident or that it exists on its own. Rather, to quote Benjamin again, "To articulate the past historically does not mean to recognize it 'the way it really was' (Ranke). It means to seize hold of a memory as it flashes up at a moment of danger."[31] It is in this spirit that I hold up the eigenface image and the composite portrait as objects of study connected by a relationship in which the past informs the present: the algorithmic processes used in the eigenface method are embedded with historical practices of racially charged classification, which makes clear the present danger posed by AFR technology and suggests a critique of its limitations and entanglements with regard to notions of recognition and identity. Tracing this historical link between the practice of composite portraiture and the representational mechanism within the eigenface algorithm also reveals a link between discourses in photography – in its role in science and art – and the forms of representation that are found in current algorithmic processes.

The second part of this study draws on contemporary artists whose work bears on practices of facial recognition. The artists Thomas Ruff, Zach Blas and Trevor Paglen have each produced works that function within this study as further sources of theoretical analysis, experimenting with and problematizing processes of facial recognition. These artists were chosen because of their

30 Walter Benjamin, "Theses on the Philosophy of History," in Walter Benjamin, *Illuminations*, trans. Harry Zohn (New York: Schocken Books, 2007), 255.

31 Ibid.

explicit concern with some of the political and social implications of facial representation and recognition technologies. Their work supports an overarching narrative that runs through this analysis, a narrative that is concerned with the visuality and representational mechanisms of facial recognition. The artworks articulate the cultural contexts in which facial recognition technology intervenes, and they pose, in particular, the central criticism of these technologies: that they reinforce normative categories of identity through reductive, technical procedures. I have chosen artworks composed using a variety of mediums in order to explore a range of responses to the implications of facial recognition. Ruff, Blas and Paglen work in the mediums of photography, sculpture and algorithmic-generated prints, respectively. The artists' works included within this study serve to supplement a central conceptual motif of the analysis of eigenface (one artist, Paglen, directly references the method in his work) through their engagement with and reformulation of composite forms of the face. Two of the artists, Blas and Paglen, have also produced written scholarly work alongside their artistic practices, and I have also made reference to this work. The concepts that these artists are working with are often articulated explicitly in these texts. I also had informal discussions with Blas and Paglen in person, which gave me further insight into the contexts and cultural circles in which they engage with their work. I conducted email interviews with Ruff, and I also refer to existing interviews with him that are included in catalogues of his work. All of the impressions I gained, both through written texts and in-person dialogue, provided further material for and insight into the approach they take towards facial recognition in their work. A primary motivation in choosing the artworks included in this study is that they use art as a vehicle for imagining alternatives to the technologies that increasingly govern our social life.

The two parts of this study experiment with the separate temporal trajectories of past and future. In historicizing the eigenface method by relating it to the composite portrait, this analysis consciously counters a preemptive logic of the technology and, instead, points "backwards" toward the past as a source for informing the future. The first part of this study, which analyzes the eigenface

method, may be understood as referring primarily to the past, while the second part points toward the future through an exploration of contemporary artistic interventions and a discussion of possible alternative responses.

Machinic Observer — Seeing as Recognition: Theoretical Framework

Because this study focuses on the visuality of AFR technology, I relate the empirical material under discussion here to the work of contemporary scholars of the image who have sought to understand how visual sense perception may be understood as a machinic process. Most of this work relates to a theme in visual culture theory concerning the "disembodiment of the eye" that occurs through the use of visual technologies and is often analyzed through referencing its expression in works of art. I argue that this theorization is useful in analyzing contemporary advanced visual technologies, but also that it has its limitations. Some of the ideas derived from this theory do not figure directly in the analysis, but I mention them here because they have inspired my thinking and my central approach to the analysis generally.

I'd like to begin an approach towards understanding machine vision with a reference to a scene from a film. In Charlie Chaplin's *Modern Times*, the protagonist, played by Chaplin, is working in a factory and becomes enmeshed in the rhythm and movements of the industrial line.[32] His arm movements become one with the rhythm of the conveyer belt that brings him more and more objects to clonk. Later on, his entire body gets entangled in the workings of an enormous machine that appears like the insides of a clock, complete with springs, cogs and levers. Chaplin's body, along with all its senses and movement, has been swallowed into the belly of the industrial machine. The factory of *Modern Times* depicts an era of pro-

32 "Chaplin Modern Times – Factory Scene (late afternoon)," YouTube video, 4:13, posted by "Olaf V/s Minions," September 5, 2015, https://www.youtube.com/watch?v=HPSK4zZtzLI.

duction in which the human body as a whole was employed within the industrial labor force of mass manufacturing, albeit in order to carry out specialized tasks. In contrast, thinking about how a person might become enmeshed in the labor and production processes of today's Information Age, it is clear that the dominant part of our body that is forced to work is not the arm but rather the eyes. Instead of the entire body becoming enmeshed in the rhythm of the industrial machine of production, the eye and the sense perception of sight become entangled within the operations of the information machine. The labor of looking has become a central demand within multiple contexts in the Information Age, where the challenge is often in making things visible, and thereby known, within a sea of data. Widespread surveillance practices have made it that the amount of data produced now far outstrips human capacities of understanding. Algorithms have been developed to codify this visual labor, to inspect and sort through the mass of data, to make "sense" through the automation of a form of sense perception. In this scenario, vision as a form of sense perception connected to the production of knowledge and meaning has become aligned with the logic, operations and rhythm (or temporalities) of the machine.

It is important to begin with a concept of machine vision, as it is a central concept that underlies my whole approach to analyzing AFR technology, as being a contemporary example. I am interested in AFR technology as an object of study because of the way it codifies and automates visual sense perception within an operation of recognition. Scholars have theorized machine vision within a discourse of art history and visual culture. John Johnston has outlined a concept of "machinic vision," which he defines as "not only an environment of interacting machine and human-machine systems but a field of *decoded* perceptions that, whether or not produced by or issuing from these machines, assume their full intelligibility only in relation to them."[33] In his use of the term "machinic," Johnston is drawing on the work of Gilles Deleuze and Felix Guattari and their understanding of the term as suggesting an "assemblage," that is,

33 John Johnston, "Machinic Vision," *Critical Inquiry* 26, no. 1 (Autumn 1999): 27, https://doi.org/10.1086/448951.

"a type of working relationship among heterogeneous elements."[34] Deleuze distinguishes this understanding of the machine, as a binary opposite of the human, or the organic. Johnston describes "machinic vision" as a disembodied perspective that derives from an assemblage of machine and human practices. He references expressions of a machinic vision, for example, through art in the paintings of Francis Bacon and in cinema through the work of Dziga Vertov. Again drawing on Deleuze, Johnston describes a machinic vision as rejecting a centered world view and a "phenomenological point of departure."[35] Instead, Johnston says that machinic vision is a "pure vision of a non-human eye, of an eye which would be in things." In this way, the act of seeing is liberated from an anchored point and becomes mobile – it may be found in objects, take on a molecular form and operate beyond human scale.

Two key movements of Deleuze's definition of the "machinic" that Johnston applies to vision are deterritorialization and reterritorialization. Johnston describes that the former occurs when a form of visual perception is freed from the person that is doing the seeing, and the latter is when that seeing is "recoded," that is, recontextualized and expressed in new form and, as a result, produces new meaning. Johnston argues that what must be understood is this recoding. He outlines the problem of approaching these moments and expressions as they occur in forms other than the traditional forms of art he previously mentioned, particularly when they occur in digital images. He states that:

> in order for there to be a deterritorialization and thus a decoding of perception, there must be a movement toward the outside of an assemblage and beyond its coding apparatus, a movement carrying us into a zone where images become indiscernible, often as a result of particle-ization of elements […] But for the digital image there is no outside, only the vast telecommunications networks that support it and in which it is instantiated as data. Instead of an outside,

34 Ibid., 28.

35 Ibid., 34.

> the digital image seems only to have an electronic underside […] which cannot be rendered visible.[36]

Johnston outlines the challenges of a circulatory and self–referential system found with images within digital networks. In the following analysis, I address the problem of revealing an "underside" of the digital image by basing my inquiry on a visual artefact of an AFR process. Specifically, I will approach the challenges posed by digital networks through a discussion on the recontextualization of the algorithmically produced eigenface image and through the examination of the work of artists who have relied on non-digital mediums. The movements that Johnston define are key in this analysis to understanding how an AFR process deterritorialize visual perception in an algorithmic process and reterritorialize it in an operation of recognition. I specifically problematize the "recoding" of vision through the eigenface algorithm and its ability to produce new meaning in terms of the identity of the subject being recognized.

Paul Virilio is someone who figures centrally in the theorization of machine vision and although his conceptualization on the topic does not appear in this analysis, he has nonetheless inspired my approach and thinking and therefore needs to be mentioned here. His book *The Vision Machine* predicted the widespread implementation of machine vision in society. He writes, "Unless you are Lewis Carroll, it is hard to imagine the viewpoint of a doorknob or a button on a cardigan. Unless you are Paul Klee, it is not easy to imagine artificial contemplation, the wide-awake dream of a population of objects all busy staring at you."[37] In his brief and singular reference to an "artificial contemplation," Virilio refers to works of literature and art production as mediums through which one can imagine and communicate the life of objects and in particular the perspective from which objects can perceive a subject. My own methodology is inspired by Virilio's suggestion that mediums outside of techni-

36 Ibid., 39.

37 Paul Virilio, *The Vision Machine*, trans. Julie Rose (Bloomington, IN: Indiana University Press, 1994), 137.

cal research might allow one to make sense of "artificial contemplation." Given the ways in which an automated process of vision considers and makes meaning of physical phenomena, this seems a promising suggestion. This analysis considers Virilio's suggestion in relation to algorithmic processes, and it attempts to formulate a narrative around *algorithmic* contemplation as it relates to AFR technology. As such, I like to bring Browne's aforementioned argument for a "critical biometric consciousness" into dialogue with Virilio: a kind of discourse between a social *consciousness* confronted with this algorithmic *contemplation*, whereby, at this intersection, it may map a critical terrain on the ways in which algorithms can give accounts to themselves through the perspective of an automated sense perception.

The artist Harun Farocki is another figure whose conceptualization figures in this analysis in particular his work with machine vision. Farocki's concept of "operational images" has been influential in understanding the ecology of images that result from the output of machine vision operations. He defines the term as "images that do not represent an object, but rather are part of an operation."[38] Farocki has described the operational image as an image that is unlike traditional images in that it is made neither to entertain nor to sell; operational images, he says, "are information and not really images."[39] He further describes the operational image as implementing a new visual regime where images are made by machines for other machines and, "the aesthetics of which are not intended."[40] The operational image poses a shift in the role of images from representational to operational, and as such ascribes to images an agency within a prescribed function. This is particularly pertinent to both parts of my analysis, but especially to the analysis of eigenface, which begins with the algorithmically produced eigenface image. The eigenface image is an example of an operational image, for it is

38 Harun Farocki, "Phantom Images," trans. Brian Poole, *Public* 29 (Spring 2004): 17 [12-22].

39 Harun Farocki, *War at a Distance*, video (Berlin: Harun Farocki Filmproduktion, ZDF, 2003).

40 Ibid.

generated only through its recognitive operation. Yet, the eigenface image overlaps the two registers of representation and operation in that it harbors both. The eigenface image is part of the operation of recognition in machine vision yet it is also an image that depicts the representation of faces (or the representational mechanism) within an algorithmic process.

Another aspect in framing the theoretical approach of this analysis, is relating an understanding of machine vision within a discourse on a historical construction of vision. Jonathan Crary's book *Techniques of the Observer* asks pertinent questions and provides certain points of departure that have contributed to the development of this outlook. Crary attends to the phenomenon of the observer (rather than to the artistic image as a source) in investigating vision as a historical construct. He states:

> For the problem of the observer is the field on which vision in history can be said to materialise, to become itself visible. Vision and its effects are always inseparable from the possibilities of an observing subject who is both the historical product *and* the site of certain practices, techniques, institutions and procedures of subjectification.[41]

Attending to the etymology of the term "observer" – meaning "to conform one's action and to comply with" – Crary describes the observer as "one who sees within a prescribed set of possibilities, one who is embedded in a system of conventions and limitations."[42] The materialization of vision, making vision, as a site of practices and techniques, "visible," is one of the primary concerns of this study. My concern is revealing the contemporary *machinic* observer as a primary observing subject. Joining Johnston's understanding of the term "machinic" as an assemblage with Crary's "observer," we can begin to explore these concepts as they manifest themselves in our

41 Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, MA: MIT Press, 1990), 5 (Italics in original).

42 Ibid., 6.

contemporary world, in the empirical material of AFR technology. In pursuing this concern, it is possible to reveal, in contemporary machine vision practices, certain historical continuities and discontinuities in the organization of vision. I seek to understand the materialization of the machinic observer's "system of conventions and limitations." Crary's focus on the organization and construction of vision as it is materialized through the human observer anticipates an organization of vision that is fully realized through the automated processes of AFR technology. His study reveals how vision has been constructed historically through the organizations of technology, society and science.

The theorists mentioned here so far have all contributed to a theoretical approach in how to understand forms of seeing that are machinic – as an assemblage, as codified, as industrialized and historically constructed. This provides a broader context within which to approach AFR as a technology in which the sense perception of vision gets enveloped by an automated process of recognition. In understanding AFR technology as one instance of a *machinic observer*, we can begin to formulate an account of how vision can be codified in a specific operation and within the conventions of "recognition." Yet, as I have explained, this codification is not without a history; it is, rather, embedded with historical and cultural practices of seeing.

In what follows, I use the phrase "a way of seeing" when referring to AFR technology as a way of making clear that these processes are embedded in cultural and historical contexts. This phrase is a direct reference to the work of John Berger, who seeks to understand the situated perspective of the observer in relation to works in art history. He mentions an especially central dynamic (albeit in a different context) between seeing and knowledge, which I argue underlies a central dynamic of machinic vision. He begins his book *Ways of Seeing* with the simple yet bold statement: "Seeing comes before words […] The relation between what we see and what we know is never settled."[43] He describes a gap between knowing something and seeing it. This gap is also a space in which a fluidity of mean-

43 John Berger, *Ways of Seeing* (London: Penguin Books, 1972), 7.

ing can exist – a fluidity of meaning that occurs before it can be cemented in the meeting of the two. As an example, Berger refers to the artist Henri Magritte, whose paintings conjure up this gap as dissonance, in the play between text and form. Seeing as recognition through machine vision, reverses this order whereby knowing comes before seeing. An algorithm must know a face before it can recognize it. Further, an image recognition algorithm must "know" the object before it can successfully perform an operation of recognition. This seemingly simple understanding of the order of things in vision prompts an important theoretical critique in the form of a question, one that underlies the analysis set out here: if a recognition algorithm must know the object before it can recognize it, how does that transform and limit its knowledge of the things it sees?

In addition to the theoretical framework concerning machine vision, this analysis is also informed and framed by an account of the body and of the imaging of the body as well as theories of biopolitics. I have drawn on the work of Allen Sekula and his study of the intersection of the body and the archive. In addition, the theory of biopolitics, specifically what it has to say about the body in relation to information and being made "intelligible," has also informed my understanding of the shift in knowledge production that occurs through the introduction of AFR technologies. As I have already established, biometric systems, as risk mitigation and security technologies, have specific desired outcomes, namely, to establish identity as clearly as possible in a geopolitical landscape of uncertainty and in the context of border control. The application of biometrics in these arenas submits the body to processes in which it gets translated into data, in the service of institutional ends. This makes it possible to inscribe the body with the institutional statuses of nationality and other terms and identities constructed outside the person's subjective experience of his or her body. AFR technologies, and biometrics in general, operate by both negating and legitimizing identity. What is sacrificed within this paradigm is the subjective experience of the body; one's own construction of self, grounded in the human sensorium, gets negated when confronted with an identity imposed from the outside. The identity and status associated with the biometric identity then has the operative func-

tion of dividing an individual not only from other bodies but also from herself. Biometrics creates a situation where one's body can act as a witness against oneself. It involves a process of dividing the surface of the individual, if you will, from what is beneath the skin, in which the body, in becoming a docile body subjugated to governance, becomes a subject of the state through its transformation into an image of the self.

This process of subjecting the human body to political inscription recalls Michel Foucault and what he terms "dividing practices," in which an individual's identity becomes defined in relation to society, and becomes vulnerable to exclusion according to prescribed categories, such as the "mad" and the "sane."[44] This division between the internal subjective experience of self and the external naming of an institutional identity becomes part of the mechanisms through which an individual is turned into a subject of governance. Foucault also describes two registers through which the subject becomes transformed into a "docile body" under state power and is both subject and subjugated to governance.[45] The first register is the "anatomico-metaphysical body" or "intelligible" body, that is, the body as an object of knowledge, for example the body as the object of certain forms of measurement.[46] The second is the "technico-political" or "useful" body that submits to and is used in regimes of discipline and correction in institutions such as the army, hospital, prison and school. Through the practice of biometrics, the scanned body inhabits both of these registers: biometrics provides a body that can be read and a body that is of use in virtue of its ability to produce information. This accords well with what Foucault says of dividing practices: when one is categorized by social and state norms, one experiences a divide either inside oneself or between oneself and others. Biometric practices, again, encompass both of

44 Michel Foucault, "The Subject and Power," Critical Inquiry 8, no. 4 (Summer, 1982):777-778.

45 Foucault references the work of Julien Offray de la Mettrie, *L'homme machine*, 1747.

46 Michel Foucault, Discipline and Punish (London: Penguin Books, 1991), 136.

these registers, in that, where the body can act as witness against oneself in the service of the categorical identities and statuses of the state, there exists a divide inside oneself, dividing what is beneath the skin from what is on the surface of it. One's embodied experience of subjectivity and the self is transformed into an image and becomes subjected to the state. The identity and status associated with the biometric identity then function to divide the individual from others.

How a body can be read and of use through a practice of biometrics is further referenced in the analysis through the work of Irma van der Ploeg, in particular her analyses on the "informatization of the body." Van der Ploeg argues that biometrics sets forth a new body ontology and she discusses biometric practices in relation to the supposed dichotomy between information – as in the "Information Age" – and materiality. She explains that technologies such as biometrics, which blur the line between "bodily matter" and "bodily information," have transformative effects on the level of embodiment and that this is important because "embodiment is central to individuality and identity in a way that my social security number or car rental records are not."[47] Van der Ploeg provides an important discussion of how biometrics traverses multiple boundaries of knowledge and simultaneously demands new definitions of bodily integrity. Her arguments provide further support for the claim that the implementation of biometric processes transform our understanding of the subject.

Outline

This dissertation is divided into two main parts. The first part is a close analysis of the AFR method of eigenface and a historicization of the processes involved with this method. The second part at-

47 Irma van der Ploeg, "Biometrics and the Body as Information: Normative Issues of the Socio-technical Coding of the Body," in *Surveillance as Social Sorting: Privacy, Risk and Digital Discrimination*, ed. David Lyon (London: Routledge, 2003), 70.

tempts to move toward a reimagining of facial recognition technology and its technical processes through an examination of the work of contemporary artists whose pieces reveal possible alternatives to the logic of this technology. Taken together, these two parts constitute an analysis of the visuality of automated facial recognition.

The first part begins with an introductory chapter on AFR technology, briefly outlining the problems and challenges that have arisen in the course of its development. The discussion then moves to an overview of the eigenface method and its technical features, outlining three aspects of its recognition process: Principal Component Analysis (PCA), the eigenvector and the "face space." The eigenface method is then related to the historical practice of composite portraiture as developed by Francis Galton, and I discuss the use of statistics as a way of seeing. Galton's practice of finding statistically salient patterns in composite portraits in order to create images of "types" serves to open up an inquiry into reductive forms of knowledge production. Ludwig Wittgenstein, who himself produced a composite portrait inspired by Galton, is brought into this discussion as the source of an alternative approach to the composite that does not follow the statistical logic of perception put forward by Galton. Wittgenstein refers to the composite portrait in the course of his philosophical investigations of language; for Wittgenstein, the composite portrait is both a rendering of the overlap of similarities between forms and a depiction of the particularities, and it thus resists any theory of generality. He refers to the composite specifically in relation to his idea of family resemblance and his account of concept formation. As I show, his perceptual interest in the composite lies not in the static center of the image, where the average can be perceived, but rather in the outlying areas, where a perceptual movement between forms can be perceived. This approach is discussed further with reference to Wittgenstein's concepts of "aspect perception" and "aspect blindness." Wittgenstein presents an alternative aesthetic approach to the composite portrait, one that directly inverts Galton's approach and, by implication, the statistical logic that underlies the eigenface algorithm. In this, Wittgenstein opens up a perceptual space in the composite portrait that defies the singular output of recognition, and he in-

stead argues for a perceptual clarity grounded in being able to see the fluidity of forms. I argue that, in relation to the contemporary context of ubiquitous facial recognition technology, this Wittgensteinian approach has both utopian and political implications.

The second part of the book focuses on artistic interventions. The artworks included in this study are understood as providing visualizations of the algorithmic process as well as of critical theoretical concepts. The work of artists provides further context to the application of contemporary facial recognition technologies, while also reconceptualizing and reimagining the use of such technologies in society. Working specifically through a visual vocabulary, artists are in a unique position to articulate how these technologies play a primary role in enculturing processes of perception and representation.

The second part draws on the analysis provided in the first. It begins with a survey of composite portraits in art, before introducing the work of Thomas Ruff, in particular his studies of identification portraiture and composite portraits in his series *andere Portraits* (1995). This examination of Ruff's *andere Portraits* looks into his appropriation of the Minolta Montage Unit, a photographic apparatus first utilized by police in Berlin in the 1970s to produce composite mugshots. Although Ruff's series does not directly deal with an algorithmic process, his work is relevant to my discussion because it problematizes the forms of representation in facial recognition practices. By taking portraits of portraits, he raises questions about the forms of representation found in identification photography and confronts the diffused relationships between archival practices and the production of subjects, citizenship and identity. As such, his work expresses some themes that are latent in the eigenface image, and it can inform our understanding of the structures of representation found in facial recognition systems. I also argue that his work may be understood as a contextualization and visualization of Wittgenstein's concept of aspect perception. I analyze individual images from the *andere Portraits* series in order to discuss Ruff's rendering of the fluidity of gender, which serves as a critique of a binary understanding of identity.

The next chapter covers the work of Zach Blas, and particularly his piece *Facial Weaponization Suite*. With this, the discussion of artistic interventions moves into the more contemporary context of facial recognition algorithms, presenting a conceptual strategy of resistance to the algorithmic gaze. I discuss Blas's own theoretical writings, which complement his art production with references to Édouard Glissant's concept of "opacity." Blas advocates a right to a specifically "informational" opacity, that is, a right to not be seen, identified and archived. Blas's work may be understood as a sculptural form of the composite portrait, that is utilized as a mask in order to resist identification. Blas's work confronts the reductive practices of automated recognition through a strategy using an excess of facial forms. In this way, I argue, Blas's work inverts the algorithm's representational mechanisms to resist an operation of algorithmic recognition.

The third chapter in this part is a study of the work of Trevor Paglen. Paglen's artistic approach can be understood in terms of a notion of transparency. Rather than confronting the end gaze of facial recognition technologies, Paglen's work ventures into the processes of algorithmic recognition that underlie this gaze, taking, as its artistic material, the training sets used by image recognition algorithms. In this way, I argue Paglen utilizes the algorithmic process as a ready-made object that has become ubiquitous in contemporary society and modifies its output in order to produce artistic objects. My study of Paglen's work focuses on two of his pieces: *Adversarially Evolved Hallucination* (2017) and *Eigenface (Even the Dead are Not Safe)* (2017). In the latter, through the subjects that Paglen chooses for his portraits, the eigenface image is related both to discourses in contemporary art and to discussions in political philosophy. These two works are further explored in relation to the goal of reimagining the very structures and outcomes that define algorithmic perception and its expanding role in the production of knowledge in society.

The concluding chapter summarizes the main findings and recommendations of this study and highlights potential areas for further research. This chapter also discusses the overarching theme of the composite as an aesthetic form that structures knowledge pro-

duction in the Information Age. In closing, I offer some thoughts about controversial uses of facial recognition technology that came to light during the final stages of writing this book.