

**SCIENTIFIC WRITING AND THE PRODUCTION OF FACTS: EXAMINING THE USE
OF KNOWLEDGE AND IGNORANCE PRODUCING STRATEGIES DURING TIMES OF
SCIENTIFIC CONTROVERSY**

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Abstract

With the large amount of research constantly being conducted, all documenting important aspects of multiple phenomena, what makes some scientific claims, and not others, stand out from a sea of possibilities to become staple pieces of knowledge? Utilizing the controversy surrounding the use of heritability studies in criminological research as a case study, this thesis analysed the rhetoric at play in two articles presenting competing arguments to (a) identify some of the discursive devices and strategies used in the production of scientific knowledge and ignorance, (b) illustrate that the production of scientific facts is first and foremost a social endeavour, (c) show that knowledge and ignorance are a part of a duality, (d) explain how the same established scientific information can be used in new claims to generate varied forms of scientific knowledge and ignorance, and (e) illustrate how the production of scientific knowledge and ignorance oftentimes involves appealing to audiences' emotions. Four main ignorance producing strategies were documented, namely denial, dismissal, diversion, and displacement, each of which were used in a number of ways to increase the facticity of scientific claims over that of competing ones. Acknowledging its strengths as a unique mode of knowledge, this study also underlines the importance to get comfortable with the uncertainties and conflicts at the heart of science.

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Table of Contents

ABSTRACT	II
ACKNOWLEDGEMENTS.....	III
TABLE OF CONTENTS.....	IV
INTRODUCTION.....	1
SCIENTIFIC CLAIMS MAKING AND REFERENCING PAST LITERATURE	2
SITUATING THE PRESENT RESEARCH	3
LITERATURE REVIEW.....	5
NATURE VS. NURTURE DEBATE	5
THE RISE OF THE BIOLOGICAL PARADIGM.....	6
THE RISE OF THE SOCIAL	10
THE RESURGENCE OF HERITABILITY STUDIES	12
PRESENT STATE OF THE DEBATE.....	15
STUDYING THE TENSIONS BETWEEN SCIENTIFIC PARADIGMS.....	16
PAST TAKES ON THE TOPIC	17
THEORETICAL FRAMEWORK	19
APPROACHES TO SCIENCE AND KNOWLEDGE	19
ESSENTIALIST/SOCIAL CONSTRUCTIONIST CONTINUUM.....	19
HYBRID VIEWS OF SCIENCE AND TECHNOLOGY	21
PARADIGMS AND PARADIGM SHIFTS.....	26
SCIENTIFIC CONTROVERSIES AND CONTROVERSY STUDIES.....	28
APPROACHES TO THE STUDY OF SCIENTIFIC CONTROVERSIES.....	30
FACTICITY.....	33
SCIENTIFIC WRITING AS AN ACTOR	34
IGNORANCE.....	36
HOW IS IGNORANCE PRODUCED?	38
INTENTIONALITY IN IGNORANCE AND KNOWLEDGE PRODUCTION	39
METHODOLOGY.....	42
NORMATIVE ENGAGEMENT AND POSITIONALITY.....	42
SELECTION OF THE CONTROVERSY/MATERIAL.....	44
ANALYTICAL GRID AND ANALYSIS PROCESS.....	48
PRESENTATION OF THE CASE STUDY	49
<i>Burt and Simons</i>	49

<i>Barnes et al.</i>	51
RESULTS	54
DENIAL	55
<i>Evolution of Heritability Studies' Denial</i>	55
<i>Examples of Denial in the Articles</i>	56
DISMISSAL	61
<i>Direct Dismissal</i>	61
<i>Indirect Dismissal</i>	67
DIVERSION	76
DISPLACEMENT	76
DISCUSSION	79
REVISITING THE ARGUMENT	79
CONTRIBUTIONS AND FUTURE DIRECTIONS.....	80
CONCLUSION	84
REFERENCES	85
APPENDIX A	105

Introduction

“Alternative facts”, a phrase coined in 2017 by then former US president’s advisor, Kellyanne Conway, as an attempt to justify dubious claims made by the then White House press secretary about the size of the presidential inauguration audience. Not surprisingly, soon after her statement, Conway was heavily criticized and mocked across the border due to her nonsensical use of these two words. Indeed, by their literal definition, facts, which are pieces of information that have an objective, and thus unique reality, cannot be alternative (“Fact,” 2021). That being said, Conway’s words are well fitted to describe the state of skepticism and informational division in which we are currently living. Now, more than ever, there appears to be a great divide on what different people believe to be actual facts and what they consider to be “fake news”.

In news articles, social media websites, and even daily social interactions, individuals from different sides of the political and/or social spectrum seem to be absolutely convinced that what they believe in is the one and only truth, while at the same time, completely dismissing their counterparts claims as obvious falsehoods. This phenomenon is not necessarily the result of an increase in the number of individuals with an inflated sense of ego, but rather a multitude of different and complex factors, most notably an increase in social media use and the algorithms that control the content presented to social media users.

Social media algorithms are designed to, for the most part, show content that aligns with the users’ own belief systems. While sometimes the case, this does not mean that certain types of information is exclusively presented to a group of people and not another, but rather that the manner in which this information is presented varies depending on the point its sources are trying to transmit. For instance, depending on their main audiences’ standing regarding COVID-19 vaccination mandates, some news outlets may choose to emphasize the negative symptoms that some individuals have experienced after having received the vaccine (Weiland et al., 2020), while others may highlight the small likelihood of vaccinated individuals of experiencing these negative symptoms (Christensen & Mascarenhas, 2021). This way, while in both scenarios the news outlets are reporting on the same subject matter (i.e., the COVID-19 vaccine and its potential negative side effects), their messages can be perceived very differently by their targeted audiences.

This illustrates the complex relationship that exists between individuals' experiences and their realities. Facts are not inherent nor absolute. Sometimes facts are purposefully twisted (e.g., "fake news"); sometimes they are partial (e.g., COVID-19 news scenarios). But facts are always constructed. Their construction involves the recruitment and mobilization of a great number of elements that, when made to act in a harmonious manner, create a reality that can be agreed upon by most people. It is this process of fact construction that the present research will document.

Scientific Claims Making and Referencing Past Literature

The use and framing of past knowledge to advance particular claims is a large component of academia and the production of scientific facts. New scientific knowledge is built upon past scientific ideas and findings, as what is believed to be true at a particular point in time sets the stage for the kind of research that is planned, developed, and conducted. Every new scientific study is either inspired or supported by past scientific findings, theories, and/or methodologies. Nowhere is this more salient than in the writing of scientific articles, where a significant portion of their structure is dedicated to updating readers on what is known, and is not known, about the topic under investigation.

The mentioning of already established scientific information in scientific articles not only situates new research and research findings in reference to what is currently in the literature, but can also give authors' claims a sense of legitimacy. Established scientific information can be included in scientific articles as a way of supporting the authors' claims, thus making these appear closer to becoming established in the literature themselves. As such, the inclusion of established scientific information in scientific articles can be seen as part of a circular process through which new scientific knowledge gets produced to then be used in the production of other scientific knowledge.

However, it is not enough for established scientific information to be referred to in an article for the authors' claims to become a fact. The manner in which this scientific information is introduced in the context of new studies can have very different legitimating effects on the author's claims. The same piece of scientific information can be framed or modalized in a number of ways to produce very different effects on the facticity of certain scientific claims (Latour, 1987). For instance, inserting information in an article using certainty verbs (e.g., *x confirms that y produces z*), as opposed to using tentative verbs (e.g., *x suggests that y may produce z*), is likely to make that information, and by extension, the author claims appear more

factual. While the framing of established scientific information can lead to an increase in the facticity of scientific claims, it can just as likely make other scientific claims appear less factual, or what will be referred from now on as producing scientific ignorance. Indeed, authors may use rhetorical writing devices when discussing established scientific information in their articles to produce ignorance of scientific knowledge that may be discordant to their own claims.

In times of scientific controversy, when there is conflict among members of a scientific discipline due to their contrasting perspectives on a scientific issue, the use of knowledge and ignorance producing strategies in scientific writing plays a very important role. Indeed, within a controversy, researchers with contrasting scientific perspectives must confront one another in order to have their respective claims appear more legitimate than all other alternatives. The writing of scientific articles and the utilization and framing of established scientific information within thereof, is a necessary tool to accomplish this end. As such, the study of the interactions between proponents of opposing views within ongoing scientific controversies provides the perfect stage for the identification and assessment of these types of strategies.

Situating the Present Research

As explained above, the facticity of a scientific claim, that is, the degree to which a scientific claim is considered a fact, is not a given outcome of the scientific method. Instead, facticity is construed through complex rhetorical processes that involve the legitimization of supporting knowledge and the simultaneous delegitimization, or production of ignorance, of opposing arguments. Through the exploration of an instrumental case study, the highly active controversy involving the use of heritability studies in biocriminological research, the present paper seeks to bring to light some of these rhetorical processes.

The main objectives of the present research are to (a) identify some of the discursive devices and strategies used in the production of scientific knowledge and ignorance, (b) illustrate that the production of scientific facts is first and foremost a social endeavor, (c) show that knowledge and ignorance are a part of a duality, (d) explain how the same established scientific information can be used in new claims to generate varied forms of scientific knowledge and ignorance, and (e) illustrate how the production of scientific knowledge and ignorance oftentimes involves appealing to audiences' emotions. Diving into this heritability controversy underlines the interest of studying the productive power of controversies and the importance for

criminologists to get comfortable with scientific uncertainties to overcome the prevalent idealized understanding of science (Lahsen, 2012, 2013).

The present paper will begin with a brief overview of the history of criminology as a social science, explaining the role that heritability studies have had within the discipline over the years as well as the controversies surrounding their use. Following this historical background, the present research will situate itself in reference to different approaches to the topics of science and the production scientific facts, introducing key theoretical and conceptual frameworks that will guide the examination of the heritability studies' controversy and the knowledge and ignorance producing strategies used by researchers in their scientific writings. Scientific articles from proponents of opposing sides of the heritability studies controversy will then be briefly described and examined for knowledge and ignorance producing strategies, which will be then, in turn, assessed and explained. Lastly, the present paper will tie up all the introduced ideas in a discussion concerning what its involved in scientific fact making and culminate by providing recommendations for future research.

Literature Review

Nature vs. Nurture Debate

It is human nature to want to understand the human experience and seek for reasons as to why people are the way they are and behave the way they do. From evolutionary remnants (Roberts, 2012) to learned habits (Fryling et al., 2011; Jeffery, 1965), explanations for human behaviours have been numerous and greatly varied throughout the ages.

Questions surrounding the “natural” (i.e., outside human control) versus the “not natural” (i.e., within human control) features of human experience have been a continuous topic of debate since antiquity in multiple areas of study, including medical thinking (e.g., Galen) and theories of justice (e.g., Plato and Aristotle; Meloni, 2015). For instance, until early modernity, this dichotomy had been very influential in the way medical conditions were thought about by delineating boundaries between what were considered non-modifiable (e.g., temperament and constitutions) and modifiable (e.g., nutrition and climate) aspects of human life (López-Beltrán, 2004; Meloni, 2015; Müller-Wille & Rheinberger, 2012).

The summoning of a similar dichotomy can also be observed in early records of socio-political thought by Plato and Aristotle, where notions of natural inequalities were used to explain stratification practices in societies (Meloni, 2015). Natural inequalities, in this context, represented all that lied outside the domain of justice and human intervention. If an inequality was seen as rooted in nature, human intervention was said to be futile or unnecessary (Meloni, 2015). Therefore, the categorization of human and social experiences into the realm of natural or not natural greatly influenced the way not only different scientific disciplines perceived and reacted towards the world, but also the way societies were organized and governed.

More recently, in the social sciences, the dichotomy of the natural versus not natural has evolved into what is now known as the nature versus nurture debate. This debate centers on the relative contribution of nature in the form of genes, or the biological, and nurture in the form of the environment, or the social, on human development and behaviour (Lorenzen, 2001). While the idea of human behaviour being the product of nurture has been relatively well received across different social science disciplines (e.g., Fornili, 2018; Hewitt et al., 2018; Patton, 2016; Warner et al., 2016), the concept of nature, or a person’s biological composition influencing their behaviour, has been the object of criticism from the scientific community in more modern times (e.g., Carrier & Walby, 2014; Gibel Azoulay, 2006; Munthe & Radovic, 2015; Singh & Rose,

2009; Venkatasubramanian & Keshavan, 2016; Walby & Carrier, 2010). Indeed, biological explanations of behaviours have been accused of being too deterministic, reductionist, and essentialist (Walsh & Wright, 2015), without mentioning, ethically problematic (e.g., Singh & Rose, 2009). However, this has not always been the case, as history has repeatedly shown that the domination of either one of these positions can and does shift with the passing of time.

The Rise of the Biological Paradigm

To better understand how different paradigms in the social sciences have favoured the nurture and nature positions individually at different points in history, it is important to first identify and analyse historical events that may have influenced the zeitgeists of the times. People's paradigmatic beliefs are closely linked to historical contexts. That is, the way people understand the world at a particular point in time is significantly influenced by the social, economic, and political conditions of the epoch they exist in. Consequently, whenever a historical event occurs, or new technological achievements are introduced, commonly held beliefs and assumptions about the world (i.e., dominant paradigms) are likely to change. It is the period of time between the catalyst that starts these changes and the adoption of a new dominant paradigm that will be referred to as a transitional period from now on.

At the beginning of the nineteenth century, a paradigmatic shift began to take place, as the social sciences became increasingly influenced by two very important movements of thought: positivism and the philosophy of evolution, or Darwinism (Morrison, 2013). On the one hand, the increased influence of positivism led to a rise in the engagement of scientific methodologies in the investigation of social phenomena (Hedley et al., 2018; Morrison, 2013). Social phenomena came to be seen as information that could be systematically collected and analysed in the same way as it had been done with material data in the natural sciences for many years prior. The gathering of observable and measurable information using scientific tools, such as census and surveys, became of great interest for all social science disciplines (Morrison, 2013).

The second movement of thought influencing the social sciences during this time was Darwinism (Morrison, 2013). In his most famous work, *On the Origin of Species*, Darwin (1859) outlined the idea that all forms of life, including human beings, were continuously evolving as a response to an always-changing natural environment. His ideas about evolutionary biology significantly affected the way people thought about the social sciences. Society and human behaviour came to be analysed through an evolutionary lens and previous paradigms supporting

a link between humans and the divine were abandoned and replaced by a biological perspective for the most part (Morrison, 2013; Rosenberg, 2000).

Over the following decades, the biological paradigm dominated the social sciences, with researchers, politicians, and influential thinkers often linking human behaviour to their biological compositions (e.g., Brozek & Keys, 1945; Bruno, 1942; Dugdale, 1910; Fink, 1985; Miller & Goldsmith, 2001). This biological turn took hold of most of the research currently being done in multiple social science disciplines, including psychology, sociology, and most notably, criminology. Indeed, influenced by positivism and Darwinism, researchers in the field of criminology began using crime statistics and criminal profiles as a way of finding a connection between biology and antisocial or deviant behaviours (e.g., Bertillon, 1889; Galton, 1890; Lombroso, 1876).

No better example of this exists than the extremely influential work of Cesare Lombroso, *L'uomo d'ilinquente*, where, in 1876, by analysing portraits of criminal offenders ('Faces of criminality'), he sought to demonstrate that criminality was a sign of a "primitive form" (i.e., atavism) within modern society. Lombroso sustained that, just by looking at a person's appearance, it was possible to establish whether or not someone accused of a crime was the perpetrator. Importantly, Lombroso's conclusions not only stimulated the adoption of a biological paradigm within the discipline of criminology but also had direct interference in practical crime investigations as well as the creation and execution of social policies (Morrison, 2013).

Fuelled by the work of Lombroso and those who followed his steps (e.g., Kretschmer, 1999; Lange, 1931), throughout the remaining of the nineteenth century and beginning of the twentieth century, the study, management, control and prevention of crime embraced a biological paradigm. Around the same time, a great number of crime statistics started to be systematically collected mainly from court records and prison census (Robinson, 1933). The extensive amount of data collected using these methods allowed for the discovery and analysis of patterns of criminal behaviour and the subsequent association—sometimes accurate, sometimes inaccurate—of crime with other social and non-social factors (Morrison, 2013).

Unfortunately, however, the growth in popularity of the biological paradigm in the social sciences took a dark turn during the late part of the nineteenth century, as research in this area,

and the knowledge it produced, became increasingly used as justifications for discrimination, social control, and other nefarious practices.

Eugenics, that is, the practice or advocacy of controlled selective breeding of human populations with the aim of improving the human species, was first introduced by Francis Galton in the late eighteenth century (Bashford & Levine, 2010). Galton promoted the idea of eugenics as a way of “improving the human race by getting rid of the ‘undesirables’ and multiplying the ‘desirables’” (Kevles, 1999, p. 435). Eugenic doctrines quickly gained great popularity among biology scholars of the time, including physicians, mental health professionals, and scientists, who were interested in pursuing new leads in the discipline of genetics (Kevles, 1999). As a result, the topic of eugenics became widely popularised in mediums used in the dissemination of scientific knowledge, such as textbooks, lectures, and articles for the educated public, and social issues came to be explained by experts as resulting from the proliferation of “feeble-minded”¹ people (Kevles, 1999, p. 435). Reminiscent of Plato’s and Aristotle’s socio-political thoughts on social stratification, the social issues of the time, such as poverty and criminality, came to be commonly attributed to “bad genes” rather than societal flaws.

While the eugenic movement gained momentum in multiple countries, including Denmark, Sweden, and Britain, throughout the nineteenth century, it was in North America, and especially the United States, that its influence took the strongest hold (Bashford & Levine, 2010; Kevles, 1999). By the end of the nineteenth century, several laws and regulations in the United States had been adopted to conform with eugenic ideologies (Bashford & Levine, 2010). For instance, in 1895, the state of Connecticut passed a law that prevented individuals suffering from epilepsy or who were considered feeble-minded from getting married (Bashford & Levine, 2010). Likewise, around the same time multiple organizations were created with the intention of furthering eugenic studies. These included organizations such as the American’s Breeder’s Association, Kellogg’s Race Betterment Foundation, and the Eugenics Record Office (Bashford & Levine, 2010).

At the beginning of the twentieth century, eugenic doctrines became increasingly problematic, as forced sterilization of vulnerable populations began to be implemented under the pretense of protecting society from the offspring of seemingly undesirable individuals (Bashford

¹ A term used in the nineteenth century to refer to individuals believed to have some form of mental deficiency.

& Levine, 2010). It is estimated that around 20,000 sterilizations occurred in California state mental institution between the years 1909 to 1979 (Stern et al., 2017). Also, according to a Government Accountability Office's investigation conducted in 1976, between 1970 and 1976, 25 to 50 percent of Native Americans were sterilized, often without their consent (Comptroller General of the United States, 1976; Dillingham, 1977). During the interwar years, the questionable ethics of such medical operations, as well as the emergence of new scientific findings pointing at a disconnect between genes and certain mental disabilities, led multiple scholars to distance themselves from eugenic doctrines, which had increasingly been labelled as classist and racist (Kevles, 1999).

As terrible and unethical as forced sterilization was in North America, the eugenic movement did not lose most of its popularity until the end of the Second World War following the aftermath of the Nazi eugenic experiments. During the mid-twentieth century, the idea of using biological factors as predictors of future criminal behaviour began gaining popularity in Nazi Germany and Fascist Italy, as authorities looked for ways to justify the different treatment and abuse of persecuted minorities (Rafter, 2008). During the Second World War, Nazis in Germany and Fascists in Italy employed biological theories of crime to validate the targeting, incarceration, and murder of individuals whom they deemed to be hereditary "asocials" (Rafter, 2008, p. 294). Jews, Gypsies, and Ethiopians, among others, were categorised, on the basis of Lombroso's teachings, as "criminalistic" and "degenerate" races (Rafter, 2008, p. 298). As a result, eugenics became one of the principal driving forces behind the systematic elimination and sterilization of individuals who had been identified as "hereditary criminals" (Kevles, 1999; Rafter, 2008, p. 294).

As the Second World War ended and the complicity of eugenics and biological theories of crime in the atrocities committed by Nazi Germany and Fascist Italy were revealed, the social scientific community shifted its focus away from biological explanations for human behaviour to adopt a more sociological perspective. This separation was made evident by the overt removal of eugenic doctrines' connotations from key scientific institutions. This included the renaming of important scientific journals, such as the *Eugenic Quarterly*, which came to be known as *Social Biology*, as well as scientific associations such as the American Eugenics Society, which became the Society for the Study of Social Biology in 1972 (Meloni et al., 2016). This marked the beginning of the end of the domination of the biological paradigm in the social sciences and the

subsequent use of eugenics and biological theories of crime as cautionary tales of what can occur when “bad science” is used by bad people (Rafter, 2008, p. 288).

The Rise of the Social

The end of the Second World War marked a paradigmatic transitional period in a number of social science disciplines, including most notably, the discipline of criminology. Following the atrocities that were committed during times of war on the basis of biological theories of crime, it did not take long for the field of criminology to begin distancing itself from the biological paradigm (Wright & Miller, 1998). By mid-century, biological explanations for crime were deemed unacceptable, disreputable, and even in some cases, taboo (Sagarin, 1980; Wright & Miller, 1998). This sentiment was captured by Sagarin’s (1980, p. 9) remarks about criminologists who defended the association of biological predispositions to crime, who he said were “often given short shrift, their ideas [were] dismissed with derision, [and] they [were] in other ways subject[ed] to an informal collegial punishment, perhaps short of ostracism, but nonetheless unwelcome.”

As the biological paradigm was losing its grip on criminological theories and practices, the sociological paradigm began rapidly gaining popularity. Gradually, the study of criminal behaviour came to be understood as the result of social disorganization and social learning, changing the focus away from the study of inherent criminal tendencies (Gibbons, 1994; Larregue, 2018, 2020; Sutherland et al., 1992).

While far from being the only critics of the biological paradigm in criminology at the time, one of the leading proponents of the sociological paradigm was Edwin H. Sutherland, who, through the publication of multiple essays, reviews, and textbooks, instigated a relentless campaign to dismiss popular biological arguments about criminal behaviour (e.g., Conwell & Sutherland, 1937; Sutherland, 1961; Sutherland et al., 1992; Sutherland & Cressey, 1974). Sutherland’s influence in the discipline grew so strong that the multiple textbooks he wrote became and remained a staple of criminology classrooms for many years during and after the peak of his career (Wright & Miller, 1998). As a result, numerous generations of criminology students, many who would later become teachers, learned and internalized a rejection for biological explanations of crime. By the time of his death in 1950, Sutherland had accomplished his goal of eliminating any form of biological thinking from mainstream criminology (Wright & Miller, 1998).

During the rest of the twentieth century, biological theories of crime were significantly scarce in prominent, mainstream academic literature. According to a study conducted by Wright & Miller (1998), not even one of all introductory criminology textbooks published in the United States between the years 1961 and 1970, devoted more than 10% of its space to biological arguments. Moreover, biological theories of crime occupied less than 3% of the combined introductory criminology textbooks' materials, and were more often than not presented as examples of "bad science". Indeed, Wright & Miller found that 75% of the introductory criminology textbooks they analysed portrayed biological explanations for crime as having little to no empirical support.

It is important to highlight the fact that the information presented in introductory course textbooks has the ability of significantly influence the manner in which a discipline evolves by controlling how certain forms of scientific knowledge are perceived not only for the time being, but also prolonged periods of time. In the majority of cases, introductory textbooks are the first sources of information where new and inexperienced members of any particular discipline get introduced to what is known and what is there to be discovered in their field of study. As such, the information presented in textbooks set the stage very early on for the type of knowledge members of any one particular discipline will be expected to accept and produce throughout their careers.

Furthermore, compared to articles, textbooks tend to present information in a more direct and affirmative manner, as they discuss study findings as if they were taken for granted facts, avoiding tentative language, such as "suggest" or "imply", which may shed light on the limitations of their production process (Bertotti & Miner, 2019). On the one hand, this allows future researchers to learn from and build upon already existing knowledge, by providing them a jumping-off point. On the other hand, however, this further reinforces the boundaries between what is commonly accepted as right and wrong types of knowledge and knowledge production processes. Proponents of views that oppose those of the dominant paradigm might therefore find themselves in a difficult position when trying to raise questions about research findings that appear in textbooks, and, most significantly, recruiting supporters within their discipline who could help them raise awareness of and legitimize their arguments.

To this day, a large number of criminologists have continued to condemn biological explanations of crime, some of the most resilient being sociological criminologists who endorse

critical perspectives (e.g., Walsh & Wright, 2015). Based on the assumption that crime is the by-product of structural relations in the political economy, critical criminologists tend to politicize biological arguments for crime and associate them to larger societal systems of inequality, such as sexism, racism and classism. Time and time again, biosocial criminology studies have been accused of being based on flawed assumptions and experimental designs (e.g., Joseph, 1998; Kamin, 1974; Wahlsten, 1990), without mentioning the large list of allegations claiming their involvement in the fostering and maintenance of multiple systems of social oppression (e.g., Carrier & Walby, 2014; Guy & Chomczyński, 2018; Larregue & Rollins, 2019; Roberts & Rollins, 2020).

This, as well as the historical tendency to pass down information dismissing biological explanations of crime in the favour of sociological ones, have fostered and enforced the “taboo” image of the biological paradigm in criminology that remains to this day (Wright & Miller, 1998). As a result, throughout large part of the twentieth century, the dominant paradigm of criminology, as well as the ways Western societies have constructed, developed, and implemented crime prevention and treatment interventions, have been almost entirely based on sociological theories of crime (Wright and Miller, 1998).

One must just take a look at the interests of the recent elected presidents of the American Society of Criminology, to be able to recognize that the social paradigm is still dominant in the discipline of criminology (Larregue, 2017). As if this was not enough evidence, a report by Larregue in 2018 indicated that, since 1970s, only 200 articles discussing biosocial themes have been published in Criminology Journals, with the vast majority of them having been published in the last 10 years or so. This goes without mentioning the limited number of college-level courses that are solely devoted to biosocial criminology (Wright et al., 2008), the negative, antiquated, and, as already mentioned, scarce representation of biological theories in criminology introductory textbooks (Beaver et al., 2015), as well as the lack of academic job opportunities offered to criminologists who support a biological perspective of crime (Beaver et al., 2015; Larregue, 2018). All of these examples demonstrate that in what concerns the discipline of criminology, the biological paradigm continues to experience rejection from the mainstream.

The Resurgence of Heritability Studies

While the hegemony of the sociological paradigm continues in criminology, its domination has been increasingly weakened since the end of the twentieth century due in part to

the development of new technologies capable of reproducing images of brain activity in real time (e.g., fMRI, PET, TMS), the creation of novel and improved medications to treat and enhance different mental conditions (e.g., Ritalin), and the advancement of knowledge on genetics (e.g., epigenetics). With the introduction of new methods to capture, measure and manipulate biological correlates of human behaviour, an increased interest in biological viewpoints has resurfaced not only in the field of criminology but in many other social sciences as well (Cacioppo et al., 2014; Fournier & Poulain, 2018; Larregue, 2020; Masters, 1996; Rapp, 2011).

Another major contributor to the resurgence in popularity of the biological paradigm in the social sciences came in the form of a number of publications exploring the association between nature and nurture in human behaviour and development. These included but were not limited to E. O. Wilson's (1975) ground-breaking *Sociobiology: The New Synthesis*, a complex examination of human behaviour seen as a combination of genetic factors (nature) and social learning processes (nurture), as well as James Q. Wilson and Richard J. Herrnstein's (1985) ambitious *Crime and Human Nature*, which attempted to explain criminal behaviour as result of rational choice and genetic constraints. This, as well as new evidence of biological correlates of human behaviour made possible by technological advancements, has led to the growing presence of the biological paradigm into mainstream criminology spaces, such as conferences (e.g., Masters, 1996), literature (e.g., Beaver et al., 2015; Gajos et al., 2016; Vaske, 2017; Wright & Miller, 1998), classrooms (e.g., Schwartz & Beaver, 2019), and even court proceedings (e.g., Becker, 2012; Farah, 2012; Glenn & Raine, 2014), despite significant resistance from its opponents (e.g., Carrier & Walby, 2014; Munthe & Radovic, 2015; Walby & Carrier, 2010).

Because of its increased accessibility, as well as the limited number of resources it demands relative to other specialized branches of biosocial criminology (e.g., neurocriminology), research on genetics has particularly gained significant momentum in the discipline (Larregue, 2018, 2020). Indeed, due to the “generosity” of behavioural geneticists, who have avidly shared their tools, expertise, and knowledge with their fellow scientists, proponents of the biological paradigm have been able to conduct a growing number of studies looking at the influence of genes in criminal and maladaptive behaviours (Larregue, 2018, p. 37; Panofsky, 2014). For

example, having access to large genetic databases and twin registries, such as Add Health², has allowed biosocial criminologists, and other non-geneticists, to mobilize genetic data and methodologies to analyse the development and evolution of issues that were once only considered in social or environmental terms (Larregue, 2018). As a result, close to 70% of all biosocial criminologists' empirical articles concern for the most part quantitative and/or molecular genetic factors (Larregue, 2018).

A mayor focus of the study of genetics has been the identification and separation of the variation in observable trait outcomes into a proportion that can be attributed to genes (heritability) and a proportion that can be attributed to environmental factors (Larregue, 2020). Heritability refers to the degree to which differences in people's genes can account for differences in their traits (Larregue, 2020). These traits could be anything, from physical characteristics (e.g., Bräuer & Chopra, 1980), to diseases (e.g., Braverman, 2015), to behaviours (e.g., Beaver et al., 2008). The study of changes in behaviours as they are affected by genes consists mainly on observing and comparing behaviours within and between families that share different arrays of genetic relationships in order to estimate genetic influences (Larregue, 2020). A great number of these studies have found that variance in almost every human characteristic, including social behaviours, is heavily influenced by people's genes (Plomin, 2008; Turkheimer, 2000). For instance, behaviours such as watching television (Plomin et al., 1990), breastfeeding (Colodro-Conde et al., 2013), and even breakfast-eating patterns (Keski-Rahkonen et al., 2004) have been said to be significantly heritable (usually between 40 and 60 percent).

Not surprisingly, therefore, heritability studies have also become one of the favoured and most controversial investigative tools of biosocial criminologists in their attempt to link biological correlates to criminal activities by providing estimations of the heritability of a number of complex crime-related phenotypes (i.e., observable characteristics of individuals), such as delinquency (e.g., Boisvert et al., 2012), lack of self-control (e.g., Beaver et al., 2008, 2009) and even gang membership (e.g., Barnes & Boutwell, 2012). Findings from these studies have suggested that a significant portion (around 60 percent) of the variability in these crime-related phenotypes can be explained by genetic factors and, surprisingly, shared environmental

² Database from The National Longitudinal Study of Adolescent to Adult Health. Data is periodically collected from a sample of 20,000 adolescents who were in grades 7-12 during the 1994-95 school year, and have been followed for five waves to date, most recently in 2016-18 (Carolina Population Center, n.d.).

factors³, or all other non-genetic influences that make the subjects of comparison more similar to one another (e.g., family environment, socio-economic status, neighborhood, school environment, etc.; Dick, 2005), have little to no influence in behavioural outcomes.

Understandably, this has caused great uproar within the criminology community. Heritability studies have been at the forefront of the debate between the biological and sociological because of their association with eugenics (Burke, 2012; Larregue, 2020), as well as their controversial findings surrounding the lack of influence of the environment on behavioural outcomes (Larregue, 2020). These findings not only put into question thousands of sociological studies showing the inverse, but also are in direct opposition to what the current dominant paradigm in criminology (i.e., the sociological paradigm) predicates, thus threatening to disturb the status quo of the discipline.

Present State of the Debate

Biosocial criminology has become the fastest growing line of research within the discipline of criminology in the last past years (Beaver et al., 2015). While criticisms remain strong, some proponents of the biological paradigm have responded by accusing their opponents of maintaining an outdated understanding of biological perspectives of crime and arguing that trying to understand human behaviour through the dichotomy of biology or sociology is an oversimplistic approach (e.g., Beaver et al., 2015; Masters, 1996; Meloni et al., 2016). The biological paradigm has been able to slowly infiltrate mainstream criminological discourses and increase its popularity by choosing not to outright reject existing sociological concepts and theories.

Instead, by looking for ways to accommodate biological notions in already existing sociological theories, proponents of the biological paradigm have been able to make their claims less threatening to the dominant paradigm (Schwartz, 2014). For instance, many modern biological theories of crime take into account all the known biological AND sociological factors,

³ Importantly, the correct categorization of environmental factors as “shared” or “non-shared” depends on the *effect* that these have on the subjects of comparison rather than whether or not they are objectively shared by them (Dick, 2005). Environmental factor that produce different effects cannot be said to be “shared” even when they are objectively shared by both subjects of comparison. For example, poverty could be objectively shared by a pair of siblings, and yet have different effects on each of them. One sibling might react to poverty by pursuing higher education in the hope of increasing their chances of finding higher paying positions in the future. Conversely, another sibling might react to poverty by dropping out of school and beginning to work to help support their family. As such, poverty would not be considered a shared environmental factor by this definition.

as well as their respective interaction, that may influence complex behavioural patterns (Ellis, 2005; Robinson & Beaver, 2009). Others integrate biological concepts to the existing conventional criminological theories (Fishbein, 1990; Vila, 1994; Walsh, 2000, 2002). Either way, these two approaches are likely to generate less intense acts of resistance from mainstream criminologists, as their assumptions and ideas are, to some degree, still being acknowledged.

To this day, opponents of the biological paradigm have continued to advocate for a more cautious approach to the study of crime and deviant behaviour when it comes to the use of what can be defined as deterministic instruments, such as heritability studies. However, with the growing amount of scientific evidence hinting to associations between biology and human behaviour that new technologies have produced, it has become increasingly more difficult to push back against the biologization of the social sciences and, more specifically, the criminological field. Notwithstanding, however, this is not to say that the debate between nurture and nature in criminology is coming to an end. It is in fact far from it. Numerous strategies for advancing and defending scientific claims are constantly being developed and utilized in this ongoing battle for paradigmatic dominance. One of the main objectives of this research is to document these strategies.

Studying the Tensions between Scientific Paradigms

The narrative of the tensions between biology and sociology in the social sciences, and criminology more precisely, presented so far in this chapter can be approached in two different ways that share a common focus on long historical windows and broad structural forces.

On the one hand, one can choose to stress the coalescence of the two different paradigms, the biological and the sociological, within the social sciences and criminology. When doing so, this narrative presents itself like a crucial element in the slow progression towards a better, more complete, understanding of the determinants of human behaviour. In this sense, science marches forward towards the truth. Ignorance is slowly vanishing. This approach would be mainly interested in examining the different ways biological theories, concepts, and findings could be applied to expand on the existing conventional theories of crime (i.e., sociological theories).

On the other hand, one can choose, like we have done so far, to stress the conflict between these two different paradigms within the social sciences and criminology. When doing so, this narrative can be understood as a long struggle for dominance wherein researchers are constantly trying to accumulate scientific and symbolic capital in order to advance their

respective claims (Larregue, 2020). Such an emphasis tends to conflate truth and power. In this scenario, the truth is not being produced nor is ignorance vanishing, they are simply switching places as power is moved back and forth between the different paradigms.

It is this second approach that is of particular interest to the present study. More precisely, this research is interested in examining how proponents of different paradigms navigate the tensions that exist between their worldviews and engage in processes that create and solidify different scientific propositions while weakening the facticity of others. How can truths be produced in specific instances of disagreements between scientists? What does power look like when proponents of the biological and sociological explanations interact in debates over a specific method or a scientific result? And what can we learn about the fabrication of truths and ignorance from documenting closely the exchanges between those proponents in vivo?

Past Takes on the Topic

While a number of past studies have adopted this conflict approach to look at the way the biological paradigm has evolved in the discipline of criminology (e.g., Larregue, 2020; Panofsky, 2014), the focus has rarely been on the strategies that have been utilized in the production of scientific knowledge and ignorance surrounding this topic. Moreover, when this has been the case (e.g., Dufresne, 2016), such an approach has been dismissed for having a limited contextual scope of the issues at hand. For instance, in his work *Héréditaire: l'éternel retour des théories biologiques du crime*, Larregue (2020) discusses Dufresne's attempt to expose the complex rhetorical and material mechanisms behind the creation and solidification of key scientific claims, such as the association between the MAOA gene and maladaptive behaviours among children victims of abuse. Larregue accuses Dufresne of overlooking the importance that institutional forces have had on the development and evolution of the biosocial criminology line of research.

Nevertheless, while Larregue's points are fair and accurate in that Dufresne's approach may be too limited to comprehensively explain the evolution of an entire line of research within a scientific discipline, Larregue seems to have misunderstood Dufresne's actual contribution. In his work, Dufresne was not interested in examining biosocial criminology's development per se, nor the evolution of the MAOA's gene debate. He was mostly concerned with demonstrating how the production of scientific facts is a complex social process that involves a variety of actors, both human and material, that are made to interact and act in conjunction towards a

common goal. In this sense, the MAOA gene debate within biosocial criminology was used as a case study to explore this knowledge production process.

Larregue's work, instead, focuses more on the big picture. Larregue describes the multiple historical, institutional, and contextual circumstances that have given rise to the past and current state of the branch of biosocial criminology. He utilizes Bourdieu's theories of power and symbolic capital to develop a very detailed recollection of the forces that have influenced the development of biosocial criminology in the eyes of different audiences (e.g., the general public and the academic community). His intention was not only to present how certain key studies or authors were able to influence public's opinion on the debate of nurture vs nature, but rather to create a comprehensive narrative of how this debate has evolved throughout the years.

When undertaking such an impressive task, it would seem only logical to see Dufresne's work as lacking depth and leading to an incomplete understanding of the events and circumstances that led to the ups and downs of biosocial theories and research in the field of criminology. However, the difference between those two approaches is not, or not only, a matter of scale and historical window. It reflects a different theoretical perspective on power. While Larregue assumes a structuralist position, postulating that clear and relatively stable forces are at play in the evolution of biosocial criminology as a discipline, Dufresne aims to show how power or structural forces can be made through scientists work in the laboratory.

Just like Dufresne, we are not interested in undertaking the task of analysing the evolution of the biological paradigm in criminology from a structuralist position, nor the development of the controversy surrounding heritability studies per se. Moreover, we are not interested in arguing for or against any side of this controversy nor exposing their respective strengths and flaws. Instead, we are aiming to analyse the different ways scientific rhetoric can be used in the advancement of scientific knowledge and ignorance (Latour & Fabbri, 2000). To this purpose, we will be using the controversy involving heritability studies in criminology research as an instrumental case study through which we will be exploring and demonstrating how different interlocutors, holding very distinct views on a particular topic, can employ past literature in order to advance and strengthen their scientific claims while debilitating those from their opponents.

Theoretical Framework

Approaches to Science and Knowledge

Science and scientists hold a very high status in modern society. Indeed, contrary to earlier decades of religious authority on knowledge, today the majority of people place their trust in scientific evidence. Much like religious leaders used to be, nowadays scientists are viewed as possessors of specialized knowledge that is often inaccessible to the lay person (Okasha, 2016). Scientists are treated as experts, and, as such, their opinions are highly respected and even regularly sought after during important social debates. Science and scientists' accounts have become a stable component of decision-making processes that affect many social institutions. For instance, in court hearings, both the accused and defendants can appeal to scientific knowledge to either strengthen their claims or discredit those from their opponents. While the production process of scientific evidence can and is often questioned as a way of countering opponents' scientifically backed claims, the intrinsic value of science, as well as its utilization in the development and maintenance of social discourses, is rarely scrutinized.

That being said, the value and meaning that people attribute to scientific findings vary depending on their individual ontological, epistemological and axiological perspectives. Indeed, a closer look at the scholarship in science and technology studies (STS) shows that the activity of producing scientific knowledge can be understood differently depending on one's position on a continuum that flows from an essentialist to a social constructionist worldview. Most approaches in STS, however, finds their niche somewhere in between this continuum. In the following pages, we will briefly explain what each of the two extremes on this continuum posit, as well as introduce and situate the STS' approach that is at the base of the present research, Actor-Network Theory (ANT).

Essentialist/Social Constructionist Continuum

At one end of the continuum, the essentialist end, science is seen as a formal activity that serves to find and accumulate knowledge through direct interactions with the natural world (Okasha, 2016). It rests upon an essentialist view according to which the world is constituted of natural, immutable, material elements (DeLamater & Hude, 1998; Ellis, 2010, p. 52; Kashima et al., 2010, p. 308). This perspective is behind the emergence of the positivist and postpositivist paradigms which seek to find empirical evidence of the material world through the employment

of systematic and rigorously-controlled scientific methodologies (Abrutyn, 2013; DeLamater & Hude, 1998).

Seeing the world through an essentialist lens means believing that there is an absolute truth which has the potential to be uncovered, as best as possible, through careful observation and analysis (Kashima et al., 2010). As such, systematic scientific methods are highly valued and seen as appropriate vehicles for the attainment of a clear and unbiased understanding of how the world operates. Scientific knowledge, in this regard, is considered to be the best available approximation of the truth (Jasanoff et al., 1995). Because essentialists believe in the existence of a unique and true reality, societal influences are seen as pollution to avoid at all cost in the knowledge production process (Jasanoff et al., 1995). Pure essentialists therefore believe in unmediated knowledge. Accordingly, not only is it possible but important to prevent social factors from intervening between (social) nature and the scientific knowledge of (human) nature (Jasanoff et al., 1995).

Going back to the two different approaches to understanding the narrative of the tensions between biology and sociology in the social sciences, the essentialist worldview is mostly aligned with the former. That is, essentialists believe that as time passes and scientific tools are improved and made to be more precise at capturing their targeted forms of information, the social sciences move forward toward the uncovering of a more complete and unique reality. In this sense, unmediated scientific evidence based on both the biological and sociological paradigms would not only be complementary but also indispensable for the uncovering of the truth and the reduction of ignorance.

At the other end of the continuum, social constructionism states that reality is subjective and unstable (DeLamater & Hude, 1998; Young & Collin, 2004). According to the social constructionist perspective, knowledge and meaning are historically and culturally constructed through social processes (Young & Collin, 2004). This perspective rejects the idea of a natural, shared, and objective reality, and embraces the point of view that everything we know about the world has been and will remain socially mediated. For social constructionists, therefore, science is primarily a social activity, and scientific claims become true only when they are widely agreed upon by scientists (Sismondo, 2010). This suggests that scientific knowledge, or what is accepted as a scientific fact, is not a direct account of the natural world, but rather the result of social processes and negotiations that mediate scientists' claims about the natural world (Jasanoff et al.,

1995). As such, this perspective advances the idea that scientists' upbringing, institutional context, and social environment not only influence the kind of research they may choose to pursue, but also the way they conduct it, and, ultimately, the manner in which they interpret their findings.

The social constructionist perspective is more aligned with the second approach to studying the tensions between biology and sociology in the social sciences. Social constructionists tend to focus on the conflicting nature of knowledge and the tensions and the long struggle that proponents of both sides of a controversy experience while trying to recruit partisans that agree with their respective points of view (Latour, 1987). Social constructionism in this case would not be seeing this conflict as a battle between what is true and what is not, but rather a battle between the reality built by some against the reality built by others. As such, once the conflict is resolved, the victorious paradigm would not be the closest to the truth, but the one which was able to become more widely accepted (Latour, 1987).

Hybrid Views of Science and Technology

STS is a heterogeneous body of research, scholars, journals, professional associations and academic programs that focuses on the history, social organization and culture of science and technology (Roosth & Silbey, 2009). Most STS scholars embrace, to a large degree, assumptions from the social constructionist perspective and, to a lesser degree, assumptions from the essentialist perspective. To begin with, analogous to the social constructionist perspective, many STS approaches share the assumption that science and technology are primarily and thoroughly social activities, active processes, that should be studied as such (Sismondo, 2010). These approaches maintain that science and technology are social in that they are not produced in a vacuum. Scientists are members of communities, within which they train and exercise their research practices. These communities set the standards for the type of research scientists conduct and determine the legitimacy and value that is given to their knowledge claims.

Contrary to more relativist social constructionist beliefs, however, many STS approaches often also adopt the realist assumption that the material world plays an important role in the making of scientific knowledge. Indeed, most STS approaches are interested in not only examining how scientific knowledge is a product of social interactions but also investigating how scientists utilize and form relationships with a variety of elements, including material objects, in the production of scientific facts.

One of the hybrid approaches in STS that we will be mobilizing in the present research is ANT. ANT is a framework originally developed by Michel Callon (e.g., 1984), Bruno Latour (e.g., 1987), and John Law (e.g., 1987) as a means to explore issues related to science and technology, or *technoscience* (Latour, 1987). However, ANT is not merely a theory of technoscience, but rather a general social theory centered on technoscience (Sismondo, 2010). This means that ANT seeks to understand the social world through the examination of the different ways it influences and is reciprocally influenced by science and technology. ANT bridges the gap between essentialism and social constructionism, and between realism and constructivism, by simultaneously acknowledging that science is an inherently social activity and that the material world plays its part, resists, and acts in the constructions, associations and networks that scientist build. According to Latour (2003) and ANT ideologies, the world is real because it is constructed.

ANT separates itself from relativist social constructionist approaches in that it rejects some of the common critical notions of social constructionism, such as the assumed fragility of factual knowledge, the overestimation of the symbolic, the presumed social determination of scientific knowledge, and the undervaluing of the agentic role of nonhuman entities (Detel, 2001; Farías & Mützel, 2015; Gieryn, 2001; Latour, 2003). ANT, instead, proposes that scientific facts are the results of social relations that exist among heterogenous entities, including material objects, which are all in themselves agentic and can form broad networks (Farías & Mützel, 2015). It is the connections between these entities, and not the entities by themselves, that contribute to the patterning of the social (Law, 1992).

Scientific knowledge, under an ANT perspective, is therefore created by a broad heterogenous network of human and non-human entities, both material and nonmaterial, concrete and abstract (Callon, 1984). These entities are labeled *actants* or *actors* since they participate in collective and distributed actions within actor-networks. Importantly, there is no analytical differences between actors and networks as every actor is an actor-network in itself. For instance, a computer in a laboratory can be both an actor and actor-network depending on how it is looked at. On the one hand, it can be seen as a network created by actors such wires, technicians, and screws. On the other hand, however, it can also be seen as an actor in a broader actor-network of entities (laboratory mice, tests, scales, etc.) leading to research results.

The creation of actor-network, such as scientific facts for example, or what has been termed *translation*, is a complex process (Callon, 1984). In “Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay”, Callon (1984) provides a detailed description of the sequential processes through which actors and actor-networks cocreate one another and thus produce new forms of action or scientific facts. It all begins with the *problematization* of a situation. This involves bringing a series of selected pertinent human and non-human actors to agree on the definition of a problem, as well as on their roles and their interests with regards to the problem at hand. The second and third step, called *interessment* and *enrolment* respectively, refer to the strategies and tactics deployed to recruit and keep the selected entities into a new network, playing their assumed roles. Finally, the fourth step, called *mobilization*, denotes the collective action that is made possible by the displacement and transformations of these now actors. Through an ANT perspective, scientific assertions are networks of humans (e.g., colleagues in the discipline, research participants) and non-human actors (e.g., surveys, scales, software) that scientists connect together in the hope that they will continue to hold together despite attempts from colleagues of recruiting them into competing network.

Scientific facts can vary in robustness depending on the stability and dimension of the networks that create them. Indeed, the larger and more stable the network, the more “objective” a scientific fact will be (Farías & Mützel, 2015, p. 524). A successful process of translation, that is, the successful enrolment of actors into a network and subsequent mobilization of thereof, is referred to as *blackboxing* (Callon, 1984). A network is said to be blackboxed, when its heterogeneity and distributed character are figuratively fused, so that it seems as if only one bounded actor is carrying the intended action or producing the intended outcome. For instance, for the most part and for the majority of people, a computer is a single, coherent object without many apparent parts. That is, most people only perceive and consider the final product of a network (i.e., computer), unless being made to think about the numerous components and human interventions that are involved in its creation and usage.

The same is true in the creation of scientific facts. Facts that are blackboxed are those which are taken for granted. That is, their legitimacy is not doubted, and the nature of their origin is not questioned or even considered (e.g., the Earth turns around the Sun). One of the main areas

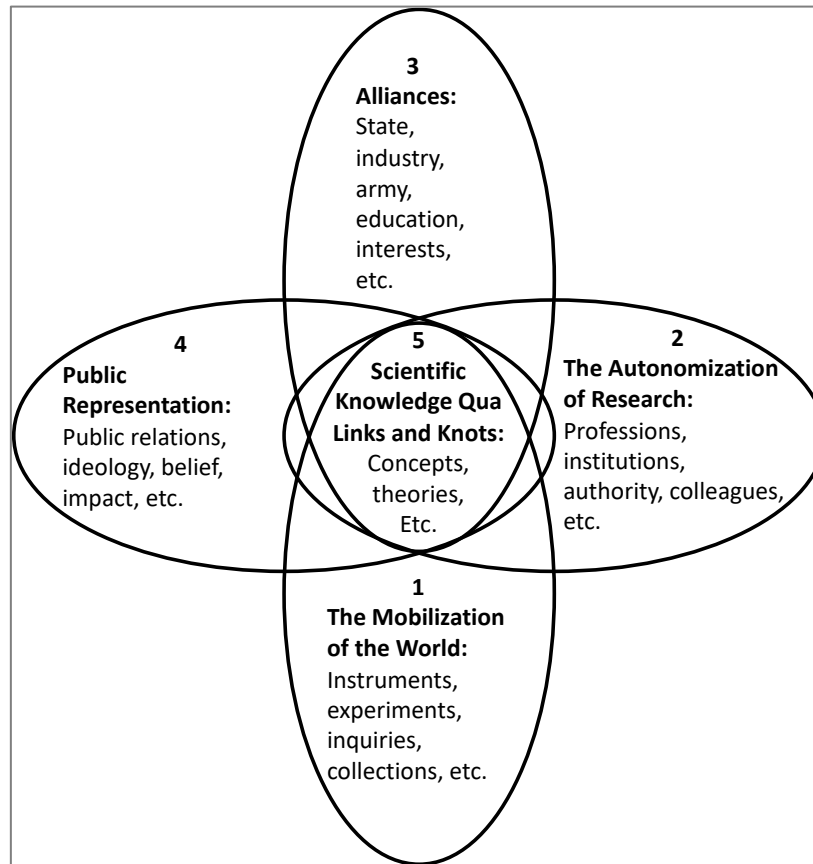
of investigation of ANT researchers is the opening of black boxes to shine light on the heterogenous constitutions of the social world.

The process of translation does not always occur in a passive manner. The creation of networks is often met with resistance from its actors as they sometimes must be made to act in ways that differ from their natural inclinations (Callon, 1984; Sismondo, 2010). It is the job of scientists therefore to find a manner to accommodate these interests together so that they can be managed and used in ways that best serve a particular objective. This means that a stable network, that is, a successful piece of technology or blackboxed scientific fact, is the result of scientists understanding the interests of an array of very different actors and translating those interests so that they can work in agreement towards a common goal (Callon, 1984).

Latour (2001) proposes the research horizon's model (Figure 1), which identifies and categorizes the activities scientists must perform in order to build long and stable actor networks. The first horizon of this model, the Mobilization of the World, represents all activities relating to data-gathering, experimentation, processing, calculation, etc. These types of activities are made possible by the development, advancement, and use of scientific instruments designed to facilitate the representation of the world in ways that lead to "interpretation, manipulation, and recombination" (Richard & Bader, 2010, p. 751). The second horizon, the Autonomization of Research, refers to all the activities scientists must perform in order to make their scientific colleagues capable of understanding, criticizing, validating, and promoting the scientific knowledge they are interested in pushing forth. This horizon involves the training and education of specialists who are themselves capable of training and educating other specialists for the purpose of advancing the facticity of the knowledge being produced. The third horizon is that of Alliances. This horizon refers to the activities that allow scientists to interest individuals and institutions in the realization of their research projects. The fourth horizon, Public Representation, involves the activities scientists perform to provide an account of their research to the lay public. This horizon is generally involved in the popularization of scientific discourses. The fifth and final horizon is that of Scientific Knowledge Qua Links and Knots. This horizon groups tasks related to science's explicit goal of producing knowledge, utilizing ideas, concepts, theories, and the like.

Figure 1

The Five Horizons of Research



For Latour, the production of solid and certain knowledge, which is primarily a goal of science, requires that scientists work on all the horizons proposed in this model.

Even when a network is created and stabilized, there is always the risk of actors breaking off and making off on their own (Callon, 1984). A blackboxed network can become destabilized when one of its actors gets recruited into a conflicting network or no longer finds that its interests are being met by remaining in that network. When this occurs, if the actor cannot be convinced to stay in the network through the process of translation, or another actor with a similar purpose cannot be recruited to take its place, the resulting scientific knowledge is likely to lose its blackboxed status and become controversial (Callon et al., 1986). This can be seen, for example, in the way information concerning the spread of the COVID-19 virus has changed over time

(Elfrink et al., 2020). The reason for this is that the role that each actor plays in a network is indispensable for it to produce a coherent and unquestionable scientific fact.

When it comes to power and the dominant paradigm or social order, ANT believes that the effects of power that dictate what we consider to be right in a society are generated in a relational and distributed manner (Law, 1992). As Law (1992, p. 390) states, "...in practice there are real differences between the powerful and the wretched, differences in the methods and materials that they deploy to generate themselves". As such, individuals within scientific disciplines may possess different types and amounts of resources depending on the paradigm they subscribe to. It can be expected for proponents of the dominant paradigm to have at their disposal a greater number of materials and methods which they can interesse into networks that mobilize the creation and reinforcement of the type of knowledge they support. The purpose of analysts of science like us therefore is to study these networks of materials and methods, understand the roles they are made to play, and point out how they could be otherwise.

Scholars in STS and ANT analyse the dynamics of knowledge production and, to do so, have proposed key concepts for the present research. At the macro level, the concepts of paradigms and paradigm shift are useful to understand how knowledge and the way to produce it change over long periods of time. It is also an important notion to understand the way scientific disciplines, and more specifically criminology, evolve. At the mezzo level, the concept of controversy and the conceptual tools that derive from the studies of scientific controversies are also key contributions of STS to the analysis of the dynamics of knowledge production and, potentially, the shift in paradigms that are happening or attempted in a discipline at a specific point in time. Finally, at the micro level, the concepts of facticity and ignorance are tools to make sense of the very specific assertions that scientists weave together to give life to some entities and not others.

Paradigms and Paradigm Shifts

People develop different understandings and beliefs about how the world operates. That is, they develop different paradigms about the world they live in. In turn, these paradigms hold different assumptions that dictate the manner in which people approach every aspect of their life, from the navigation of the social world, to the way they interpret different types of information, to the manner in which they evaluate others' actions (DeCarlo, 2018). Accordingly, in the context of scientific research, paradigms also influence the way people approach and think about

the production, distribution and consequences of scientific knowledge, marking the line between the type of theories and research methodologies that they deem valid and those that they do not.

According to Kuhn (1962), at any one point in time, every scientific discipline follows a dominant paradigm that frames the way scientific knowledge is produced and interpreted. This is what the philosophers of science refer to as a period of *normal science*. This is a period where members of a particular scientific discipline share common beliefs about which theories are right, a recognition of key past achievements in their field, an understanding of the important problems of their field, as well as the type of methods that should be used to solve them. In periods of normal science, the assumptions held by the dominant paradigm are rarely questioned. Kuhn argued that this is most likely due to the fact that scientific disciplines are particularly successful at socializing their members and thus limiting the spread and influence of views contrary those from the dominant paradigm.

Importantly, during periods of normal science, challenges and questions that arise within a discipline are expected to be solved and responded within the terms of the dominant paradigm (Kuhn, 1962). Failing to do so would not only reflect badly on those attempting to solve them but also be considered an *anomaly*. As time passes, given that no one paradigm is perfect, anomalies accumulate and ultimately become real problems within a discipline. In turn, this may generate feelings of uneasiness and distrust with the terms of the dominant paradigm among certain members of the scientific community. When this occurs, alternatives to the dominant paradigm may start to increase their influence and popularity, reducing the grasp that the dominant paradigm has on the discipline's "what's", "why's", and "how to's". This transitional period is what Kuhn refers to as a period of *crisis* or a *revolution*.

During periods of crisis, alternative ways of thinking that are capable of addressing the real problems left unsolved by the dominant paradigm are likely to become adopted by some scientists, specially the younger and more open-minded ones (Kuhn, 1962). Eventually, believers of the older—previously dominant—paradigm may become marginalized, allowing for the alternative to become the new dominant paradigm itself. This marks the commencement of a new period of normal science.

Kuhn's ideas about paradigm shifts align with the approach that the present research adopts to assess the tensions that exist between the biological and sociological paradigms in the field of criminology, as they suggest that science does not follow a logical progress towards the

truth. That is, Kuhn's ideas suggest that science does not progress by accumulating what could be accurate representations of nature, but rather, appears to move from one paradigm to another, such that periods of normal science are separated by periods of crisis (Roosth & Silbey, 2009). As such, it can be argued that the field of criminology is currently experiencing a period of crisis, where a dominant paradigm, the sociological paradigm, has been challenged by an alternative paradigm, the biological paradigm, which has created tensions between proponents from both sides as well as scientific controversies.

Looking forward, one could expect these tensions and controversies to get resolved once one of the paradigms is able to recruit enough support from the academic community, thus marking the beginning of a new period of normal science. That being said, it is not the resolution of this current period of crisis, nor the resulting period of normal science that is of interest for the present research, but rather the period of crisis itself. It is the exploration of the tensions and controversies that are characteristics of periods of crisis that will allow us to shed light on some of the mechanism utilized by scientists to increase the support for their ideas. It is the instruments and strategies they utilize for gaining the battle for the dominant position in the discipline which will be the subject of study in the present research.

Scientific Controversies and Controversy Studies

Paradigm shifts do not occur peaceably. During periods of crisis, proponents of the alterative paradigm push against the established normalcy boundaries, that is, the boundaries that outline and delimit what is accepted and not accepted within a given discipline, seeking to get their claims acknowledged (Sismondo, 2010). Concurrently, aiming to maintain the paradigmatic status quo, proponents of the dominant paradigm employ methods of resistance against the threat imposed by the alternative paradigm. This conflict between proponents from both the alternative paradigm and the dominant paradigm is at the origin of scientific controversies. Indeed, whenever new ways of thinking about a certain problem are introduced, a controversy is likely to emerge.

The Mapping Controversies on Science for Politics' consortium has defined a controversy as "every bit of science and technology which is not yet stabilized, closed or 'blackboxed'... [It is] a general term to describe shared uncertainty" (Macospol, 2007, p. 6). More simply put, controversies are situations where actors "agree to disagree" (Venturini, 2010). A controversy is born at the moment two or more actors can no longer ignore each other, and end

whenever those involved are able to devise a compromise that allows them to live together in harmony (Venturini, 2010).

While there are many different ways to define and explain controversies, most social controversies share the following characteristics (Venturini, 2010): First, they facilitate the formation of all types of different and complex relationships among all kinds of entities. In other words, controversies function as spaces where many different kinds of entities, that would otherwise not interact with one another in different situations, engage in conflicts and negotiations. Importantly, entities within controversies do not necessarily need to be human beings or human groups, but can also belong to non-human categories, such as natural and biological elements (e.g., genes) and scientific or technical artifacts, among many others. That being said, not all entities are equally important or act the same way within a controversy. Different entities may play different roles and their involvement could range from merely supporting other entities or being the defining puzzle piece that decides the end of the controversy.

Second, controversies demonstrate the dynamism of the social world. Through the study of controversies, it is possible to observe not only how different and unexpected alliances are formed among diverse groups of entities, but also the breaking apart of seemingly indissoluble social unities. In other words, it is through the study of controversies that the constant state of creation and re-creation of the social world can be observed.

Third, controversies are reduction-resistant in that those involved tend to disagree on almost everything, including what they disagree in. Partisans from opposite sides of the controversy may problematize controversy issues in very different manners and may even disagree on how to define or operationalize certain entities. This is what makes the resolution of controversies so difficult: the biggest issues do not necessarily lie in that the partisans from opposite sides cannot find common ground on any one particular question, but that in most occasion they cannot even agree on what the question is.

Fourth controversies emerge when concepts and ideas that have previously been taken for granted are put into question and begin to be discussed by an increasing number of individuals.

Fifth and last, controversies involve conflict. Within all social controversies, individuals with conflicting interests and worldviews clash both directly and indirectly in order to create a new social order and/or social hierarchy in the universe they will share. Indeed, controversies

both decide and are decided by power dynamics. Social controversies involve individuals' attempts to redistribute or prevent the redistribution of power and thus maintain or reverse social inequalities. When speaking of social inequalities, it does not necessarily need to involve human social status, but could also refer to the importance that is given to other non-human actors. For instance, during a controversy concerning evolutionary theory, some individuals may seek to either conserve or reduce the prestige of the scientific method, depending on their standing. As such, the power that is given to science may change once the controversy is closed.

For these reasons, the study of controversy sets the perfect stage to examine how the social world is unremittingly constructed, deconstructed and reconstructed. Ultimately, therefore, the study of scientific controversies allows researchers to investigate how periods of crisis get resolved, as well as the mechanisms utilized by scientists in order to gain support for their respective claims in a particular scientific discipline.

To understand how social phenomena comes to be accepted as the norm, it is not enough to observe actors in isolation from the social networks that become stabilized through the complex processes taking place during controversies. What should be observed instead, are the actor-networks, which are the transient configurations where actors renegotiate their ties to one another and their individual identities and purposes, creating a coherent and seemingly irrefutable reality (Venturini, 2010).

Approaches to the Study of Scientific Controversies

In their work on scientific knowledge, controversies, and public decision making, Martin and Richards (1995) identified four different approaches to the study of controversies, namely the positivist, the group politics, the social structural, and the sociology of scientific knowledge (SSK) approach, each of which differs in purpose and point of view⁴. What follows is a very brief description of each of these approaches as well as the placement of the present research with respect to these approaches.

⁴ It is important to point out that these refer to the approach categories Richards and Martin (1995) identified for the study of scientific controversies. As such, they are not equivalent to, nor share all the characteristics of the more commonly known and complex theoretical concepts and lenses (e.g., positivism and SSK) that inspired their naming. That being said, certain aspects of these larger theoretical concepts and lenses can also be observed in some of the approaches with which they share a name, such as SSK's interest in scientific communities' operations and principle of symmetry.

First, as its name implies, the positivist approach seeks to analyse a controversy from a standpoint that follows orthodox scientific views and standards (Martin & Richards, 1995). When analysing a controversy, scientists that adopt the positivist approach may be interested in uncovering why there is a controversy in the first place. In other words, positivist scientists may be mostly interested in understanding why, in the face of strong scientific evidence, some individuals may still choose to criticize or question orthodox scientific views.

Second, the group politics approach focuses on the activities of various groups, such as government and citizens organizations, corporations, and expert panels, as they compete with one another for power during times of controversy (Martin & Richards, 1995). Analysts who adopt this approach to the study of controversies may be interested in looking at the conflicts and compromises that exist between contending groups during a controversy, as well as the way scientific knowledge is mobilized as a tool for political gain when public policy stakes are at issue. In this approach, science is mainly an instrument.

Third, the social structural approach provides insight into controversial issues by using concepts of social structure, or patterned sets of relations between individuals and groups, such as class, the state, and patriarchy. In this approach, the assertions that become accepted as scientific facts are those imposed by powerful structures.

Fourth, and most relevant for the present research, the SSK approach finds controversies especially valuable sites for the study of scientific claims making (Martin & Richards, 1995). Using a SSK approach, scientific controversies have the advantage of exposing the social processes behind the production of the dominant and the alternative accounts about the natural world. This approach contrasts the more traditional positivist approach in that the analyst, by unpacking how science is made, can question or challenge the orthodox scientific knowledge claims that would have otherwise gone by unscrutinised. One of the main assumptions of the SSK approach is that scientific claims made by partisans from opposite sides of a scientific controversy are the product of social constructions and not a reflection of the “real” world. This suggests that conflicting scientific claims have to be treated and analysed symmetrically and impartially (i.e., principle of symmetry). The principle of symmetry ensures that scientific claims and knowledge advanced by opposite sides of the controversy have equal chances of being questioned and challenged.

Both the group politics and the social structural approach are principally used to analyse controversies that occur outside the scientific field, such as those that involve government policy, public statements, social movements, class struggle and so on (Martin & Richards, 1995). However, they are not as useful in the study of controversies that occur within scientific circles. While the positivistic approach could easily be used in the analysis of scientific controversies, this approach alone is not sufficient to account for all the nuances brought forth by social dynamics, thus limiting its scope. As a result, the present research will borrow from a SSK approach to scientific controversy, as it is not only suited for the examination of controversies that occur within scientific communities, due to its focus on scientific knowledge claims making, but also provides a wider scope of analysis that covers the study of both the cognitive and social dynamics involved in the development and evolution of controversies. More fundamentally, ANT is an offspring of SSK and they share vocabularies and views about science as an activity and scientific controversies as a forum where the world gets made. As it was mentioned previously, what ANT adds to SSK is an interest in materiality and an attempt to reconcile the relativist and realist ontologies.

By embracing the SSK-ANT approach, the present study takes the position that the validity, or lack of thereof, of scientific claims derives from the interpretation, actions and practices of members in the scientific community rather than their intrinsic nature. Based on this assumption, we will explore claims made from opposite sides of a controversy by giving them equal credibility value. That is, we will not seek to present either of the competing paradigms of interest in a more favorable manner than the other. We will also abstain from assuming an evaluative and/or judgemental role in the heritability studies' controversy analysis. Instead, we will focus on examining the mechanisms through which paradigms are able to remain in, or attain a dominant position within a discipline, and not the validity or truthfulness of the scientific claims they support and advance. Moreover, concordant to the SSK-ANT approach, we will also avoid assuming a prescriptive role about the nature of the mechanism of knowledge validation that we will examine.

Given that the SSK-ANT approach postulates that scientific claims are socially constructed, it considers the closure of a controversy, or the process through which a scientific dispute gets resolved, as the result of pressures and constraints exerted by the adjudicating community (Martin and Richard, 1995). This closely resonates with arguments advanced by the

present research about the way paradigms attain and maintain their dominance within a particular scientific discipline. It is not the inherent validity or truthfulness of the scientific knowledge produced by the different paradigms which makes them more likely to become dominant, but the way some of this knowledge is articulated into existing networks and promoted while other gets ignored because of its inability to successfully connect with any existing network. This is where the minute tasks, practices, procedures behind the production of scientific fact, or facticity, enters the scene.

Facticity

Just as lawyers assemble pieces of evidence and testimonies of individuals in a way that would allow them to create a coherent narrative of events to win court cases, according to ANT, scientists and engineers engage in similar activities. Scientists and engineers assemble multiple and diverse actors into stable networks. That is what the process of building technological artifacts and/or scientific facts is all about. As Sismondo (2010) puts it, machines function, and facts are accepted, when their constituting actors are made to act in unison to achieve a consistent effect.

As the processes behind the creation of scientific facts and technological machinery may be very complex, once science or engineering networks have become stabilized, or blackboxed, they often times become part of the background, invisible (Sismondo, 2010). It is the accumulation of black boxes which generates “progress” in science and engineering, as it shapes the scientific or engineering baseline from where to begin novel research and build new machineries. For example, once the theory of heliocentrism became blackboxed, researchers began devoting their research efforts to answering questions regarding the organization of the solar system and the forces that make the planets rotate around the sun, taking for granted the fact that the sun is at the center of the solar system and not the Earth.

As mentioned above, the robustness of scientific facts changes depending on the stability of their networks. In scientific fact making, a key element that influences the stability of a network is the amount of circulation of a scientific assertion. When scientific facts are utilized by scientists as actors in their own networks and put into circulation through heterogenous local points, moving them “from one laboratory to the next, and from there to a journal, then to a policy document, to a ministry office, to an industrial floor, from there to a market, to consumers, to concerned groups, and so on”, they are constantly being tested and contested by

multiple other actors (Farías & Mützel, 2015, p. 524). Provided that they are able to endure this probing, they can then become indisputable, blackboxed facts (Latour, 1987).

As also already stated, actors within these heterogenous networks are heterogenous in that they can be human, non-human, concrete or abstract entities, with no methodologically significant distinctions among them. For instance, to create, disseminate and stabilise heliocentrism as a scientific fact, Galileo had to enlist the help of not only other scientists and influential thinkers but also many other non-human actors, including Copernicus' ideas, a telescope, knowledge about Venus phases and the Moon's phases, and so on, in order to overshadow the claims from his main opponent, the Church. As such, abstract elements and concepts such as words, cognitive processes, frameworks, and emotions, among many others, can be, and commonly are, mobilized and translated into networks to produce scientific facts.

Scientific Writing as an Actor

While approaching the study of scientific fact making through the examination of the activities and actors that fall under all five horizons of research described by Latour (2001; see Figure 1 above) would be a fascinating endeavour, due to resources constraints, the present research will focus only on what occurs in the second horizon (i.e., Autonomization of Research). That is, the present research is concerned with the strategies used by researchers to inform, educate, and mobilize the validation, support, and help of colleagues within the scientific community during their fact making ventures. What better way to study how scientists engage and communicate with their scientist colleagues than through the examination of scientific writing?

One of the actors that is essential for the advancement of scientific claims and their establishment as scientific facts is scientific rhetoric. Scientists must make sure that their claims not only reach a wide audience—as having a significantly large portion of the scientific community agreeing with a scientific fact is crucial for their blackboxing—but are also presented in a way that is persuasive enough for them to be believed as unquestionably factual. Scientific writing is an effective medium for accomplishing these ends. While sometimes scientific writing may seem to be dense, unemotional, or flat, and may be erroneously categorised as the opposite of rhetoric prose, it is in fact far from it. This manner of presenting scientific evidence follows rhetoric rules, including the appeal to audiences' emotions, that are oftentimes extremely

effective at convincing readers about the facticity of their claims. This means that every form of scientific writing involves choices, and each of these choices have effects.

In scientific writing, every argument and the way it is constructed, the language that is used, the inclusion of images, tables, diagrams, and key words, are all carefully selected because of their potential persuasive effects on the readers (Sismondo, 2010). While every text uses rhetoric prose in one way or another, scientific articles, and other forms of scientific writing, are a particularly effective genre of persuasive writing, as they present layers of text that can serve as “mutual referents” (Latour & Fabbri, 2000, p. 122). Every claim made in a scientific article is either backed up by deductive logic or a number of other sources that are explicitly referred to within it.

Interestingly, proponents of different paradigms are able to utilize the same reference sources in their written works, even when the points they are trying to drive across are in direct opposition. It is through the molding or modalization of statements, the introduction of doubts, the use of assertions, among other rhetorical strategies that scientists are able to produce very different portrayals of past literature as well as influence the facticity of their claims (Latour, 1987; Latour & Fabbri, 2000).

In the context of scientific writing, the modalization of a claim refers to the way in which said claim is qualified, or framed (Latour, 1987). Modalities are the linguistic devices that are used either to “enhance or detract from the fact-like status of [a] statement” (Latour et al., 1986, p. 69). Some modalities can be used to weaken the facticity of a claim by allowing for various speculative possibilities about the relationship between two items (Bertotti & Miner, 2019). For instance, the claim *x causes y* is likely to experience a reduction in facticity when it is modalized with the insertion of a uncertainty marker such as the word *may*: *x may cause y*. These types of facticity diminishing modalities have been referred to as *hedgies* by linguists (Bertotti & Miner, 2019).

Other modalities can have the opposite effect. That is, they can enhance the facticity of a claim by expressing the authors commitment to its certainty (Bertotti & Miner, 2019). These types of modalities emphasize the strength of a claim and illustrate the author’s conviction. For instance, a statement such as *x causes y* can be amplified when modalized with a certainty marker such as *clearly*: *clearly, x causes y*. These types of modalities have been referred to as *boosters*.

Decision to add citations into an article are not made in a random fashion. It is important to remember that blackboxed facts are scientific claims that have been able to withstand the numerous questionings and probing that they experience while being circulated through diverse local points. As such, in order to transform a scientific claim into a black box using scientific writing as an actor, scientists must ensure that their claims will not be easily refuted by “dissident” readers who may be skeptical of the information they are being presented.

In reference to the production of scientific ignorance and knowledge, the relationship that exists between scientific writers and readers takes an antagonistic turn, as scientific writers must try to anticipate all the ways their audiences may challenge their claims and prepare accordingly so that their texts are able to withstand and confront these imagined potential attacks (Latour, 1987; Sismondo, 2010). Good articles, therefore, are those which arrange information and references in such a way that leaves readers with no other options than to accept the writers’ claims, despite their multiple efforts to disagree with them. One way of doing this is by isolating dissident readers, making them feel as if they alone are in disagreement with the authors’ claims (Latour, 1987). Perceiving a lack of support from other scientists or other academic works, and/or feeling overpowered by the masses of evidence called upon by an author, makes readers less likely to challenge claims they disagree with (Latour, 1987).

Ignorance

Science has traditionally been considered principally as a producer of knowledge. However, over the past decade, science has also been increasingly documented by scholars as a producer of ignorance (Kourany & Carrier, 2020). Increased interest on the production of ignorance, the way it relates to knowledge and, by extension, the way the large majority of individuals think about and interact with the world, has led to the creation of a completely new area of inquiry: *Agnotology*. Importantly, large part of the ignorance that is studied in this relatively new field is the product of science. Whether it be the health effects of smoking (Proctor, 2011), the impact of processed and sugar-packed foods on human health (Moss, 2013), or global warming (Oreskes, 2011), examples of the involvement of science in the production of ignorance and its dissemination among the general public have been numerous.

Contrary to what is most commonly believed, the relationship between ignorance and knowledge can be a very complex one. To begin with, ignorance as a concept can be defined in a myriad of ways depending on the lens through which it is studied. This complicates how its

relation with knowledge is understood. For example, ignorance is most commonly thought of as being simply the void that precedes knowledge (Kourany & Carrier, 2020). Ignorance, in this sense, is said to only exist in the absence of knowledge. Here, when knowledge is acquired, ignorance is believed to have disappeared. Ignorance can alternatively be seen as the result of different cognitive processes, be it when attention is focused elsewhere, or the conscious or unconscious avoidance of acknowledging information that may be seen as uncomfortable (e.g., information that raises uncomfortable emotions, such as guilt, shame, or uncertainties; Bovensiepen & Pelkmans, 2020). Here, ignorance is seen as a cognitive and, arguably, survival strategy that allows individuals to maintain a “peace of mind” even when uncomfortable information may be readily accessible for them to acknowledge.

Most relevant to the present research, ignorance can also be described as the social construction of confusion, for example, through the *denial*, *dismissal*, *diversion*, or *displacement* of certain forms of knowledge (Rayner, 2012). According to this definition, knowledge cannot be produced without simultaneously producing and mobilizing ignorance and vice versa. Whenever new scientific facts get established, information that contradicts their existence needs to be broken down, or in some more radical cases, completely hidden from public discourse (Rayner, 2012). Ignorance is then produced when individuals are made to feel either certain enough about, or incapable of contesting, the facticity of some kind of knowledge, to the point where they no longer seek out or seriously consider alternative information that may potentially contradict it (i.e., uncomfortable information; Bovensiepen & Pelkmans, 2020). It is the strategies used to produce this type of ignorance that the present research will focus on.

Inspired by Kuhn’s ideas on paradigm shifts and the study of scientific controversies, the production and distribution of ignorance can then be seen as a strategy to defend a dominant paradigm from alternative knowledge that threatens to undermine what is commonly accepted as reality in any one specific scientific discipline (McGoey, 2012; Rayner, 2012). In other words, ignorance can be used as a defense mechanism against knowledge produced by alternative paradigms that may be uncomfortable or damaging to the validity and coherence of dominant viewpoints (Rayner, 2012). In the case of the controversy surrounding heritability studies, therefore, it can be argued that knowledge about genetic correlates of crime has been ignored by mainstream criminology for many years as a way to defend the sociological viewpoints that currently govern the discipline. It can also be said that some proponents of the biological

viewpoint who want to merge biological and sociological explanations of crime into one common paradigm have obfuscated the epistemological groundings of the two viewpoints to make them compatible.

How is Ignorance Produced?

The production and distribution of ignorance can take many forms. On the one hand, it can be straightforward and simple, such as when uncomfortable knowledge is left out of the principal means of knowledge production and transmission (e.g., blacklisting books, articles, courses, conferences; Fallin et al., 2019; Heimer, 2012) or when the process behind the production of uncomfortable knowledge is criticized in the scientific literature (e.g., making claims about research design's issues; Rayner, 2012; Stocking & Holstein, 2009). In the latter example, raising concerns about the validity of the process of knowledge production, or even referencing to this process, can cause said knowledge to lose its facticity (Latour, 1987). Attracting the attention to the construction of a scientific assertion suggests, by itself, that the assertion is made by a human, that it is the product of some choices and that it could be, and probably will be in the future, different. Bringing up the conditions of production of an assertion is a move that chips away at the magical property with which we invest facts.

On the other hand, the production of ignorance can also be more subtle and sophisticated, as when audiences' emotions are triggered through the employment of discursive techniques that decrease the facticity of uncomfortable knowledge when it is cited in scientific work. By appealing to readers' emotions, it may be possible to instill in them a sense of trust or distrust about certain claims, as well as influence the extent to which they feel competent or capable of refuting them. For instance, Bovensiepen (2020) notes that by appealing to emotions, such as those associated with nationalism or feeling of inadequacy, corporations can make some individuals less receptive or interested in information that does not align with a pro-nationalist rhetoric, thus making them more welcoming of propositions that may not necessarily be in their best interest. Bovensiepen also points out that, even in cases where the existence of uncomfortable information is unavoidably acknowledged by individuals, the emotional cost that may accompany the consideration of such information could be a sufficient motivator for them to want to remain in the dark and/or prevent it from circulating.

Intentionality in Ignorance and Knowledge Production

Most agnotological research has tended to focus on one of two important aspects of ignorance: Either the manner in which it has been utilized as a strategy for wielding and maintaining political power, or the social effects that ignorance can have in a society (Bovensiepen, 2020). The former examines how ignorance can be a strategic tool used by governments and those in power to control and govern populations, for example by diminishing or refusing to recognize as legitimate knowledge produced by certain groups of people (Vitebsky, 2002). This type of ignorance has been most commonly referred to as ‘strategic ignorance’ and is most commonly discussed in the literature as a collective, strategic, intentional, and rational fabrication (e.g., The Monsanto papers; Bovensiepen & Pelkmans, 2020). What is most commonly associated with this type of ignorance is the motivation of institutions of power to coordinate ignorance producing activities in the pursuit of an overall long-term goal, while being driven mainly by logic and reason, rather than context and emotions (Bovensiepen & Pelkmans, 2020).

The second aspect of ignorance that has been most commonly studied in agnotological research centers on the “productivity” and “social effects” of ignorance (Bovensiepen & Pelkmans, 2020, p. 390). Rather than studying the power dynamics of ignorance, or focusing on those who impose ignorance on others as a power acquiring and maintaining strategy, such as powerful institutions, governments or corporations, this perspective focuses more on regular individuals’ who engage in the production of ignorance as a customary practice or conduct, such as ordinary citizens, and the religious or social dynamics that shape their lives (Bovensiepen & Pelkmans, 2020). Studies examining the social effects and productivity of ignorance tend to avoid making assumptions about the rationality and intentionality of its relevant actors, and instead opt to highlight the socio-cultural contexts within which ignorance is produced and implanted. For instance, this sort of studies are more interested in examining the religious and/or cultural traditions that encourage and foster the production of ignorance among a population, rather than analysing the population intentionality when using ignorance strategies.

In summary, the way in which the notion of intentionality has been interpreted when studying either the production or the social effects of ignorance has been relatively straightforward for the most part. When it comes to the study of ignorance production processes, intentionality has mainly taken the frontstage by being ascribed to the powerful entities, who are

believed to be producing ignorance as a rational and strategic way to achieve their desired goals (Bovensiepen & Pelkmans, 2020). When it comes to examining the social effects of ignorance, however, intentionality has mainly remained in the backstage, as the subjects of study are not the action themselves nor the actors behind them, but rather the contextual circumstances that allow for the production of ignorance, as well as the effects that the overall action of ignorance production may bring. The intentionality of the actors which produce ignorance, or upon which ignorance is produced, is not really relevant in this case.

While both these takes on the intentionality of ignorance production capture, to a significant degree, researchers' perspectives on ignorance issues, there exists value in adopting a less rigid understanding of actors' intentionality when conducting agnotological research. It is possible that the production of ignorance has become so institutionalized in certain areas of human functioning that it has become a naturalized or institutionalized disposition. This makes it harder to determine specific degrees of intentionality in social in/action. In these cases, ignorance does not emerge as a strategy, but rather as a form of 'praxis' (Anand, 2015, p. 309) or the result of 'banal' actions (Bovensiepen, 2020, p. 491).

For example, when conducting research on ignorance production through the assessment of scientific literature, it is important to keep in mind that it is likely impossible to identify the researchers' intentions for their writing style choices, unless these are explicitly expressed in their texts. While readers may speculate about the meaning behind researchers' motivations and purposes, in most cases it is impossible to affirm with certainty what these are by only reading their works. As such, instead of focusing on the degree of premeditation that took place before the utilization of any one particular writing technique, it may be more fruitful to invest efforts in examining how a piece of scientific literature, and the rhetorical techniques it displays, produces scientific knowledge and ignorance, regardless of the authors' intentions.

The present research avoids making assumptions about the intentionality or degree of consciousness behind the use of some rhetorical techniques in scientific literature, to favour the examination of how these techniques produce scientific knowledge and ignorance. Of course, this is not to deny nor to underplay the fact that researchers conduct research and write scientific texts with a clear agenda in mind. The reasons why researchers produce scientific literature may well be clear to readers, as most of the time it involves the advancements of scientific claims or the introduction of new scientific findings.

This is further made clear in literature that is explicitly addressing a controversy, given that oftentimes it is researchers themselves who express in their texts what they intend to accomplish with their work. What remains difficult to decipher, however, is whether the strategies used to produce ignorance of uncomfortable knowledge in their texts were consciously utilized by them. Indeed, sometimes the manner in which agendas are advanced and defended do not necessarily need to be fully conscious, as there has been evidence that suggests that even when there is strategic mediation among some researchers, some strategic utilizations of ignorance are nested within more habitual and unconscious forms of argumentation (Bovensiepen & Pelkmans, 2020).

Methodology

Normative Engagement and Positionality

There are different ways of approaching criminological research. The way research is thought about, designed, implemented, and interpreted, is not only influenced by differences in epistemological, ontological and axiological assumptions, but also the way the public role of criminology is conceptualized. The public role of criminologists as social scientists, and the field of criminology as a scientific discipline, has been a great topic of debate within academia for many years. After looking at an extensive amount of existing literature on the topic, Turner (2013) identified and evidenced three main perspectives on the public role of criminology, which she classified as (a) criminology fighting for the truth, (b) criminology making news, and (c) criminology as a democratic underlabouring.

The first perspective, criminology fighting for the truth, sees criminologists as experts who possess information about the real world that is not available or being heard by the general public (Turner, 2013). It is the responsibility of criminologists therefore to fight against interpretations of reality offered to the public by those with egotistical or political motivations that are “probably a lot less honest” than those that they could offer, and instead, educate the public on what they know to be the one and only truth (Currie, 2007, p. 183; Turner, 2013). This perspective of criminology’s public role adopts a postpositivist approach in which criminologists are seen as objectively capable of capturing and understanding reality through complex processes of systematic observations and experimentation. However, in this perspective, the role of criminologists does not end in producing scientific knowledge, but expands to include the influencing of policy by assertively promoting and nurturing the knowledge produced by their research, while actively opposing calculated truths that go against the public’s best interests (Turner, 2013). In summary, criminologists in this perspective are tasked with making the ill-informed public more educated on the truth.

Similarly, the second perspective of criminology’s public role sees criminologists as experts possessing information that is not often readily available to the general public, namely the experience of marginalized groups. However, this perspective does not see criminologists as producing facts or truths in an objective manner (Turner, 2013). Instead, this perspective considers criminologists own agendas and their associations with the journalistic sources as a tool for influencing public opinion and policy. Here, journalists are seen as allies in the fight for

more progressive ideologies. In this perspective, the role of criminologists consist of forming relationships with journalists and gaining working knowledge of culture and the media in order to advance progressive “discourse, language and representation of crime and justice” and influence criminal justice policy (Barak, 1988; Turner, 2013, p. 153). Criminologists in this perspective are encouraged to abandon notions of neutrality and objectivity to adopt a more radical approach to protecting the public’s interest through the strategic dissemination of information that oppose dominant discourses about crime (Barak, 1988; Turner, 2013).

While it still considers criminologists as producers, bearers, and interpreters of a special kind of knowledge, the third and last perspective, criminologists as democratic underlabourers, rejects the notion of criminologists taking sides and strategically choosing which “truths” to disseminate. In this perspective, criminologists are not considered as experts whose opinions carry more weight than any other groups in policy decision making, but rather as mediators who can support decision-making processes. Understanding that political decision making must be based on a number of different factors, this perspective sees criminological knowledge not as a defining element that guides policy, but rather as one of many points of view on crime and justice that must compete to influence public change. In this role, criminologists are diplomats who ensure that political decision makers, and all the stakeholders involved, are aware of the different perspectives on an issue, where different groups agree, and where they disagree and why. It is about facilitating a democratic process where all the parties involved can learn from each other.

The present research will function under the last perspective, not taking sides in the controversy that it seeks to analyse and exposing the mechanisms through which scientific knowledge and ignorance is produced. It is important to acknowledge, however, that by analysing two different points of view under the same light (e.g., the dominant and the alternative perspective), the present research may be perceived as siding with the less popular one. Indeed, investing an equal number of resources to examine and explain two different points of view may be considered by some as a way of giving a voice to the perspective in the position of underdog and, in doing so, siding with it. When little can be found in the literature about an alternative perspective, any form of research that discusses it in a non-negative light can be taken as a piece of support.

That being said, it is also important to reiterate that the present research does not seek to side with any of the positions that will be discussed. It will remain true to the principle of symmetry and aim to be as neutral as possible when examining each position's claims as to not prioritize any one of them in particular. Furthermore, the present research does not seek to determine which type of scientific knowledge is more or less valid, but rather demonstrate that the production of science is foremost a social process, that involves complex mechanisms of knowledge and ignorance production.

Selection of the Controversy/Material

The controversy surrounding the use of heritability studies in criminological research was selected for the purposes of the present research as it displays two characteristics that make it ideal for the observation of how scientific knowledge and ignorance can be constructed and deconstructed. First, this controversy is relatively current and heated, which means that there are multiple direct interactions between actors and actor-networks that can be thoroughly studied concurrently as they play out (Venturini, 2010). Second, the chosen controversy has been extensively documented. Numerous articles documenting the different points of view that are mobilized during this controversy have been written and published for academics to follow. In addition, narrowing the focus to the impact of heritability studies in the field of criminology specifically, as opposed to a wider examination of the evolution of the biosocial paradigm in the social sciences in general, allows for a more realistic, resource-aware, and in-depth examination of the way scientific knowledge is created and/or ignored, taking into consideration the time and resource constraints of the present master's thesis.

Inspired by Janko et al.'s (2014) approach to the study of knowledge controversies about climate change, the present research was designed to uncover and examine rhetorical techniques used in the advancements of claims surrounding the controversy of heritability studies. More specifically, the present research aimed to identify and analyse differences in the reporting of past literature (i.e., citations) in two key articles published in the same journal, *Criminology*, that present opposing arguments about the use the heritability studies in criminological research.

The first article, titled "Pulling back the curtain on heritability studies: Biosocial criminology in the postgenomic era" was written by Callie H. Burt and Ron Simons in 2014 as a response to the increase in the number of heritability studies conducted in criminology since 2008. Callie H. Burt is an Associate Professor at Georgia State University in the Department of

Criminal Justice and Criminology, as well as the Center for Research and Interpersonal Violence (Burt, n.d.). Her research interests focus primarily on developmental and life-course sociology/criminology, elucidating the psychosocial mechanisms through which social inequalities—with a particular emphasis on racial disparities—influence social behaviours (e.g., criminality, health risks). Burt's research has experienced some degree of notoriety among the criminology and sociology communities, as it has been published in multiple prestigious academic outlets, including *American Journal of Sociology*, *American Sociological Review*, *Criminology*, *Journal of Health and Social Behavior*, *Social Forces*, *Social Problems*, and *Justice Quarterly*. Burt was awarded the Ruth Shonle Cavan “Young Scholar” Award from the American Society of Criminology in 2014.

The second author of the first article, Ron Simons, is a Regents Professor of Sociology at the University of Georgia, a Fellow in the Center for Family Research, and a Co-Director of the Center on the Biological Embedding of Social Events and Relationships (University of Georgia, n.d.). Simons’ research interests include medical sociology, family and the life course, criminology, race, inequality, and social psychology. Similar to Burt’s, Simons’ research has also been published in some of the top sociology and criminology journals, including the *American Sociological Review*, *Journal of Health and Social Behavior*, *Social Science and Medicine*, *Criminology*, *Journal of Marriage and Family*, and *Social Problems*. During the past few years, he has received the Outstanding Mentoring Award from the Division of Convict Criminology, has been inducted as a Fellow into the American Society of Criminology, and has been given the UGA's SEC Academic Achievement Award.

The second article, titled “Demonstrating the validity of twin research in criminology”, was also written in 2014 as a direct response to Burt and Simons’ critiques of heritability studies. Its authors include:

- James Christopher Barnes, an Associate Professor and Interim Director at the University of Cincinnati’s School of Criminal Justice, who’s research interests include the identification of potential links between genetics and crime, as well as the assessment of offenders’ decision-making processes (University of Cincinnati, n.d.);
- John Paul Wright, another professor at the University of Cincinnati’s School of Criminal Justice, and recently judged to be one of the most prolific and most cited criminologists in the United States, who’s work focuses on integrating findings from a number of

disciplines, including human behavioural genetics, psychology, and biology (University of Cincinnati, n.d.);

- Brian Boutwell, an Associate Professor of Criminal Justice and Legal Studies at the University of Mississippi, who specializes in quantitative genetics, with a focus on environmental and psychological risk factors for antisocial and violent behavior (The University of Mississippi, n.d.);
- Joseph A. Schwartz, Associate Professor in the College of Criminology and Criminal Justice and Co-Director of Biosocial Criminology Research and Policy Institute at Florida State University, whose research focuses on the intersection of biological and social influences on behavior and health across various stages of the life course (Schwartz, n.d.);
- Eric J. Connolly, Assistant Professor of Criminal Justice at Pennsylvania State University, whose research focuses on biosocial criminology, considering factors such as genetics, neuropsychology, and evolutionary psychology when studying human behavior (Penn State Abington, n.d.);
- Joseph L. Nedelec, Associate Professor in the School of Criminal Justice and Director of the Online MS Program at the University of Cincinnati, as well as co-founder and current Vice President of the Biosocial Criminology Association. His research interests include biosocial criminology, life course/developmental criminology, evolutionary psychology, intelligence, quantitative behavior genetics, and cybercrime (University of Cincinnati, n.d.); lastly but not least,
- Kevin M. Beaver, Professor of Criminology at Florida State University's College of Criminology and Criminal Justice, whose research examines the biosocial underpinnings of antisocial behaviours (Florida State University, n.d.).

Altogether, their work has been published extensively in a broad array of top criminology, biology, genetics, psychology, and medical journals, including but not limited to *the American Journal of Public Health, Biological Psychiatry, Criminology, Developmental Psychology, Sexual Abuse, Evolution and Human Behavior, Journal of Criminal Justice, Journal of Quantitative Criminology, Personality and Individual Differences, Journal of Research in Crime and Delinquency, Crime & Delinquency, Justice Quarterly, Psychological Bulletin,*

Environmental Research, Behavior Genetics, Journal of Theoretical Biology, and Psychological Science.

The journal where both of the articles under analysis were published, *Criminology*, has been one of the most prestigious and influential international journals in the field of criminology for decades (Barranco et al., 2016). It is the official organ of the American Society of Criminology (2020b) founded in 1941, “an international organization concerned with criminology, embracing scholarly, scientific, and professional knowledge concerning the etiology, prevention, control and treatment of crime and delinquency” (Wiley Online Library, 2021). *Criminology* presents itself as being “devoted to crime and deviant behavior...Major emphasis is placed on empirical research and scientific methodology” (The American Society of Criminology, 2020a). Since some of the earliest studies looking at degree of journal impact in the 1980s, to this date, *Criminology* has consistently been ranked as one of the top five journals in the discipline of criminology by scholars and scientist institutions (Barranco et al., 2016). Most recently, according to the Journal Citation Report (2020), the journal is ranked as the third most influential out of 69 scientific journals in the discipline of criminology, having been cited more than nine thousand times in 2020.

The two chosen articles exhibit the same high amount of perceived legitimacy that comes along with being associated with well-reputed scientific institutions and the peer-reviewed process. As a result, they have been frequently used as supporting references in a large number of studies. Indeed, according to Web of Science, each of these articles has been cited a significant number of times (59 for Burt and Simons and 86 for Barnes et al.), demonstrating the high level of influence that they have in the scientific community, and more importantly, the debate about the use of heritability studies in criminological research.

Not only have these two articles been frequently cited, but have also inspired a chain of direct article replies, where a number of researchers, including some of the original authors, have continued the conversation on the appropriateness or inappropriateness of the use of heritability studies in criminology. Since the publication of Barnes et al.'s (2014) “Demonstrating the Validity of Twin Research in Criminology” article, Burt and Simons (2015) have written a second article titled “Heritability Studies in the Postgenomic Era: The Fatal Flaw Is Conceptual. Exchange and Commentaries on Heritability Studies in Criminology”, where they respond to Barnes et al.'s accusations, clarifying their position and defending their original claims. The

publication of this article prompted Wright et al. (2015) to write a rejoinder, “Mathematical proof is not minutiae and irreducible complexity is not a theory: A final response to Burt and Simons and a call to criminologists”, where they defended and reiterated some of Barnes et al.’s (2014) original arguments and proceeded to dismantle and dispute some of Burt and Simons’ (2015) more recent made claims. Furthermore, the editors of the journal *Criminology* also invited some researchers, most notably Morris and Beckley (2015) and Massey (2015), to express their opinions and clarify their positioning in regards to the controversy by writing and publishing commentary pieces about the debate started by Burt and Simons and Barnes et al. This makes Burt and Simons’ (2014) and Barnes et al.’s (2014) original articles important players in the unfolding of the heritability studies’ controversy, and thus perfect candidates for our analysis.

Another aspect that makes these two articles particularly useful is the manner in which one of them was written as a direct response to the other. Indeed, in their article, Barnes et al.’s (2014) defend the use of heritability studies in criminology by responding to Burt and Simon’s (2014) arguments against the practice. As such, when read in the order in which they were published, these articles follow the structure of a regular debate, where claims are formulated and contested during back-and-forth interactions between actors. This facilitates the examination of the way actors may react to and try to weaken the knowledge producing strategies of their adversaries, as well as the identification of some of the ignorance producing strategies that may have otherwise gone unnoticed when no direct response is made to particular claims.

Analytical Grid and Analysis Process

Given that we are interested in analysing the use of rhetorical techniques in the citation process and not the validity of the sources of evidence utilized by the authors, the present research will focus on analysing the different ways these two articles have framed and utilized an identical set of references in order to advance their respective claims and ignore the claims of their opponents. In order to do so, a database was created by (a) Looking at the articles’ reference list and identifying common references, (b) searching the in-text citations of every shared reference within both articles, and (c) entering the section or paragraph containing each in-text citation into an Excel database.

Data analysis consisted of examining the different types of discursive devices and rhetorical strategies that were used to either strengthen and/or weaken the legitimization of the authors’ scientific claims. Like mentioned in the Theoretical Framework chapter, these may

include the use of modalities (e.g., hedges and boosters), direct attacks to methodological technicalities, and/or the appeal to readers' emotions, among others. A list of discursive devices to look for in the present analysis (appendix A) was drawn from Latour and Fabbri (2000), Latour's (1987), and Bertotti and Miner's (2019) articles on rhetorical practices in the construction of scientific facts. The present research also adopted an exploratory approach in that it sought to find additional discursive devices and rhetorical strategies to the ones utilized in Latour's, Latour's and Fabbri's, and Bertotti and Miner's articles to contribute to the current literature on the subject.

To begin to analyse and understand the knowledge and ignorance producing strategies employed by Burt and Simons (2014) and Barnes et al. (2014), it is necessary to first introduce their arguments individually. The following sections will present a brief overview of each of their articles.

Presentation of the Case Study

Burt and Simons

The debate on heritability studies investigated in the present research originated in 2014, when Burt and Simons published their article "Pulling back the cultural curtain on heritability studies: Biosocial criminology in the postgenomic era". In this article, the authors expressed their concerns for the resurgence in popularity of heritability studies' methods and assumptions in criminological research.

Burt and Simons argued that heritability studies looking at correlates of crime had not only been increasing in number over the last decade, but also had been producing results evidencing a strong link between individuals' genetic composition and complex behaviours. They emphasized their disconcert with the fact that the large majority of these studies had reported significantly sizeable heritability estimates (~50%) and minimal effects of environmental factors (e.g., parenting and community factors) for criminal behaviours and other related outcomes. If true, such findings would suggest that most of the popular theories and assumptions in the field, which are based on sociological premises, had to be revised.

In their article, Burt and Simons (p. 225) question the validity of such controversial findings, pointing out how "nonsensical" it is to try to partition genetic and environmental influences on human behaviour, and listing some of the inherent flaws present in the methodologies and assumptions of some of the most popular models of heritability studies (i.e.,

twin studies, adoption studies, and studies of twins “reared apart”). In a highly controversial move within the biosocial criminology community, Burt and Simons finalize their article by calling for the complete removal of heritability studies from criminological research and advocating for the renewal of the dialogue about the relationship between heritability and the environment as well as the adoption of a postgenomic biosocial agenda in criminology.

One of Burt and Simons’ main arguments concerns the inherent flaws in heritability studies’ methodologies and assumptions, which, according to the authors, bias the estimates of their results toward the inflation of heritability effects and the underestimation of environmental influences on behaviours. The mentioned flaws included but were not limited to a lack of clarity in heritability estimates’ terminology (e.g., unshared vs. shared environments) and, most notably, the inevitable violation and consequential effects of a number of heritability studies’ assumptions, especially the equal environment assumption (EEA) in twin studies.

The EEA states that environments of monozygotic (MZ), or identical twins are not more similar than those of dizygotic (DZ), or non-identical twins. This leads to the interpretation of observed differences in concordance rates between MZ twins and DZ twins as resulting from genetic factors as opposed to environmental factors. Introducing evidence from past studies showing that MZ twins experience more similar social environments than DZ twins, Burt and Simons present their argument that the EEA is often, if not always, violated in heritability studies that look at criminal or related behaviours, which consequently renders their estimates invalid. The reason for this, according to Burt and Simons, is that heritability calculations using the twin study model are crucially dependent on the EEA, and even minor violations to this assumption could result in substantial overestimation of heritability estimates and underestimations of the influence of shared environment. Furthermore, to prove their point that the majority of heritability studies in criminology disregard the detrimental effect on findings of a potential violation of the EEA, Burt and Simons provided a list of recent heritability studies where these effects were not examined (p. 234).

While not as detailed as when speaking about EEA violations, Burt and Simons dedicate most of what remains of their article to criticize other aspects of twin studies, including but not limited to their propensity to violate another assumption (i.e., genetic additive assumption), their likely inflated heritability estimates; the lack of variation and questionable quality of their frequently used data (e.g., Add Health data); their tendency to rely on large confidence intervals;

and researchers' tendency to misinterpret twin study results and draw unjustified conclusions from their estimates of shared environmental effects. Burt and Simons also go on to explain some of the limitations of other heritability studies models, namely adoptions studies and studies of twins reared apart, that tend to either inflate genetic estimates, decrease environmental estimates, or both.

Lastly, Burt and Simons make a call to scholars interested in biosocial criminology to move beyond heritability studies and begin to recognize that looking at the effect of genetics on human behaviour is only meaningful when environmental influences are also taken into consideration. The authors explain that it is now widely accepted that human behaviour is the result of the interaction between individuals' biology and environment. As such, researchers should not be focusing their efforts in trying to assess the amount of variability in a behaviour that is the product of genes, but rather the way in which a person's biology and environment interact to produce said behaviour. Burt and Simons make the point that, even if it were possible to calculate heritability estimates, these would have little, to no, practical use, as "they do not predict the likely developmental endpoints for individuals or groups, the consequences of interventions, or the causal processes or mechanisms involved in phenotypic variations" (p. 246). Importantly, they also stress the fact that their intention is not to criticize biosocial criminology or biosocial criminologists, but instead to bring awareness to the flaws of heritability studies. Having this end in mind, Burt and Simons express their support and enthusiasm for research based on a postgenomic paradigm, especially in the area of epigenetics, a field of study that focuses on the many ways gene expression is influenced by the environment (Bagot & Meaney, 2010; Bollati & Baccarelli, 2010; Charney, 2012).

Barnes et al.

While Burt and Simons' (2014) article presents the authors' concerns with the continuous and increasing use of heritability studies in criminological research, without focusing on any one particular study or scientist, the article by Barnes et al. (2014) is framed as a direct critique of Burt and Simons' arguments. This is not to say that Barnes et al. did not also present arguments in favour of heritability studies, but rather that the way in which they defend their use in criminological research takes a more defensive approach. Barnes et al.'s responses to Burt and Simons' article can be separated into three main arguments, namely (a) Burt and Simons' critiques are outdated and no longer relevant, (b) assumptions' violations do not invalidate

heritability studies' results, and (c) Burt and Simons misrepresented behavioural genetics and some researchers' conclusions about heritability estimates of crime.

Barnes et al. begin their article by explaining how behavioural genetic research has been criticized since its creation over more than 100 years ago, especially by those who are solemnly against the association of biology and human behaviour. As a response to these critiques, a number of scholars from different disciplines, such as behavioural genetics and statistics, have engaged in a prolonged effort to improve and ensure the robustness of behavioural genetic methods, in particular those designed to assess heritability. Barnes et al., go on to affirm that for every new concern raised about the validity of behavioural genetics, new empirical evidence defending the practice has emerged. Using this information, Barnes et al. argue that the concerns Burt and Simons present in their article have already been addressed in past literature, and therefore are no longer relevant.

As a direct response to Burt and Simons' concerns about the EEA violation in twin studies, the second argument that Barnes et al. make is that the violation of twin studies' assumptions does not necessarily invalidate their results. In order to prove this point, Barnes et al. use a series of mathematical calculations to demonstrate the basis of twin study designs, and illustrate through multiple simulations and empirical evidence the minimal impact that violating the EEA would have on heritability estimates. To further drive their point across, Barnes et al. also present the argument that, even if the EEA violation would result in the overestimation of heritability estimates, this impact would most likely be counteracted by the effects of the very common violation of the random mating assumption (RMA). The latter being the assumption that humans mate randomly, which, when violated, results in the deflation of heritability estimates. They conclude this section of their article by affirming that violations of behavioural genetic assumptions, in particular the EEA, rarely occur, and that even when they cannot be prevented, they are rarely classify as serious enough to justify the complete abandonment of heritability studies, as Burt and Simons advocate for.

Lastly, Barnes et al. question Burt and Simons' scientific integrity. They accuse Burt and Simons of selectively citing and misrepresenting past research evidence with the intention of making it seem as if their claims were more widely supported than they actually are. Barnes et al. go as far as to suggest that, rather than this being a simple mishap or misunderstanding from Burt and Simon's side, this was more an intentional strategy from Burt and Simons of reviving

concerns about a practice that has repeatedly been demonstrated to be a useful tool in the study of human behaviour. Throughout their article, Barnes et al. also include short snippets of how they believe Burt and Simons purposefully avoided mentioning key information that would have invalidated some of their claims. For instance, Barnes et al., accuse Burt and Simons of purposely leaving out information concerning the effects of the RMA's violation and cherry-picking the studies they included as examples in their articles.

To prove that Burt and Simons had intentionally excluded studies that did not align with their claims from the list of examples they provided, Barnes et al. replicated Burt and Simons' literature search. They found over 60 studies that tested the effects of a potential EEA violation, the majority of which showing little-to-no influence on heritability estimates. They used these findings to affirm that Burt and Simons had not been transparent in their research.

Barnes et al. end their article by listing a few of the benefits of heritability studies for modern behavioural research. These include but were not limited to heritability studies being the starting point of the journey towards a "true biosocial criminology" (p. 613); the impressive evolution and complexity of behavioural genetic statistical designs that allow for a more accurate examination of the genetic and environmental covariation between traits; and the better and more nuanced understanding of environmental factors resulting from the partitioning of variance into genetic and environmental sources. Barnes et al. then proceed to plead for scholars not to abandon heritability research, but instead, work to revise and continue improving its methodologies and statistical models in order to address its known problems. Finally, concerning Burt and Simons' petition to further explore epigenetic processes, Barnes et al. go on to explain that this is an area of research that not only is in its infancy, but also has endured heavy criticism. Therefore, making it an unsuitable replacement for heritability studies.

Results

As explained in the Theoretical Framework chapter, scientific facts are statements that have been blackboxed through the process of recruiting and mobilizing human and non-human actors into stabilized networks (Latour, 1987). It is by making such networks stable, or closing black boxes, that scientific knowledge is produced. Accordingly, in order to open a black box, it is necessary to destabilize the network that has led to its production. As such, it is in the best interest of researchers to not only find ways to destabilize their opponents' actor-networks, but also create actor-networks that are strong enough to withstand multiple attempts of destabilization.

In the context of scientific literature, blackboxed scientific knowledge is that which has been discussed in such a way that reduces or eliminates, for a time at least, the likelihood of destabilization of its actor-network. In other words, scientific knowledge that is presented in scientific literature in a manner that makes it difficult for readers to disagree with it, criticize it, or put it into question, is likely to become blackboxed. Contrarily, when scientific knowledge is presented in the literature in a way that facilitates its criticism or questioning, its black box can more easily be opened.

When writing about a controversial scientific topic, scientists with opposite worldviews employ strategies to either produce knowledge by making their statements more difficult to contest or produce ignorance by making their opponents' claims more open to potential criticisms. By examining the manner in which Burt and Simons and Barnes et al. inserted the same group of citations in their articles, the present research aims to (a) identify some of the discursive devices and strategies used in the production of scientific knowledge and ignorance, (b) illustrate that the production of scientific facts is first and foremost a social endeavor, (c) show that knowledge and ignorance are a part of a duality, (d) explain how the same established scientific information can be used in new claims to generate varied forms of scientific knowledge and ignorance, and (e) illustrate how the production of scientific knowledge and ignorance oftentimes involves appealing to audiences' emotions.

This chapter will document the instances in which Burt and Simons and Barnes et al. engaged in four common types of knowledge and ignorance producing strategies, namely denial, dismissal, diversion and displacement, as a way of weaponizing their written works to fight against their opponents' claims. Emphasis will be placed on the different discursive devices

utilized by the authors to either deny, dismiss, divert, or displace uncomfortable knowledge, explaining their effects on claims' facticity.

In total the two articles under analysis shared 26 references. All together, these references were cited a total of 67 times in both texts. Of these, 39 citations belonged to Burt and Simons' article and 28 to Barnes et al.'s article.

Denial

One of the most common strategies of ignorance production is *denial*, which is most frequently defined as a "persistent refusal to act on information or even accept its existence" (Rayner, 2012, p. 113). In a more sociological sense, denial does not refer to individuals' cognitive or affective state, but rather the refusal or inability to acknowledge certain kinds of information, even in cases where individuals or external organizations make an active effort to bring this information into attention (Rayner, 2012). More generally, denial represents an organization's or individual's refusal to acknowledge or engage with information that they find uncomfortable.

Evolution of Heritability Studies' Denial

One of most straightforward demonstrations of the use of denial as an ignorance producing strategy in the field of criminology is the lack of coverage of biosocial research, and by extension heritability studies, in introductory textbooks (Beaver et al., 2015; Wright & Miller, 1998). However, while the omission, or denial, of certain types of knowledge from textbooks is a very effective ignorance strategy, it can only last as long as the involved knowledge and ignorance producing networks are able to remain stable. The enrolment of different actors by opponents of the dominant paradigm into their knowledge and ignorance producing networks may significantly affect the ability of mainstream researchers to continue denying the inclusion of alternative forms of knowledge within mainstream teaching materials. This is what has been occurring in the social sciences, and most notably criminology, during the last decades, as new technologies that allow for a more precise examination of the associations between individuals' biological compositions and their behaviours have been translated into networks that advance biological paradigmatic notions.

As knowledge about individuals' genetic composition becomes more clear and widely available, and new and improved methods for calculating individuals' heritability estimates are popularized, the interest to find connection between heritability and individuals' behaviours has

resurfaced in the social sciences (Beaver et al., 2015; Larregue, 2020; Masters, 1996). Accordingly, heritability studies in the field of criminology have increasingly been gaining momentum among researchers, thus making it more difficult for mainstream criminologists to continue omitting their existence in introductory textbooks and scientific articles. This has resulted in the rapid and exponential increase in the number of heritability studies in criminology that motivated the writing of Burt and Simons' piece.

As a result, mainstream criminologists, who subscribe to the sociological paradigm, have had to adapt and find new and more sophisticated ways of generating ignorance about alternative paradigmatic views, even when not being able to completely omit them from mainstream criminological discourses. When it comes to the ignorance producing strategy of denial, this can, and has been done in a number of different ways, including the presentation of alternative knowledge in an incomplete manner. That is, in a manner in which key details that would make the alternative claims appear more factual and difficult to refute are left out of the discussion. Using the data collected from Burt and Simons' and Barnes et al.'s articles, the following section will demonstrate the ignorance producing strategy of denial at play in their texts.

Examples of Denial in the Articles

The strategy of denial was utilized in a number of instances both by Burt and Simons and Barnes et al. However, the most explicit and easily observable instances came in the form of direct critiques in Barnes et al.'s article concerning Burt and Simons' tendency to selectively include, and most importantly, omit certain types of information from their article. Indeed, in several occasions, Barnes et al. accuse Burt and Simons of knowingly choosing to leave out the explanation of certain methodological technicalities of heritability studies with the intention of protecting their claims from seeming inaccurate.

For instance, as pointed out by Barnes et al. (p. 607), Burt and Simons did not include information about the RMA and its presumed inevitable violation, which would result in the inflation of the estimates of the shared environment effect and a deflation of those of heritability:

When the assumptions of random mating and the EEA are considered in tandem, calculation and simulation results reveal that violations of one assumption tend to counterbalance violations of the other. Based on these results, we cannot conclude that violations of the EEA will overstate heritability because violations of the assumption of random mating lead to underestimates. Scholars should, therefore, be skeptical of the unilateral dismissal of heritability studies by Burt and Simons because of among other reasons, their lack of a discussion of the assumption of random mating.

Instead, Burt and Simons chose to focus on the EEA, the heritability studies' assumption that when violated produces the opposite effect (i.e., inflated estimates for heritability and deflated estimates for shared environment effect) as a way to advance their claims of heritability studies' fallibility. Barnes et al. highlight how convenient the omission of such information is for Burt and Simons' case, as acknowledging a potential counteracting effect to EEA violations would surely make their claims significantly less solid and more susceptible to criticism or scepticism from their audiences.

Another instance of the use of the strategy of denial was also pointed out by Barnes et al. in their article:

The bolded studies at the top of appendix D [i.e., list of resulting studies from Barnes et al.'s literature search] in the online supporting information represent the studies that were cited by Burt and Simons. As shown, Burt and Simons cited a total of nine studies, only two of which included an empirical analysis (p. 598)

Their selection of just a few sources of information becomes more suspect when juxtaposed against appendix D in the online supporting information, which indicates that Burt and Simons could have easily selected from the 60+ scholarly studies that empirically assessed the EEA (p. 613).

Here, Barnes et al. accuse Burt and Simons of selectively omitting heritability studies that tested the effects of the potential violation of the EEA from the list they provided as evidence to demonstrate the current state of the literature on heritability. As Barnes et al. pointed out, the inclusions of such articles, which showed a lessened impact of EEA violations on heritability estimates, would have had severely debilitated some of Burt and Simons' principal claims. Instead, by choosing which articles to include in the list provided, and most importantly, which articles to leave out, Burt and Simons were able to support the argument that the large majority of recent heritability studies disregard the effects that a potential violation of the EEA may have on their findings.

Including an actual list of sources for audiences to examine and confirm by themselves that what is being said in the article is accurate, not only reinforces Burt and Simons' claims by providing additional pieces of evidence in their favour, but also decreases the likelihood of alternative studies contradicting the authors arguments being found. Indeed, by being presented a readily available list of heritability studies to examine, audiences are less likely to feel the need to look elsewhere for additional information to confirm or dismiss any doubts they may have

about a particular claim. In this sense, the inclusion of a list that excluded potentially condemning evidence against their argument may have, in fact, increased the odds of their claims appearing more valid than the complete absence of thereof.

Another instance of denial in Burt and Simons article came in the form of the misquotations of prestigious researchers. As also pointed out by Barnes et al., some of the direct quotations that were included in Burt and Simons article lacked certain pieces of information that, if included, would have made the authors claims appear less solid, or even contradictory. For instance, the Psychology and Social Development Professor Terry Moffit was quoted in Burt and Simons' (2014, p. 226) article as saying:

Although evidence from the different methods [referring to the number of different methods utilized to calculate heritability estimates] are used to “provide convergent findings,” given that “each of the primary designs used by behavioral geneticists has its own Achilles heel(s)” (Moffitt, 2005: 57), we show that all of these models are biased toward inflating heritability and underestimating shared environmental influences.

Reading this except alone would suggest that Moffitt supports Burt and Simons' claims of heritability estimates being biased, as well as their mobilization in favour of their abandonment. Most notably, given Moffitt's occupation and experience on the subject of heritability studies⁵, having her support would make it significantly more difficult for Burt and Simons' inexperienced readers of contesting or refuting their claims using methodological technicalities. Thus, mobilizing Moffitt's judgement into their knowledge and ignorance producing networks would be likely to have a great stabilization effect.

However, as pointed out in Barnes et al.'s article (p. 612), when looking at the actual source where Moffitt's quote was taken, it can be observed that some key information was missing from the Burt and Simons' quotation:

A fundamental assumption guiding this review is that sturdy inferences ought to be drawn from a cumulative body of studies whose methods differ as much as possible, but provide convergent findings about the same construct. As we have seen, each of the primary designs used by behavioral geneticists has its own Achilles heel(s), but fortunately, each

⁵ With over 40 years of research experience, Terry Moffitt, Ph.D., is a Professor of Psychology at Duke University and a Professor of Social Development at King's College London (Duke University, 2021). Her areas of expertise include but are not limited to longitudinal methods, developmental theory, clinical mental health research, neuropsychology, and genomics in behavioural science. Seeking to uncover ways in which molecular genetics, psychology, and the environment interact to shape risk and resilience outcomes, Moffitt and her team have conducted and published 9 empirical studies on the behavioural effects of genes and environment interactions to date.

design's idiosyncratic flaws are offset by compensatory strengths of the other designs. As a consequence, although particular studies and particular designs may be subject to critique, this does not invalidate inferences derived from the entire cumulative evidence base (Moffitt, 2005, p. 57).

Ironically, Moffitt's original quote is actually the complete opposite of what Burt and Simons were trying to transmit. In fact, in the original quote Moffitt advocates for the use of heritability studies, pointing out their importance and usefulness, despite of some of their flaws.

By choosing to include sections of Moffitt's words that benefited their cause in the form of a direct quote, while omitting those who contradicted their claims, Burt and Simons were able to solidify their arguments in a more efficient way than they would have had using paraphrasing. The reason for this is that direct quotes appear to be more legitimate as they remove the possibility of misunderstandings and mistranslations from the formula (Gibson & Zillmann, 1993). That is, when readers find a direct quote, they might be less inclined to question its legitimacy as they are meant to represent the direct words of other, oftentimes legitimate, sources. What is particularly interesting in this case is the fact that the direct quote was taken from a source that completely contradicted the point Burt and Simons were trying to make.

The last instance of the use of denial in Burt and Simons article that will be discussed in the present research is the way the intentions of Beaver (2011), a well-known biosocial criminologist, were misrepresented to support their claims. Beaver was misquoted in Burt and Simons (p. 236) as saying: "The only reason that MZ twins should be more similar than DZ twin pairs is because they share twice as much genetic material (Beaver, 2011, p. 86 [sic])"

This quote was used as evidence to prove that biosocial criminologists frequently ignore the assumptions at the base of classical twin studies, particularly the EEA. This quote was meant to highlight how Beaver (2011), as well as many other of his biosocial criminology colleagues, oftentimes fail to inform their readers about the potential validity concerns of heritability estimates when twin-based studies' assumptions are violated. However, as Barnes et al. (p. 612) pointed out, in the original Beaver's article, the unedited quote reads as follows:

As a result, if the assumptions of twin-based research are met, the only reason that MZ twins should be phenotypically more similar than DZ twins is because they share twice as much genetic material (emphasis added; Beaver, 2011, p. 87).

This implies therefore that Burt and Simons edited and omitted some of Beaver's (2011) words in an attempt to make them fit their narrative. This is a very interesting situation, which

provides a clear demonstration of how the framing and use of quotations can be weaponised in order to advance one's claims and ignore those of the opposition. Once again, it is interesting to see that Burt and Simons chose to include a quote that, when unedited, flatly contradicts the exact claims they were trying to make.

It is important to point out that if it was not for Barnes et al.'s remarks, Burt and Simons misuse of Moffit's and Beaver's words would have gone by unnoticed by readers unfamiliar with Moffit's, Beaver's, and/or Barnes et al.'s works. This is a perfect example of how knowledge and ignorance producing networks, and by extension blackboxed facts, can be construed and deconstructed though the way scientists interact with different actors across time.

More specifically, in this scenario, Moffit's and Beaver's words, knowledge, and prestige were first appropriated by Burt and Simons in an attempt to close the black box of heritability studies not being acceptable methodological tools for criminological research. However, they were later on reutilized by Barnes et al. as a way of opening the black box that Burt and Simons had previously attempted to close. Therefore, demonstrating how the same actors can be used to create networks leading to completely opposite ends. Moreover, this also highlights how important it is for researchers to reduce as much as possible the likelihood of potential attacks from opponents by ensuring that the information they are using from past literature cannot be turned around against them.

Burt and Simons were not the only ones that employed the strategy of denial. While less visible given that in the scope of the present research there are no articles directly pointing them out, strategies of denial can also be seen in Barnes et al.'s article. Having had the opportunity to read, analyse, and respond to Burt and Simons' article, choosing not to address all of their critiques of heritability studies suggests denial may be at play. Was the absent information omitted because of space or time limitations? Or was it omitted because it was deemed uncomfortable? It is important to examine which of the arguments made by Burt and Simons were left out, or denied, from Barnes et al.'s rebuttal.

One important instance of denial that can be observed in Barnes et al.'s article is their failing to mention the relevant fact that Burt and Simons were not arguing against biosocial criminology in general, but against the use of heritability studies in criminological research more precisely. This information is important as it places Burt and Simons, not at the opposite end of the spectrum in the nurture or nature debate, but rather as proponents of biosocial criminology,

who are trying to perfect the use of biosocial studies in the field. In this sense, knowing that its authors are proponents of the biosocial perspective, Burt and Simons' article feels less like a critique against the association of human biology and behaviour, and more like an attempt to promote the conversation about what needs to be done for biosocial criminology to be legitimized within the discipline of criminology. The mentioning of Burt and Simons positioning concerning biosocial criminology in Barnes et al.'s article could have had the effect of making proponents of biosocial criminology, and heritability studies in particular, lower their defenses and be more open to what Burt and Simons had to say. Therefore, preventing the blackboxing of Barnes et al.'s claims.

Dismissal

While denial refers to the outright refusal to acknowledge or engage with certain types of information, dismissal represents the acknowledgement of the existence of information only to refute it as erroneous or irrelevant (Rayner, 2012). Organizations and individuals can dismiss information they find uncomfortable in a multitude of ways. For instance, they can accuse said information of being unreliable, irrelevant, imprecise, or simply untimely. However, dismissal can also occur in more covert ways, such as by the number and type of alliances the authors' make while presenting their arguments, or the manner in which they choose to present certain forms of information. Examples of these will be discussed in the sections below.

Direct Dismissal

Dismissal was the ignorance strategy most frequently used in both of the articles under assessment. In fact, both articles were specifically crafted as a way of expressing the authors' disapproval of their respective opponents' claims. Both Burt and Simons and Barnes et al. clearly pinpointed the reasons as to why readers should not believe, or at least be skeptical of the type of information their opponents are presenting. To do so, they placed particular emphasis on the technical and methodological flaws in each other's arguments. Sometimes, the strategy of dismissal was utilized in a more direct fashion, such as when the authors overtly numbered the technical issues with heritability studies or responded directly to their opponents' claims. Clear examples of direct forms of dismissal in Burt and Simons' article include but are not limited to their concerns about the consequences of EEA's violation, the overuse of Add Health data in recent heritability studies, as well as the technical flaws of adoption-based and twins-reared-apart research designs. Some instances of direct dismissal can also be seen in Barnes et al. article, such

as their accusations against Burt and Simons scientific integrity. However, given limitations of time and space, only a few of these will be touched upon in the present research.

Criticizing the Sources of Data. A noteworthy example of direct dismissal of heritability studies, and more specifically twin studies, by Burt and Simons (p. 237) was when they expressed concerns about the overuse of a single data source among recent heritability studies:

As can be observed in table 1, of the identified 20 criminological twin studies published since 2008, 17 used the Add Health data. We do not argue that the genetic twin sample in the Add Health is deficient; indeed, the quality of the data seems to be extraordinary (Harris et al., 2006). We do believe, however, that reproducing findings of similar heritabilities for various criminal-related traits on the same set of 289 MZ and 452 DZ twin pairs is problematic. Moreover, this means that most recent heritability estimates in criminology have been based on the same imperfect measures (self-control, delinquent peers, delinquency, and victimization) that are available in the Add Health data.

In this argument, Burt and Simons highlight the problematic nature of having many of the most recent and popular heritability studies' findings in criminology use the same data set (i.e., Add Health data), which contains information from the same sample of twins, collected using the same measurement tools, at the same time range. Mentioning this lack of variability in the samples used to test potential relationships between heritability estimates and criminal behaviours can raise concerns among readers about the generalizability of the studies' findings, as well as the robustness of pro-heritability studies' arguments (Mroczek et al., 2021). In fact, by implying that the measures in the Add Health data set were "imperfect", and highlighting the point that these were data utilized by "most recent heritability estimates in criminology", Burt and Simons were able to put under scrutiny not only the articles they are directly referring to, but also all those which currently, or will later on, use them as reference to advance their own claims.

It is also important to point out that Burt and Simons begin their critiques about the overuse of Add Health data by acknowledging that it is in fact of "extraordinary" quality, before drawing down the point that its overuse was problematic. This is a representation of a commonly utilized three-part rhetorical technique, in which individuals show concession with their opponents' views to later introduce their counterpoints (Bertotti & Miner, 2019). More specifically, this technique involves (a) an author presenting a proposition that is contrary to their perspective (e.g., "We do not argue that the genetic twin sample in the Add Health is deficient",

(b) the author conceding to that point (e.g., “indeed, the quality of the data seems to be extraordinary”), and finally, the author (c) immediately returning with a counterpoint or reprise to undermine that concession (e.g., “We do believe, however, that reproducing findings of similar heritabilities for various criminal-related traits on the same set of 289 MZ and 452 DZ twin pairs is problematic”).

Showing concession serves to bolster and defend the author’s position by illustrating the invalidity of their opponents’ propositions (Bertotti & Miner, 2019). It may also give readers the impression that the author is unbiased and rational in their claims, carefully considering the pros and cons of their opponents’ positions. This rhetorical technique also has the capacity to disarm readers, or at least reduce the arsenal at their hands, as it makes it more difficult for them to use the argument that has been conceded with in their rebuttals of the authors claims.

Good vs. Bad Scientist. Direct forms of dismissal also included attacks to opponents’ integrity and capabilities. Indeed, rather than only targeting their opponents’ claims, both groups of authors also utilized some of their writing space and resources to launch direct attacks to their opponents themselves. Each group of authors, however, adopted different approaches to the employment of this type of dismissal strategy. Barnes et al. chose to emphasize their closeness to the scientific community and portray Burt and Simons as lacking scientific integrity by listing instances where they appeared to be following a biased agenda. Burt and Simons, on their part, pointed out their opponents’ lack of common sense in multiple occasions, thus giving their own claims the appearance of rational superiority.

In order to gain more credibility and take advantage of the prestige that accompanies the title of scientists, Barnes et al. employed strategies that allowed them to create a divide between their level of scientific integrity and that of Burt and Simons. While some of these strategies were subtle, such as over relying on specialized scientific language and writing styles, most were far less so, consisting mainly of pointing out the research and scientific writing faux pas in Burt and Simons’ article. By planting doubts about Burt and Simons legitimacy and objectivity as scientists among their readers, Barnes et al. facilitated the dismissal of the formers’ claims. A more detailed discussion about some of these attacks to Burt and Simons scientific integrity will follow in the sections below.

Acknowledging Inconsistencies in Opponent’s Claims. One way in which researchers can discredit their opponents’ legitimacy as scientists is by pointing out

inconsistencies in their positionings throughout their careers. In other words, by making opponents appear less secure of what they believe in and thus less reliable when it comes to the information they produce. For instance, Barnes et al. attack Burt and Simons credibility as reliable sources of scientific information by pointing inconsistencies between their current claims and those in their past works. A clear example of this can be seen when Barnes et al. (p. 611) called out Burt and Simons for criticizing the overuse of Add Health data in recent heritability studies, even though Simons himself had not only “built his career” using a data set comprised of less cases, but also shown support for the use of the Add Health data in his previous work:

... Burt and Simons singled out the Add Health data set as being problematic because it is used in most heritability studies by biosocial criminologists. They pointed out that the entire twin sample nested within the larger probability sample includes only 289 MZ twin pairs and 452 DZ twin pairs for a total of $N = 1,482$ twins. We are somewhat perplexed by this as Simons has built his career on the FACHS data that include a little more than 800 respondents. In terms of sample size, the twin subsample of the Add Health data dovetails nicely with the FACHS data. What makes these criticisms all the more surprising is that Simons has pointed out in no less than five separate publications that the Add Health data represent an ideal data set to examine genotypic influences on social behaviors (Simons, Beach, and Barr, 2012; Simons and Lei, 2013; Simons et al., 2011, 2012, 2013).

By questioning Burt and Simons’ honesty in their statements, as well as their fidelity to their own perspectives, this observation makes their claims appear less solid, thus facilitating their dismissal.

It is also important to note the tonality in which Barnes et al. presented their observations. They appear to be using a mocking tone when discussing Simons’ apparent faux pas, which may instill feelings of disdain for Burt and Simons’ claims in their audiences. Using words such as “perplexed”, and phrases such as “what makes these criticisms all the more surprising,” Barnes et al. not only emphasize the irony in Burt and Simons’ critiques, but also hint to Burt and Simons’ seeming lack self-awareness. Furthermore, instead of giving a straightforward and more serious response to Burt and Simons’ criticisms of the Add Health data use (e.g., similar sample sizes are frequently used in other studies), Barnes et al. chose to assume a more playful approach and use Burt and Simons’ own logic against them. Barnes et al. pointed out that, by Burt and Simons’ own standards, Simons’ career, which they claim was built using a data with “little more than 800 respondents”, would not have much merit. This may give readers the impression that Burt and Simons’ claims should not to be taken too seriously.

Highlighting Opponents' Short Sight. Opponents' claims can also be made to seem less factual by making opponents appear short sighted. That is, by making opponents appear less open minded or less capable or willing to see the big picture of the issue at hand, researchers may be able to persuade readers to question the comprehensiveness, validity, and importance of their opponents' claims. Barnes et al. do this by pointing out the multiple uses of heritability studies and the different ways in which their utilization has produced highly impactful research findings. They also call out scholars who, instead of trying to revise and address some of the known issues with the methodology, call for its complete abandonment:

In a similar way, ACE models [i.e., statistical models used to analyse the results of twin studies] have evolved over time. They now can be used to examine the genetic and environmental covariation between traits (Loehlin, 1996) and can test for sex differences (Boisvert et al., 2013). Highly complex behavioral genetic designs, including genetic growth curves (McArdle and Plassman, 2009), Bayesian integration to assess GxEs (Eaves, Foley, and Silberg, 2003), and "children of twins" designs (D'Onofrio et al., 2007) emerged out of basic heritability studies. Our point is as follows: Scholars should not abandon research or research methods; instead, they should work to revise their methodologies and statistical models to address known problems. (p. 614).

And

...we argue that heritability studies are not biased and that scholars reconsider the call by Burt and Simons for an "end" to heritability studies. There is still much to be gained from heritability studies and the classical twin design. For instance, recent heritability studies have shown that genetic factors underlie the etiology of criminological variables that may have otherwise been assumed to be purely social in origin (e.g., Beaver, 2011b). Additionally, twin studies provide an avenue by which scholars can more accurately estimate the impact of environmental factors on antisocial behavior. Twin studies can be used to control for genetic influences so that the impact of an environmental variable on antisocial behavior can be analyzed without the confounding influence of genetic factors (e.g., Burt et al., 2010). Thus, the value of the classical twin study has not depreciated (p. 616).

These excerpts demonstrate provisions from Barnes et al. of the potential questions dissident readers may have about heritability studies. Namely the "why", even knowing their methodological complications, heritability studies continue to be frequently utilized in the social sciences. By pointing out the strengths and benefits of the methodology, Barnes et al. not only dismissed and defended their claims against potential opponents' criticisms but also turned the attention back to their opponents, challenging them to explain the cost benefits of removing heritability studies from criminological research in their entirety.

Appealing To Common Sense. Instead of targeting their opponents perceived scientific integrity, Burt and Simons accuse Barnes et al. of lacking common sense. Throughout their entire article, Burt and Simons frequently express their discontent and surprise with the fact that the use of heritability studies has not been met with much opposition from members of the criminology community. Sometimes this is done in a straightforward manner, with authors directly remarking that certain aspects of heritability studies go against common sense:

The twin study separates phenotypic variation into three components: additive genetic (h), shared environment (c), and unshared environment (e). The unshared environment also includes model error. Notably, the terms "shared" and "unshared" environment do not correspond directly to common sense interpretations. (p. 229).

Some other times, this is done in more subtle ways:

We are surprised that these somewhat astonishing findings reported in recent studies, such as the reports of more than 50 percent heritability for such complex social behaviors as crime and victimization, have not generated more critical attention in criminology. We also are perplexed by the lack of response to the heritability study finding that so-called shared environmental factors play a minor role in explaining variation in crime-related phenotypes. (p. 224).

and

The lack of critical attention to heritability studies in criminology is even more conspicuous given their known limitations [...] Remarkably, as we discuss, many of the recent criminology studies have failed to mention crucial assumptions and technical limitations, and even fewer have discussed the implications of their violation, especially for assumptions whose violations bias toward heritability. (p.224).

For example, in the quotes above, instead of directly accusing proponents of heritability studies of lacking common sense, Burt and Simons utilized words, such as “surprised”, “astonishing”, “perplexed”, “so-called”, “conspicuous”, and so on, to express their discontent and perplexity over the fact that these types of studies had received very little opposition from the criminology community. Expressing confusion towards the lack of scrutiny received by heritability studies, signals readers that such a lack of reaction is not to be expected. This positions the acceptance of heritability studies as a rarity or as a reaction outside of what could be considered commonsensical, thus further isolating any potential dissident reader and, by extension, making them less likely to express their disagreement and advance contradictory claims. In addition, by making criminologist feel ashamed for not having been more critical of

heritability studies, Burt and Simons are also appealing to their audiences' emotions as a way of promoting the condemnation of heritability studies within the discipline.

Indirect Dismissal

Sometimes, the strategy of dismissal can also be used in indirect manners. These indirect dismissal strategies differ from the direct ones in that the information that is being dismissed is not singled out or precisely called out by the authors in their text. Instead, authors may choose to use more subtle writing techniques to make the sources of uncomfortable information appear less reliable or the uncomfortable information itself less legitimate, noteworthy, or relevant. Here, what is at stake is not what it is said, but rather the way that it is said.

Argument from Authority. As touched upon above, some of the most frequent instances of indirect dismissal found in the articles under analysis relate to the manner in which both groups of authors positioned themselves and each other with respect to the scientific community. Given that science and scientists, as science producers, are esteemed at such a high degree in today's society, by making themselves appear more 'scientific', authors can make their audiences more readily accepting of their claims, and by extension, more skeptical of those from their opponents. This strategy was used by both Burt and Simons and Barnes et al. in multiple ways, including but not limited to the recruitment of support from authority and the tailoring of content to appeal to intended audiences. The use of these strategies is likely to produce feelings of isolation in readers, making them perceive views opposing the ones presented as deviations from what is scientifically accepted and falling outside the realm of common sense. Examples of the use of these types of indirect dismissal strategies in the articles will be discussed in the sections below.

Argument from Authority and Referring to Former Texts. When it comes to making their claims appear legitimate, one strategy that was repeatedly used by both groups of authors was that of including a considerably large number of citations as a way of emphasizing the amount of support their claims had from the scientific community. A large portion of Burt and Simons' and Barnes et al.'s citations followed a similar format in which a relatively large list of references (i.e., four or more names) were included as support for the authors' statements. For instance, when discussing the technical issues that are associated with the violation of the EEA, Burt and Simons (p.232) wrote:

...the EEA has been the subject of much debate and has sparked the production of a large literature that spans several decades and cuts across multiple fields of study (e.g., Allison et al., 1996; Bulik, Sullivan, and Kendler, 1998; Conley et al., 2013; Cronk et al., 2002; Derks, Dolan, and Boomsma, 2006; Eaves, Foley, Silberg, 2003; Felson, 2014; Hannagan and Hatemi, 2008; Hatemi et al., 2009; Kendler and Gardner, 1998; Kendler et al., 2000; Littvay, 2012; Rose et al., 1988; Scarr and Carter-Saltzman, 1979).

To which Barnes et al. (p. 599) responded with the following statement:

...numerous studies examining the potential moderating effects of environmental similarity on h2 and c2 estimates have found that violations of the EEA result in statistically nonsignificant parameter deviations (e.g., Allison et al., 1996; Borkenau et al., 2002; Bulik, Sullivan, and Kendler, 1998; Cronk et al., 2002; Felson, 2014; Hettema, Neale, and Kendler, 1995; Kendler et al., 1994; Kendler and Gardner, 1998; Klump et al., 2000; Littvay, 2012; Loehlin and Nichols, 1976; Morris-Yates et al., 1990; Plomin, Willerman, and Loehlin, 1976; Scarr and Carter-Saltzman, 1979)...

Referencing multiple sources when inserting a citation, or what is commonly referred to as appealing to an “argument from authority”, is one of the most widely used strategies for the production of scientific knowledge and ignorance (Latour, 1987, p. 31). When writing, researchers often appeal to numerous allies in order to create the impression that what they are saying is supported by a majority, thus making those who disagree with their claims less inclined to voice their opinions even in cases when they might be right to do so. The reason for this is that citing another publication with a reference such as “(Allison et al., 1992)”, means that the particular point the authors are trying to make can be backed up by Allison et al., in their 1992 article. Readers interested in contradicting said point, therefore, would not only have to override Barnes et al.’s expertise and knowledge, but also those from Allison et al., and any other allies recruited to bear on the issue.

Not surprisingly, the larger the number of citations that are recruited for support, the more difficult it would be for readers to dismiss or question the claims being made. Indeed, with a large number of citations, readers would have to find an equally large array of arguments that would allow them to weaken each of the cited articles to advance opposing claims (Latour, 1987). Whereas an article devoid of, or with a limited number of citations, positions its readers in a ‘fairer’ fighting stage, where they may feel more comfortable to argue with the authors on a one-on-one basis. In Latour’s (1987, p. 33) words, “[a] document becomes scientific when its claims stop being isolated and when the number of people engaged in publishing it are many and

explicitly indicated in the text. When reading it, it is on the contrary the reader who becomes *isolated*".

Returning to the examples taken from Burt and Simons' and Barnes et al.'s articles, it is easy to see how their audiences may find it difficult to disagree with some of their claims, as dissident readers would be forced to resist the pressure exercised by a significantly large number of supporting sources. Furthermore, it is important to point out that scientific articles are the result of a long process that involve the mobilization of different actors. Behind the publication of every scientific article, there are an infinite number of actors, including technological tools, researcher's institutions, editors, publishing houses, peer reviews, scientific journals, among many others.

Each of these add support and a level of legitimacy to the claims that the article presents. That is, people are more likely to accept claims from articles that use scientifically reputed methodologies, are written by known researchers in the field, and are published in renown scientific journals. As such, before even reading the articles, dissident readers must confront the fact that the claims that can be found within them are most likely backed up not only by the level of expertise of the authors, but also the institutions that gave them their professional titles, as well as those that provided them with the resources used to produce the documents, such as their places of employment. It must be noted that in the context of the present research, at the baseline, Barnes et al. are placed at an advantaged position merely by the fact that they are a group of seven researchers, who are affiliated to six different educational institutions. Comparatively, Burt and Simons are a group of only two researchers who are associated to the same university.

Moving beyond the authors' titles and institutional affiliations, article' claims are also supported by the editors and referees who allowed the articles themselves to be published in the first place, as well as the journal (i.e., *Criminology*) where they were published. This already amounts to a significantly large number of supporters that any opponent of Burt and Simons or Barnes et al. must face even before beginning to read their articles. Once the reading begins, dissident readers are further confronted with the overwhelming amount of support to the authors' claims from the cited professionals, as well as their respective expertise, institutional affiliations, published works, and publishers.

It is arguably clear that Burt and Simons and Barnes et al. were well aware of the power that citing multiple sources as backup for their claims would have on their audiences. In more

than one occasion, moving beyond only writing a long list of supporting citations proceeding one of their claims, both groups of authors made sure to explicitly highlight the number and/or importance of their supporters from the scientific community. For instance, Burt and Simons (p. 224) stated:

Since at least the early 1930s, scholars-including prominent geneticists, neuroscientists, and molecular biologists-have been warning about the fallibility of heritability studies in human populations, especially for complex social behaviors such as crime (e.g., Joseph, 2004; Kamin, 1974; Lewontin, Rose, and Kamin, 1984; Wahlsten, 1990; Wilson, 1934).

Further down in their article, they proceeded to say (p. 233):

...even prominent scholars (e.g., Rutter) in the behavioral genetics field had highlighted the problems in the models and recommended that we should move beyond heritability. Finally, we wanted to keep the list manageable so that the reader can get an idea of the characteristics of the recent studies on which we focus without being overwhelmed.

Similarly, when discussing the response to critiques against the association of heritability and behaviours in the 1980s, Barnes et al. (p. 589) wrote: "...a small but growing force of behavioral geneticists, statisticians, and other scholars launched a prolonged effort to collect larger samples of twins, other genetically related relatives, and adoptees."

Notably, in the examples presented above, both groups of authors made sure to not only name supporters that would likely be respected due to their membership in the scientific community, but also include a sufficiently large range of scholars from a variety of scientific disciplines, as to drive across the point that their claims were supported by many scientists regardless of their areas of expertise. That is, by widening the scope and number of the scientific disciplines that supported their claims, rather than focusing solely on the main discipline of interest, criminology, the authors were able to make their claims appear widely accepted by multiple types of scientists alike, and thus more legitimate (Dufresne et al., 2018).

It is also important to point out that Burt and Simons highlighted the fact that one of their supporters was a "prominent scholar" in the behavioural genetics field. Recruiting the support from sources that would most commonly be expected to be on the opposite side of the controversy, in this case a behavioural geneticist that is familiar with the use of heritability studies, could be a very efficient strategy of knowledge and ignorance production. Indeed, by doing so, Burt and Simons may give readers the impression that their arguments are so infallible that even those who usually are in favour of heritability studies cannot help but agree with their

position against their use in criminology. In this way, if Burt and Simons are able to convince their audience that even experts in the subject would not recommend the use of heritability studies when conducting criminological research, those who continue to defend opposing views are more likely to be seen as misinformed and mistaken.

The Drawbacks of Having Many References. The use of numerous citations and the manner in which these are used can play a very important role in the production of knowledge and ignorance. However, merely listing a number of references is sometimes not enough for a text to be able to withstand a confrontation with a bold opponent. Sometimes, this might even become a source of weakness. Indeed, if an author explicitly reference other studies in their papers, it is then possible for readers to trace each reference and examine not only its credibility but also its degree of attachment to the authors' claims (Latour, 1987).

Latour (1987) identified four main potential issues that can be found when examining articles' references. First, references may be misquoted or wrong. Second, some cited sources might have little or no bearing whatsoever on the claims that the authors are making. Third, some citations may be what is called perfunctory, which occurs when authors attach citations to claim solely with the purpose of displaying their affiliations with specific scientists or group of scientists. Lastly, and most damaging of all to the authors' credibility, some citations may actually reflect the contrary of the authors' thesis.

If dissident readers are bold enough to write their own piece exposing their findings, the examination of easily available references may end up being significantly detrimental for the author. For instance, in their article, Barnes et al. (p. 613) take particular issue with Burt and Simons' choice and use of references, which they made sure to point out to their readers in more than one occasion:

Where Burt and Simons selectively cited some studies and incorrectly cited and quoted others, they also relied heavily on highly questionable sources. They cited Joseph (1998, 2001, 2004, 2006, and 2010), for example, an amazing 70 times in their article and online supporting information. This averages out to one citation of Joseph per page. Relying so heavily on a single source makes it difficult to see how Burt and Simons introduced anything that Joseph had not already discussed. Moreover, Burt and Simons cited as evidence an unpublished manuscript (Suhay and Kalmoe, 2010) and a newsletter (Richardson, 2011) from a website constructed and maintained by individuals politically opposed to gene-behavior research.

As can be observed in the quote above, as well as throughout their article, Barnes et al. accused Burt and Simons of committing all four types of referencing mistakes identified by Latour (1987). First, as already mentioned in the section on denial, Barnes et al. accused Burt and Simons of intentionally misquoting Beaver (2011) in their article as a way of advancing their narrative. Second, Barnes et al. also pointed out the fact that some of Burt and Simons references (i.e., Richardson, 2011; Suhay & Kalmoe, 2010) were not reliable sources of information when it came to learning about the use of heritability studies in criminology. Third, Burt and Simons were accused of over-relying on Joseph's works and not bringing any new points to the conversation. And lastly, as was discussed earlier, Barnes et al. highlighted the fact that Burt and Simons had not only misquoted Moffit (2005), but also translated her words in such a way that made it appear as if Moffit was saying the opposite to what she actually intended to say.

Context of Citation and Modalities. Supporting sources are not only referred to in scientific articles, but they are also qualified, framed, or modalized (Latour, 1987). Whether it is by using specific language markers or switching the type and amount of information that is presented, the context that authors choose to give citations in their scientific texts can significantly influence the facticity of their claims.

One of the ways in which citations can be modalized to fit different narratives is through the selection of the language used in their insertion. Different adjectives and verbs have different connotations that can make certain sources and actions appear more or less legitimate. Examples of this can be observed in the ways Burt and Simons and Barnes et al. change the language they use to refer to groups of researchers depending on whether they are in favour or against their respective claims. When citing sources to support claims about the negative effects of EEA violations on heritability estimates, Burt and Simons (p. 232) stated:

...many scholars have asserted that the EEA, including its trait-relevant form, is invalid and that the more similar environments of MZ than DZ co-twins bias heritability estimates upward to a significant degree (e.g., Beckwith and Morris, 2008; Horowitz et al., 2003; Joseph, 2004; Lewontin, Rose, and Kamin, 1984; Richardson, 2011).

While Barnes et al. (597), wrote:

Certain critics have cited violations of the EEA as a damning limitation for twin research in sociology (Horwitz et al., 2003), political science (Beckwith and Morris, 2008; Charney, 2008; Suhay and Kalmoe, 2010), educational psychology (Richardson and Norgate, 2005), and social psychology (Simons, Beach, and Barr, 2012).

Notably, only two of the cited sources included in the two excerpts above are a perfect match (i.e., Beckwith & Morris, 2008; Horwitz et al., 2003). However, in both excerpts, both groups of authors are referencing the same group of researchers. What varies is the manner in which these researchers are referred to.

On the one hand, Burt and Simons attempt to make these researchers appear both numerous and prestigious by introducing them as “many scholars”, a definition that carries with it a connotation of high status and reliability. On the other hand, Barnes et al. refer to the same group of researchers as “critics” and quantify them using the adjective “certain”, taking away the occupational and numeric power that had been given to them by Burt and Simons in their article.

By changing the adjective with which they are introduced from “many” to “certain”, Barnes et al. make it seem as if the support for their opponents’ claims is minor. Following the argument from authority strategy, this is likely to facilitate readers ability to potentially disagree with Burt and Simons’ statement, as they would not feel too outnumbered nor isolated. Furthermore, by changing the description of these researchers from “scholars” to “critics”, Barnes et al. remove the prestige that was attributed to them in Burt and Simons’ article through their association with the scientific community. Now, in Barnes et al. article, they are merely seen as a group of individuals that disagree with their statements, but whose occupations and thus levels of expertise are not explicitly specified. By leaving place to uncertainty when it comes to their level of expertise on the subject matter, Barnes et al. makes it easier for readers to disagree with the claim their cited sources are making.

Another clear example of how modalities can be used to insert similar citations while producing different effects in their facticity can be seen when comparing the following quotes from Burt and Simons’ (p. 231)

Research clearly demonstrates that MZ co-twins experience more similar social environments than DZ co-twins. For instance, MZ twins are more likely to be treated similarly by their parents (Evans and Martin, 2000), to have the same friends (Cronk et al., 2002; Horowitz et al., 2003), to share the same classroom (Cronk et al., 2002; Morris-Yates et al., 1990), to spend time together (and therefore experience the same social environments more frequently; Horowitz et al., 2003; Rende et al., 2004), and to go out together than DZ twins (Kendler and Gardner, 1998).

and Barnes et al.’s (p. 597)

...critics of twin research have correctly pointed out that MZ twins tend to have more environments in common relative to DZ twins, including parental treatment (Kendler et al.,

1994), closeness with one another (Horwitz et al., 2003; Lykken et al., 1990), belonging to the same peer networks (McGuire and Segal, 2013), being enrolled in the same classes (Cronk et al., 2002), and being dressed similarly (Cronk et al., 2002; Loehlin and Nichols, 1976).

Here, both groups of authors are presenting the same information, which is that MZ twins have been shown to share more common environments relative to DZ twins. What varies, however, is the modalities they chose to employ when presenting said information. For instance, Burt and Simons decided to use certainty markers, or boosters, such as “clearly” and “demonstrates” to express their full commitment to the ‘truth-value’ of the propositions they are making, and thus increase their facticity (Bertotti & Miner, 2019, p. 247). However, Barnes et al., chose to introduce their citations with neutral markers, such as “pointed out”, and uncertainty markers, or hedges, such as “tend”. These types of makers serve to undermine the facticity of claims as they allow for the speculation of other possibilities (Bertotti & Miner, 2019). When hedges are included in a sentence, the relationship between a condition and an outcome are not seen as definitive. Saying that MZ twins *tend* to have more environments in common relative to DZ twins, implies that this is not always the case, thus leaving the door open for readers to speculate about circumstances where the contrary may be true.

Another way in which citation context can influence the facticity of a claim has to do with the type and amount of information that accompanies it. More precisely, how factual a claim appears to be is impacted by whether or not information concerning the history of its citations is included. Citing sources in a way that does not allow their origins to be tracked, or that reduces the likelihood of doubt or surprises, makes them, and by extension the claims they are supporting, appear more factual (Latour, 1987).

As knowledge approximates blackboxing, its citations become increasingly less modalized, to the point where no additional information is given concerning the conditions of its production, and thus, it comes to be seen as a fact, an indisputable assertion (Latour, 1987). Knowledge blackboxing therefore involves the movement of statements from being heavily modalized to having less, or being devoid of modalities. For instance, this process would consist of shifting statements such as “Past literature has not been able to successfully demonstrate that the correlation between cigarette smoking and lung cancer is coincidental”, to “since cigarette smoking causes cancer...”. Accordingly, the opening of a black box involves the reverse process, moving assertions from having no modalities to being heavily modalized. Heavily modalized

statements that display the conditions of their production, give access to their audience to their strengths and weaknesses. Contrarily, statements devoid of information about the conditions of their production leaves readers without options other than to trust the authors' statements and see them as factual.

By examining the different ways the same information was used in both Burt and Simons' and Barnes et al.'s articles to advance opposing claims, it is possible to see some of the effects that changes in degrees of modalization can have on claims' facticity. For instance, Burt and Simons and Barnes et al. discussed Harris' (1998) findings, giving different degrees of specification to the information they presented. On one side, Harris is cited by Burt and Simons (p. 246) in the following way:

... we urge scholars to recognize that existing heritability estimates are the result of models biased toward inflating genetic influences and underestimating shared environmental ones, and that using these rough and biased heritability estimates to undergird specious debates about the irrelevance of shared environmental factors, such as the family, neighborhoods, and SES (e.g., Harris, 1998; Rowe, 1994), does a disservice to both scientific and public knowledge.

On the other side, Harris' findings are discussed in Barnes et al. (p. 614) in the following way:

...family processes and parenting behaviors tied to offspring conduct are clearly tangled in the complex web of biology and environment (Harris, 1998). [...] Scholars were so locked into their standard social science paradigm, however, that it took the work of Rowe (1994) and subsequently Harris (1998) to show how the elements of the nonshared environment were important to understanding why some children were influenced by family processes while other children in the same household were not. Heritability studies provided these insights, and they led to more refined studies into parenting and families (Beaver, 2008; Harris, 1998; Rowe, 1994; Wright and Beaver, 2005).

When considered alone, Burt and Simons citation makes it seem as if in his 1998 article, Harris had tried to utilize presumably biased heritability estimates to downplay the importance that shared environmental factors have on behavioural outcomes. Here, because no information about Harris' study or actual findings is presented, readers have no other option than to take Burt and Simons interpretation of Harris' intentions for granted. Readers of Burt and Simons may not see Harris' work as anything other than an attempt to advance claims about heritability determinism using flawed methodological tools, even when they do not really know what his study actually found. However, when more details are provided about Harris' findings and conclusions in Barnes et al.'s article, Harris' study is transformed from merely an attempt to

undermine the impact of environmental factor in human behaviours to an attempt to consolidate the role that both biological and sociological influences play in human experiences.

Diversion

The strategy of diversion involves the creation and implementation of an activity that distract attention away from information that is deemed uncomfortable, thus preventing it from being created or shared (Rayner, 2012). Diversion is interlaced with some of the other strategies mentioned above. That is, many of the strategies that have already been discussed can also be said to be a form of diversion. What changes, however, is the presumed motivation for their utilization. For instance, when discussing dismissal strategies, it was said that certain claims can be dismissed by targeting the perceived scientific integrity of their proponents. However, attacking an opponent's integrity, instead of actually addressing the issue at hand can also be seen as a form of diversion. Indeed, any action that diverts attention away from the issue at hand, in this case, the question whether heritability studies are an appropriate research tool in criminology, is a form of diversion strategy.

Another way in which the strategy of diversion can be used to produce ignorance on certain claims is by introducing a new subject of concern to focus on. This was done by Burt and Simons at the end of their article, when they decided to propose the furthering of epigenetic research as a replacement for heritability studies. By bringing forth the prospect of a new biosocial methodology into the mix, new questions and concerns may arise that are unique to its adoption and implementation. As a result, attention is diverted to a new issue and all claims regarding the use of heritability studies in criminology can be left behind.

Displacement

The last strategy that is going to be discussed in the present research is displacement. Displacement refers to the process by which an organization or an individual decides to engage with, and address, a simplified representation of an issue, rather than the predicaments or repercussions associated with it (Rayner, 2012).

The manner in which the controversy concerning the use of heritability studies in the social sciences, and more specifically criminology, was touched upon by both Burt and Simons as well as Barnes et al. in their respective articles is in itself an example of the displacement strategy. Both articles chose to focus on heritability studies per se, instead of the wider issue at hand which is the linking of biological factors, such as genes, to complex human behaviours and

its effects in society. They both primarily examine the methodological validity of heritability studies to determine whether they are an adequate tool to assess a link between the biological and the sociological, instead of looking at the bigger picture and examining the reasons why heritability studies would be, or not be, an effective, appropriate, or reliable methodological tool for the study of complex human behaviours.

Most, if not all, of the arguments that were presented by both groups of authors in favour or against the utilization of heritability studies in criminology were primarily based on the intrinsic technical issues that such methodologies have, as well as the manner in which these could potentially compromise the validity of heritability estimates. However, at no point in their writings do the authors explain the reason why caring about the legitimacy of heritability estimates is important. Why does it matter if they do not actually capture what they are meant to capture? If they are actually capturing what they are intended to capture, how does this change the way we think about crime and criminal behaviour? What are the consequences linked to heritability estimates being incorrect or correct? In other words, why is this debate even being held in the first place?

Fighting a debate on highly technical grounds is a common way of producing ignorance when debating controversial issues. For example, the acceptability of using glyphosate in agriculture was mainly fought on the measures of glyphosate carcinogenicity, therefore obfuscating the other effects the substance has such as increasing the dependence of farmers on industrial-style agriculture and the pesticide industry (Paskalev, 2020).

By deciding to focus on the methodological technicalities of heritability studies, both groups of authors are narrowing the type and number of discussions that could be had on the matter. This, by extension, limits the amount and range of critiques that can be brought forth to contest their respective arguments. Narrowing the focus of the issue at hand, rather than addressing the real-world repercussions that could result from it, simplifies the controversy and makes it appear as if it could easily be closed at some point in the future. In the context of the present research, narrowing the focus to the effectiveness and validity of heritability studies, as opposed to the impacts that their use in the discipline of criminology could have in society and the social sciences as a whole, reduces the types of conversations that can, and are currently being had on the subject matter to the technicalities of the scientific method.

As demonstrated by Burt and Simons, Barnes et al., and the majority of the scholars that were cited in their articles, when on the topic of the use of heritability studies in criminology, scholars have tended for the most part to show support for their position by recruiting information about the validity of their heritability studies' findings and raising concerns about their opponents' scientific knowledge and integrity. This is not surprising, as once inside the controversy, which has a particular set of simplified arguments that are being used, contested, and reproduced, it is difficult to not only introduce a more comprehensive perspective on the issue, but also be able to pull away enough information from the existing debate to even begin formulating this new comprehensive perspective.

Using examples from Burt and Simons' and Barnes et al.'s articles, this chapter demonstrated how scientific knowledge and ignorance can be produced through the way citations are inserted into articles. It also showed how the same information can be used to generate different effects on claims' facility depending on the discursive devices interlocutors employ. The type and amount of information that is presented, the use of modalities, the recruitment of allies, the tonality of statements, among others, all factor in readers' ability and willingness to refute an author's claims.

Discussion

Revisiting the Argument

Based on the premise that the facticity of scientific claims is highly dependent on rhetorical writing strategies, the present research sought to demonstrate that it is not only the type of information that is presented in the literature, but also the way that it is presented, that influences the degree to which a claim is perceived as a fact. As such, the present research examined the manner in which past literature was cited in two articles presenting conflicting perspectives on a controversial issue to uncover the different ways that presenting the same information can produce very different, or even opposite, outcomes in claims' facticity.

The results of the present study illustrate only a tiny portion of the vast number of processes that take place in scientific fact making. Besides shining light on some of the rhetorical strategies, such as denial, dismissal, diversion, and displacement, that scientists use in their writings to produce scientific knowledge and ignorance, the present research also revealed other important aspects of the production of scientific facts. First, it demonstrated that science does not result solely from the application of systematic methodologies, but is first and foremost a social product. It highlighted the fact that science is created through dialogue and complex interactions between multiple and diverse actors that come together in such ways that allow for the formation of a comprehensive and widely agreed upon reality.

Second, the present research deepened the understanding of the concept of knowledge and ignorance duality, highlighting the complex relationship that exist between the two concepts and acknowledging that one cannot be produced without also producing the other. That is, in order for new scientific knowledge to be produced and considered factual, ignorance of alternative or conflicting knowledge must be produced as well. This was done by showing how both Burt and Simons and Barnes et al. utilized ignorance producing strategies against their opponents' claims as a way of advancing their own respective claims in their articles.

Third, the present research also demonstrated that established scientific information can be used in new literature to generate a wide variety of scientific knowledge and ignorance. It attained one of its main objectives, which was to show how the same established scientific information can be modalized differently by interlocutors with opposing views on a controversial issue to advance contrasting claims in their own articles. Moreover, the present research also illustrated how past scientific findings and statements can serve as building blocks for the

production of new knowledge, as well as be made to be more or less factual by their insertion in more recent literature.

Finally, the exploratory aspect of the present research also highlighted the fact that the production of scientific knowledge and ignorance involves appealing to audiences' emotions. Indeed, it was shown that the production of scientific knowledge involves more than merely conducting investigations using scientific methodologies and informing audiences about findings. To make a scientific claim factual through the use of writing, audiences must also be made to feel (a) confident and certain about what they are being told, as well as (b) isolated and overpowered when trying to dissent from the author's arguments. In this sense, producing facts does not simply require appealing to reason but can also entail appealing to the affects, debunking a traditional opposition.

Results also demonstrated that triggering certain emotions in audiences can influence the effectiveness of certain ignorance producing strategies. For instance, the appeal to disdain and shame were used in a number of occasions by Barnes et al. and Burt and Simons respectively to facilitate their audiences' dismissal of their opponents' claims. By making remarks about Burt and Simons' statements and scientific integrity using a mocking tone, Barnes et al. instigated feelings of disdain for Burt and Simons' reasoning, thus potentially facilitating the readers' dismissal of the latter's claims. Similarly, by expressing disconcert about the lack of critical attention to heritability studies in criminology, Burt and Simons triggered feelings of shame in criminologists who may have felt pressured to be less accepting of heritability studies after reading their article.

Contributions and Future Directions

The present research focused on the production of scientific knowledge and ignorance concerning the use of heritability studies in criminology. However, the findings and conclusions drawn from this study could easily be applied to any other controversy or scientific debate. Every time scientists that hold opposing views on a given issue try to advance their claims, they must utilize rhetorical techniques that allow them to increase the facticity of their claims while reducing that from their opponents. A scientific assertion holds together a network of entities (e.g., twins, statistical tests assumptions, hopes for a new and improved biosocial criminology, etc.) and in order to leave the realm of artifacts, it can choose to do so by disassembling a competing network. As such, the present research contributed to the wide literature on SSK,

ANT, and controversy studies in a number of ways, as well as paved the way for future investigations on the production of scientific knowledge and ignorance in general.

To begin with, it contributed to the literature on SSK by participating in reconciling realist and constructionist theories of knowledge production. It proposed an understanding of knowledge production processes in which the concept of a material world and the systematic collection and analysis of data that accompanies the scientific method can coexist in harmony with ideas surrounding the social construction of reality. Indeed, while materiality was not the focus, the present research proposed that material objects, as well as the information that is produced using the scientific method, is translated into actor-networks in order to create scientific facts. This proposition is partly realist in that it acknowledges the existence of absolute materials and a shared reality, but it is also partly constructionist in that it sees this reality as meticulously created through the translation of different actors into stable networks.

Another important contribution to SSK and ANT of the present research was its examination of the instability of scientific claims' facticity. It emphasized that the facticity of a scientific claim can be modified as many times as it can be inserted in later scientific writings. In Latour's (1987, p. 29) words "The fate of what we say and make is in later users' hands". As such, a claim can be made to appear more like a fact, a black box, if it is inserted in an article as a closed, taken for granted statement. Contrarily, a claim can be made to appear less like a fact if it is inserted in an article with modalities that undercut its certainty status (e.g., using uncertainty markers to qualify it, alluding to the conditions of its production).

Moreover, the present research also contributed to the study of controversies and paradigm shifts by shining light on the actors that may play important roles in the advancing and protection of paradigmatic assumptions, such as key scientific institutions. It is important to stress the heightened claims' dissemination reach of the journal where the articles under study were published. As briefly touched down upon in the methodology section, the journal *Criminology* has been one of the most prestigious and popular journals in criminology over the past decades, owning some of the most influential pieces of literature in the field. Because of this, the articles it publishes are frequently and amply mobilized in other scientific writings. This means that their scope of influence can be significant. Burt and Simons' and Barnes et al.'s articles are not the exception to this rule. As reported by Web of Science scientometric indicator

at the time of writing this paper, each of these two articles has been cited many times in other articles, which suggests that both of them have had a significant impact in the academic sphere.

Following the logic behind the blackboxing of facts, the repeated referencing of Burt and Simons' and Barnes et al.'s articles in other articles further down the line has the potential of closing or opening the black boxes of their claims. Future research may want to assess how Burt and Simons' (2014) and Barnes et al.'s (2014) claims have been used in the literature, paying particular attention to the ways they have been modalized to be rendered more or less of a fact, as well as the way the closing or opening of black boxes have advanced the conversation about the use of heritability studies in criminology. An examination of the different ways claims are referenced in the literature throughout time may provide a window into processes of knowledge and ignorance production, not only showing how different types and degrees of modalization can influence the facticity of scientific information, but also illuminating the transformations that can occur to claims as they drift further from their origins.

One special aspect of the analysed material is that it is analogous of the real conversations that occur among experts in the field concerning the debate on heritability studies. Given that Barnes et al.'s article was written as a direct response to Burt and Simons' article, and Barnes et al. were able to dispute Burt and Simons' claims one by one, the present research was also able to clearly capture some of the mechanisms used by researchers to block, obstruct, or reverse the blackboxing of claims starting from their production.

Importantly moreover, as mentioned in the methodology section, Burt and Simons' (2014) and Barnes et al.'s (2014) articles generated a chain reaction where a number of researchers (e.g., Burt and Simons, 2015; Wright et al., 2015; Moffit and Beckley, 2015; Massey, 2015), wanting to continue the conversation about the use of heritability studies in criminology, made their opinions and alliances known through the writing and publishing of article replies and commentaries. Future research may benefit from exploring how this specific debate has developed since the publication of Barnes et al.'s (2014) original article. Being able to follow a particular claim as it circulates and is revised by multiple and distinct actors, provide important insight into the role of rhetorical writing strategies in the production of scientific knowledge and ignorance. Due to the way in which the debate of heritability studies in criminology started by Burt and Simons (2014) has evolved in the literature, future research would be able to examine

more closely how the facticity of a specific claim can be changed as it is inserted and reinserted into multiple disputing articles.

Lastly, the present research demonstrated that the production of scientific knowledge and ignorance involves a lot more than merely conducting experiments and gathering data. Indeed, it showed that to elevate a scientific claim to the fact category, researchers must engage in a number of processes intended to persuade their audiences of the uncertainty of opposing narratives. Given how scientific evidence is widely accepted and commonly used to organize social structures and dictate social policy, acquiring a better understanding of how certain scientific claims become blackboxed, or seen as certain, can have serious real-world implications. When it comes to the discipline of criminology, for example, dominant discourses of crime tend to dictate the manner in which societies think about and react to criminal acts and offenders. It is therefore important for criminologists to be capable of recognizing that science is neither absolute nor sacred, as well as identifying the strategies used by other scientists to advance their respective claims, so as to be able to form informed opinions without experiencing too much rhetorical interference.

Conclusion

Diving into this heritability controversy underlines the productive power of controversies and the importance for criminologists, and social scientists, to get comfortable with scientific uncertainties to overcome the prevalent idealized understanding of science (Lahsen, 2012, 2013). This thesis is not trying to persuade the readers to welcome or fight against the new versions of biosocial criminology that are bubbling on North American campuses, departments and scientific journals. It is not either about throwing the towel and letting go of science altogether for it is just words, on the contrary. This thesis is about developing a more sophisticated understanding of how science is made so that criminologists can develop a surer footing when controversies rage.

It is important for criminologists to engage with the way scientific facts are produced (in the office, in the laboratories, in the research papers) so as to let go of our tendency to idealize science. Science is not poetry nor religion. Contrary to those modes of knowledge, it has rules that prize transparency and debate. But science, like poetry and religion, is a human made product. It is a craft. Not acknowledging the selection, the constraints, the creative powers that are necessary to make scientific assertions just “increases public vulnerability to backlash campaigns” against science (Lahsen 2013: 547). We, as criminologists, cannot take a shortcut; we have to delve into the science to understand how it is made. We need to recognize that, from the way it is produced to the way it is later used, scientific knowledge is never devoid of politics. The goal of this thesis is not to solve the debate on heritability studies but rather to bring the actors involved to explain how they came to their position. Analyzing the ways stakeholders in a controversy produce their claims is our role as a democratic underlabourer.

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Appendix A

List of discursive devices found in the material under study

Discursive Device	Definition	Examples
Positive modality	- Sentences that lead a statement away from its conditions of production. - Boosters: elements of discourse that enhance the acceptability of a statement, emphasize the strength of a proposition, and assert the writer's conviction.	- X produces Y <i>Clearly</i>, X produces Y
Negative modality	- Sentences that lead a statement in the other direction towards its conditions of production and that explain in detail why it is solid or weak. - Hedges: elements of discourse that undercut the facticity of claims.	- A study conducted by S, showed that X can produce Y, when the right circumstances are present. - X <i>may</i> produce Y
Argument from authority	Appeal to prestigious and more numerous allies. Do the authors bring friends in? (e.g., Nobel prize author, a journal, an article with many authors...)	
Misquoted citation	Citation was not quoted properly (e.g., changing the original wording, or inserting the quote in the text in such a way that changes its original meaning)	
Questioning technicalities	Author includes citation to question technicalities (e.g., methodological issues or flawed assumptions) of opponent's claims	
Types of reporting verbs	Certainty verbs vs tentative verbs used when reporting findings	- Certainty verbs (e.g., confirm, demonstrate, show) - Tentative verbs (e.g., imply, suggest, suppose) - Neutral verbs (e.g., found, state, report)
Showing concessions	Three-part rhetorical device that bolsters the speaker's case and weakens that of their opponents: They entail stating (1) a proposition that is contrary to one's perspective, (2) conceding to that point, but then (3) immediately returning with a counterpoint or reprise to undermine the concession.	X is associated with Y [proposition]. This association is noteworthy [concession], but it is uncommon [reprise].