4-12-2016

Neuro-Oppression: Does Neuroscience Perpetuate Social Marginalization?

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Abstract
Moral theories proposed by Immanuel Kant and Alan Gewirth argue that the ability to reason can demarcate who is granted moral worth. Social groups such as women, non-white peoples, queer and trans people, and essentially those who are not considered mentally or physically 'normal' have been marginalized through naturalistic arguments of intellectual inferiority rooted in biology. Michel Foucault argues that oppressive systems form through a genealogical socio-historical process that posits one identity as superior, and the other as inferior. I will use a similar Foucauldian historicist framework to argue that the neurosciences are susceptible to this naturalistic fallacy, and thus can perpetuate the marginalization of people.

Document Type
Thesis

Degree Name
Bachelor of Arts (BA)

Department or Program
Philosophy

Second Department or Program
Neuroscience

First Advisor
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Fourth Advisor
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Keywords
Foucault, oppression, marginalization

Subject Categories
Neuroscience and Neurobiology | Philosophy

LAKE FOREST COLLEGE

Senior Thesis

Neuro-Oppression: Does Neuroscience Perpetuate Social Marginalization?

by

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April 12, 2016

The report of the investigation undertaken as a
Senior Thesis, to carry two courses of credit in
the Department of Philosophy and the Neuroscience Program

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ABSTRACT

Moral theories proposed by Immanuel Kant and Alan Gewirth argue that the ability to reason can demarcate who is granted moral worth. Social groups such as women, non-white peoples, queer and trans people, and essentially those who are not considered mentally or physically 'normal' have been marginalized through naturalistic arguments of intellectual inferiority rooted in biology. Michel Foucault argues that oppressive systems form through a genealogical socio-historical process that posits one identity as superior, and the other as inferior. I will use a similar Foucauldian historicist framework to argue that the neurosciences are susceptible to this naturalistic fallacy, and thus can perpetuate the marginalization of people.

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May You accept this humble sacrifice.

&

Simi, Rhett, Scarlet, and Shadow. May we be reunited in paradise.

&

Kayla Huber. Our dialectic will never stagnate.

&

The Goon Squad. I hope you appreciate the font selection.

&

To my brothers in Delta Chi: '…'

&

The Lake Forest Mallus: സൂപ്പർ ലൈക്ക് !

&

Leo Podolsky. Every mention of 'oppression' is dedicated to you.

ܗܐ ܠܝ.
ܗܐ ܫܘܒܬ ܠܢ ܒܢ̈ܝܐ ܕܬܘܪ̈ܐ
ܐܝܟܐ ܕܒܢ̈ܝ ܒܢ̈ܝܐ ܚܠܘ.
ܠܠܗܝ. ܠܚܡܢ ܕܬܠܒܕ

ACKNOWLEDGMENTS

This work would not have been possible without the unfaltering support of Professor Lou Lombardi who patiently provided me constant reassurance and guidance. Likewise, I am indebted to the insightful critiques of Professor Anne Houde, Professor Chad McCracken, and Professor Susan Long.

Thank you to the nurturing faculty of the Department of Philosophy for helping me mature and develop my love for philosophy over the years. Your support helped me embark on this work. I am eternally grateful to all my friends who helped balance my mental, social, and emotional health throughout the process. I acknowledge that the inspiration for my thesis layout and font choice came from Tea Thaning '15. Finally, without my family providing me food, healthcare, financial support, and most importantly their prayers, I would not have survived this project.

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Chapter One

Philosophical Discussions

Human rights and human worth, often deriving from Immanuel Kant, are rooted in associating agency and freedom with the capacity to reason. If entities are limited in reason, it can be morally justified to deprive them of participation in the exchange of respect and dignity as required by universalizing maxims that necessitate ethical treatment. Therefore, the ability to reason is often a critical qualifier for who we determine to be fully human. I will explore how the neurosciences have gained the authority to demarcate which entities can and cannot reason, thus putting this discipline in a pivotal role in determining who is worthy of human rights. I will argue that neuroscience is not only insufficient but also incapable of demarcating rational capacity. To support this argument, I will elucidate how women are socially marginalized through neuroscientific arguments to illustrate how neuroscience, as an enterprise attributed with the authority to determine who is rational and who is not, is ripe for misuse by those with the social ability to dominate. The framework I will provide is translatable to how other social identities, such as people of color, queer and trans people, and those who are diagnosed as mentally deviant, are delineated as inferior through neuroscientific evidence. However, for the sake of brevity and focus, I will isolate my critique to women as a social identity. I will elaborate the process of how the neurosciences participate in marginalization by analyzing specific neuroscientific literature in the next two chapters. However, before I endeavor to critique neuroscience, I will lay the philosophical foundations through which I present my normative aim and also present the descriptive process that will inform the significance of this concern.

First I will explore Immanuel Kant's moral theory, which hinges on the concept of rationality intertwining with moral worth. For my argument, moral worth will be defined as the guarantee that one's agency will not be imposed upon by another agent. With full moral worth, agents are granted human rights, and in essence a respect for and an admission of their personhood. When these qualifiers are denied, the deprived agent is dehumanized and can therefore fall victim to maltreatment that we would otherwise not impose on full moral agents. After elucidating Kant, I will describe Alan Gewirth's description of human rights and his Principle of General Consistency (PGC) to lay the foundations for why we should subscribe to a moral maxim that respects human dignity, worth, agency, and freedom for all human beings. Though both Kant and Gewirth have rigorous mechanisms to evaluate moral worth, I argue that they have not sufficiently clarified the sense of human reason essential for moral worth, though I do acknowledge Gewirth's account is more inclusive of variations of human reason than Kant's. This provides space for a mechanism, such as neuroscience, that demarcates rationality, to enter the argument and therefore define who is and who is not deserving of moral worth. Consequently, it is also ripe for abuse by those who fit the traditional criteria of the rational beings to claim more human worth than those who do not.

Secondly, I will explore John Stuart Mill's concept of individuality to see if individual variations on the expression of rationality is worth respect. This argument will lay the foundation for why irrelevant factors in others that do not hinder our or their personal agency should not enter the moral calculus. Thirdly, I will argue that the ability to deny those who are deemed different moral worth is due the authority those in power have to demarcate who is rational and who is not. In doing so they maintain that rationality is a qualifier of human rights, as posited by Kant, yet by modulating the

criteria and inappropriately demarcating who is truly rational, they are able to deny marginalized people human dignity. To elaborate this process, I will elucidate George Wilhelm Friedrich Hegel's dialectical phenomenology of the Lord and Bondsman to describe the process whereby denying the right to be recognized by an 'other' creates a parasitic, paternalistic, and almost inescapable relationship whereby those in power become the agents that determine, reduce, and ultimately negate any sense of self in the 'other'. The philosophical notion of the 'other' has variable definitions but conceptually it merely stands from an entity that is not the agent of action and may be the entity that is acted on by an agent. In identity politics and theory, the 'other' is merely a marginalized entity. In this paper, I will use both the abstract philosophical notion of the 'other', simply as the passive agent, as well as the 'other' being a signifier of a marginalized entity. Considering this definition, 'othering' would be the process whereby an entity is acted on by a dominant entity and therefore marginalized. Hegel's account of the Lord and Bondsman describes this toxic relationship that is situated in a historical and genealogical process of denying recognition to a marginalized entity that serves to strengthen the degenerative process. Therefore, to expand on Hegel, I will elucidate Michel Foucault's historico-genealogical account of madness and the process of institutionalization and medicalization of the mad to describe how controlling and denying agency to the mentally deviant, i.e. those who cannot reason, historically developed in the Western world. I will use what Foucault has developed in his critique of psychiatry and extend the argument to say that the neurosciences are in some senses a modern expression of such an enterprise. In the following chapters, through my analysis of both historical and current literature, I will also show that neuroscience inherits many of the troubling attributes associated with domineering and 'othering' qualities.

Finally, the normative pressure that pushes marginalization of those who are expressively 'deviant' is rooted in the drive towards normalcy as defined by the dominant 'non-deviant' identity. Once I develop my critique of neuroscience and its historical relationship to women, I will provide an account of the idea of normalcy and its implications in the concepts of predictability and control in the final chapter. With this I will tie my critique of statistics to the normative significance that underlies what drives social marginalization.

Human Rights and Moral Worth

A normative maxim, or principle, that recommends what we ought to do considering what we know about the nature of things is a difficult claim to provide. The main concern when proposing an ethical system is accounting for both an objective source of authority in addition to a system through which an argument for what is the right thing to do can be justified. Immanuel Kant's account of moral theory attempts such rigorous objectivity by providing the categorical imperative. Kant first argues that the only moral thing that is good in-and-of-itself is a good will. A good will must be determined by Moral Law motivated by duty, which is defined as "the necessity of an action from respect for the law."[1] Duty, for Kant, should be a pure motivating factor from the respect for the law and should not be complicated by self-preservation, personal interest, or happiness, which may raise interests that do not align with duty. In order for there to be a law that commands such obligation by duty it needs to be something that applies with absolute necessity to everyone, regardless of any particular interests they

[1] Immanuel Kant, *Groundwork for the Metaphysics of Morals*, ed. Allen W. Wood (New Haven: Yale University Press, 2002), 16.

have.[2] For Kant, considering we are rational agents, we can think and act in accordance with how every other rational agent would. This reasoning gives rise to the categorical imperative, or universal command, which says: "Act only in accordance with that maxim through which you can at the same time will that it become a universal law."[3]

The rigor in investigating an *a priori* source to validate Kant's moral maxim is to permit both objectivity as well as an undeniable and absolutely necessary normative source. For Kant this necessity to avoid contradiction comes from the fact that we cannot deny that we are rational beings. My reason for introducing this Kantian condition of rationality is to demonstrate the implications of such a justification. If someone is viewed as incapable of pure rational judgment, then they could be denied participation and the moral rights guaranteed to full moral agents. Though Kant only describes rationality in an abstract sense required by the *a priori* conditions of his argument, the implications of a purely reason based system of morality can be compromising if certain entities are argued to be inferior in their reasoning capacity. Kant emphasizes, for example, that young children would not yet possess the necessary rational capacity. However, he does not fully demarcate how we would know where human rational agency would be lacking. In essence, leaving the qualifiers for rationality undefined permits those who can argue for a restrictive definition of rationality to dehumanize those who do not meet the criteria. Therefore, though the capacity to reason can be a reliable source to provide a rigid maxim for moral oughts, the contingency on such an inconclusive measure creates ground for misuse by those deemed rationally superior. For example, Immanuel Kant

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[2] Ibid., 24.
[3] Ibid., 37.

argued that both women and non-white races fell short of full rationality, and therefore could be denied full humanity.[4] Because these moral theorists do not give a clear mechanism for demarcating rationality in a person, these theories could be misused to marginalize those deemed inferior in their capacity to reason.

Alan Gewirth provides a more expansive and inclusive account for human rights, but as I will show through my elucidation of his work, it still falls short of appropriately accounting for those who have been viewed as intellectually inferior. Therefore, it succumbs to the same limitations fighting between universal objectivity fixed by necessity, and accounting for the variations of human expression. Gewirth argues that all humans have human rights on the condition that they have the capacity of exercising them. This capacity is founded on purposive agency. This is the sense of having purposes that an agent wishes to fulfill and the ability to control his behavior in relation to the circumstances of his action.[5] Because purposive agency requires a degree of rationality, for Gewirth the degree of human rights is compromised based on mental deficiency and the possibility of imposing harm on themselves or others.[6] However, Gewirth does not hold a high standard for purposive agency; being able to take care of oneself is sufficient to be deemed a purposive agent. If you could argue that intellectual inferiority limits self-care and purposive action, then you could deny someone moral worth by arguing for such incapacity. With human purposive action, in the sense of being able to direct one's behavior to achieve purposes as the determining element in his moral theory, Gewirth

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[4] Thomas E. Hill and Bernard Boxill, "Kant and Race," in *Race and Racism*, ed. Bernard Boxill (Oxford: Oxford University Press, 2001), 455.
[5] Alan Gewirth, *Human Rights: Essays on Justification and Applications* (Chicago: University of Chicago Press, 1982), 8.
[6] Ibid., 8.

argues that there is a general human right to freedom and well-being to engage in such action without interference from other persons.[7] Gewirth proposes a dialectically necessary method to argue that every agent must logically agree that other agents have human rights.[8] The method for recognizing another person's moral worth only becomes dialectically complete when one recognizes that any purposive agent has the same grounds for rights to well-being and freedom. Thus, the same justification for one's own moral worth applies to all other purposive agents as well. One can challenge this notion of extending human rights to other purposive agents only on the pain of contradiction.[9] This culminates in Principle of General Consistency (PGC) which demands, "Act in accord with the generic rights of your recipients as well as yourself."[10] This normative statement is parallel to other moral maxims such as The Golden Rule or Kant's Categorical Imperative. One thing to note here is that although Gewirth provides a normative requirement to grant every purposive agent human rights, there is still an insufficient account of what rationality looks like. Though he hints at a generic account of mental deficiency and potential of behavioral harm to oneself or another as being two indicators of compromised rationality, Gewirth does not argue that rationality should be mechanical or philosophically rigorous, and therefore leaves open the possibility for animal rights. This account is more inclusive than what Kant provides, however, the general ambiguity in defining reason leaves Gewirth's account not fully equipped to buffer the potential for abuse.

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[7] Ibid., 15-16.
[8] Ibid., 20.
[9] Ibid., 51.
[10] Ibid., 52.

Even though the account for rationality is insufficient, if it is taken seriously as a necessary qualifier for human rights and moral worth, then the application of this measure needs to be done with caution. The issue is that rationality and its expressions might vary based on individuals, and people may still abide by ethical action even if their rational mechanism and behavioral expressions differ from the more abstract norm. If Gewirth's conditions are to be considered, as long as the actions of others and their freedom is not hindered, then there should be no issue as to why another person should be deprived of moral worth even if their mechanism for reason is different. Yet as I will show in later sections exploring trends of discrimination that use neuroscientific evidence as a qualifiers of rationality, the ability to deny rational agency to others is an avenue to deprive those who mentally differ from moral worth and its associated human rights.

The Importance of Individuality

Considering the potential for abuse, as well as ambiguity surrounding a criteria of moral worth that I have described above, perhaps another approach is needed in order to accommodate those who are susceptible to marginalization if they do not meet some generic criteria such as rationality. John Stuart Mill argues that individuality in thought and expressions should be respected, for it fosters genius, and permits society to progress**.** However, someone need not be a genius to see issues with popular opinion, and therefore their individuality and ability to vary from common thought may help society progress through critique. Mill develops a more inclusive approach to respecting someone's moral worth than Kant and Gewirth. For Mill, individuality should be respected so long as it does not harm others, and therefore it allows people to express themselves as such and

permits human happiness.[11] Mill fears, however, when faced with excessive individuality, social forces attempt to tame and enforce conformity by disciplining deviance through control.[12] In this process a commonality or sense of normalcy is emphasized, and even if the idea of choice is entertained among individuals, it is directed towards preferring what is commonplace or the dominant view.[13] Any aberration is chastised and demonized for it does not allow this hegemonizing normativity to exercise an unidirectional and uninterrupted control.[14] The result of being labeled as different for expressing oneself as an individual runs the risk of being diagnosed as mentally deviant, and having one's liberty and agency stripped.[15] It was once tolerable to completely eradicate those who were non-conforming, but nowadays we are encouraged to be more 'charitable'[16] and place those who are different in therapy to modulate them back into normalcy. Mill is more focused on the social and legal restrictions on expression and action. His analysis aligns with the Foucauldian genealogical process of powering-over and institutionalizing which I will describe below.

One distinction to make here is that Mill's emphasis on individuality seems to strive from expressions that a person has choice over, instead of qualities that are not easily changeable, such as their sex, race, or sexual orientation. Therefore, it can come off as patronizing to believe someone's variance in-and-of-itself has any merit towards progress. Yet, that is one form of individuality that deserves respect considering it is not a

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[11] John S. Mill, "On Liberty: Chapter 3: Of Individuality, as One of the Elements of Well-Being," in *Utilitarianism; On Liberty; Considerations on Representative Government; Remarks on Bentham's Philosophy*, ed. Geraint Williams (London: J. M. Dent, 1993), 124.
[12] Ibid., 128.
[13] Ibid., 129.
[14] Ibid., 133.
[15] Ibid., 137.
[16] Ibid.

variance that should be demonized on two accounts. Firstly, as Mill would agree, these characteristics do not interfere with another's well being. Secondly, though Mill does not fully account for this, an individual or 'different' expression that is not a person's choice cannot be argued to be morally superior because these qualities are not based on merit or any effort on behalf of the agent. Gewirth might argue that these marginalized identities do not compromise someone's purposive agency. This is because people from these marginalized groups can lead their own lives, and their identities are not necessary hindrances to purposive agency. Thus, Mill would then say that even if these lives are different from the norm they should be respected, because it does not interfere with another person's freedom. In fact, such differences should even be encouraged because it allows for a diversity of outlooks and insight. However, as I will elucidate below, the process of marginalizing individuals who bear deviant identities is an attempt to move them towards normalcy and predictability. This process is destructive as it negates their personhood holistically and reduces them to objects or mere features that can be modulated. The result of such a dehumanizing process is either to eradicate such groups or in a more modern fashion diagnose and pathologize their differences and complement it with therapy or embark on less 'medical' efforts to have individuals conform to a norm largely defined by the dominate group.

Though Mill may not have considered the idea of an undecided difference, such as sex, race, etc., when exploring individuality and its connection to well-being, these differing identities succumb to the same demands of mediocrity and conformity that Mill articulates. However, because it is difficult to fully subordinate and modify such differences, deviant identities undergo a process called 'othering' that is a more brutal and totalizing marginalization than someone with a minority opinion or expression endures.

Someone with a minority opinion may be at liberty to be an individual and to deviate from majority beliefs, and they are also at liberty to relinquish any deviant beliefs if the pressure to conform is insistent. However, marginalized social identities such as women, non-white races, or homosexuals are faced with the challenge to emulate a dominant identity, while simultaneously being barred from the privileges or even identification with the dominant group no matter how convincingly they imitate a notion of normalcy. They are tethered to such identities either through biological restraints on their phenotype or rigid social consensus on their status, and thus would not be at any liberty to easily change their identities at will. Hegel's account of the Lord and the Bondsman describes this dialectical process whereby the 'other' is marginalized into an inescapable objectified state in which the dominant agent drives a normative pressure on the 'other' to yearn for recognition from their oppressor. Elucidating this process below will lay the foundation for subsequent auxiliary arguments on why such a phenomenon is concerning specifically as it unfolds in the neurosciences.

Producing Normative Control of the Other

In *Phenomenology of Spirit* Hegel's account of a lack of mutual recognition in the Lord and Bondsman relationship lays the foundations as to how certain individuals are marginalized and gives birth to the conceptual matrix wherefrom we can understand how neuroscience, as an 'othering' enterprise, is aligned with this problematic relationship. Hegel proposes that an ideal situation of mutual recognition exists when two entities are able to see each other as they would see themselves. The manifestation of this is his account of marriage in *Philosophy of Right*. Marriage would be a consenting relationship between two individuals to self-sacrifice their differences and reciprocally see oneself in

the other.[17] Marriage therefore stands for an ethical union that creates the foundation from which families form. However, because of the social realities and patriarchal attitudes and gender roles of his time, Hegel's account of marriage is not fully egalitarian between the two entities. This does not disregard the usefulness of the framework for how a healthy dialectic between two self-conciousnesses should manifest. Hegel recognizes other levels of ethical situations such as Civil Society and the State. However, the abstract framework of marriage constructs a scenario whereby an ethical union can occur between two individuals. Marriage, Civil Society, and the State, when realized correctly on earth, move in an intangible normative direction, called the Ethical Idea, towards which we should progress.[18] In essence, the idea of mutual recognition allows a dialectical process to ensue by beginning at the personal level with individuals selflessly recognizing the humanity of others.

However, while the account of marriage demonstrates an ideal state in which interactions between individuals should be founded to make social progress, Hegel's account of the Lord and Bondsman describes an unrelenting relationship that produces an incapacitated and subjugated 'other' by denying selfless recognition and harboring a stagnating dialectic where a denigrating dehumanization festers. Hegel describes this scenario in the abstract language of self-consciousnesses interacting with each other. A self-consciousness simply put is an entity or state of being that is aware of itself through another entity's awareness of itself. This is merely an abstract and general descriptor of entities that gain their necessary being and self-awareness through the awareness and

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[17] Georg W. Hegel, *Hegel's Philosophy of Right*, trans. Thomas M. Knox (London: Oxford University Press, 1965), 115.
[18] Ibid., 218.

recognition of themselves as conscious beings mediated through other self-aware consciousness who are engaged in a similar process of identity formation. Additionally, a self-consciousness has a will and when it encounters things that do not have a will, such as objects, it can move the non-conscious object as it wills. Self-consciousness exists primarily in-and-for-itself, and any prioritization of another self-consciousness is only for the sake of gaining acknowledgement or recognition. In essence, there is a selfish motive to gain recognition from another self-consciousness and therefore it is profitable to return recognition to the other.[19] Self-consciousnesses balance a double identity wherein each is independent, not needing the other to be for-itself, and dependent, demanding recognition from another to bolster its sense of self. In the healthy relationship, there will be a self-aware dual action wherein recognition is both extended and received, satisfying a pure Notion of recognition.[20] It is necessary that each self-consciousness differs to satisfy an ontological duality necessitating the struggle to self-sacrificially see oneself in the other and negate the abstract nature of their differences through synthesis.[21] When this process is balanced selflessly, the ideal situation of marriage is realized. I will first provide an exegetical description below of how the self-consciousness functions in a dialectical process in order to lay the foundation for the phenomenological mechanism that is fundamental to understanding the idea of 'othering', i.e. marginalization, through Hegel. Understanding the mechanism of the Hegelian dialectic will then give a clear account of where a respectful healthy relationship between individuals can bloom, as described

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[19] Georg W. Hegel, *Hegel's Phenomenology of Spirit*, ed. John N. Findlay. trans. Arnold V. Miller (Oxford: Oxford University Press, 1977), 111.
[20] Ibid., 112.
[21] Ibid., 114.

through marriage, or social marginalization can occur, as described through the Lord and Bondsman.

When one self-consciousness, in this case the Lord, refuses recognizing the other self-consciousness, in this case the Bondsman, the dialectic is stagnated and cannot fully move forward. The Lord exploits the Bondsman for recognition, simultaneously maintaining an independent identity while not returning the favor, thus reducing the Bondsman to *thinghood*. In this reduction, the Bondsman, still being self-conscious, *works* on himself as an object through the active exploitation of the Lord. He will actively reduce himself to being an exploitable object for the Lord. Through this the Bondsman has to sacrifice his will for the sake of the Lord. This becomes concerning, because if we connect the idea of agency to the moral theories mentioned above with Kant and Gewirth, the Bondsman sacrificing his will can deny him full moral worth, and therefore be denied the rights of a moral agent. In this process that the Bondsman goes through, the Lord gains recognition from the Bondsman, who is now an exploited object, while not creating a complete self-dependency on the Bondsman. The Bondsman on the other hand gives recognition to the Lord and his intentions by negating being-for-himself and instead being-for the Lord by self-objectification. However, this reduction does not carry to the point of self-destruction because the Bondsman must exist as an exploitable 'other' for the Lord to profit on the recognition.[22] This relationship demonstrates the point of selfish exploitation by those in power who seek to gain recognition without having to return it.

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[22] Ibid., 116.

In relationships of social marginalization, the dominant identity participates in the same process where they gain recognition from the marginalized through the acts of emulation, subordination, and obedience. However, there is no obligation for the oppressor to return the favor and recognize the humanity of the other. If we substitute the Lord and Bondsman for a dominant and subjugated identity, respectively, this Hegelian abstract process becomes more grounded in the nuances of the marginalized lived experience. For example, in a world dominated by patriarchal values, women, the Bondsman, have been led to develop a subservient view of themselves in reference to men, the Lord, and masculinity. Therefore, they model their mannerisms, physical and social expressions in reference to men. In order to gain social recognition in a society hinged on ontological and normative attributes associated with men, one has to emulate these male-associated values. For women, these come in mainly two polar expressions. One way could be through objectifying themselves to please the male gaze by being hypersexual or appeasing to male sexual fantasies. We see this through the sexualization of women in media as well as heavy emphasis on physical presentation placed on women to wear make-up or dress femininely. On the other hand, in order for women to be taken seriously in male-dominated spaces they feel pressure to abandon femininity and present themselves in traditional male expressions such as wearing male-inspired attire, not wearing make-up, taking assertive stances, and overcompensating for the prejudices they face about intellect and competence. This is under the assumption that they may gain recognition and be seen as people. In this process they stop being for-themselves, and therefore further exploit and reduce themselves to *thinghood* in an attempt to gain recognition. No matter how much they attempt to replicate masculinity, full access to the benefits of manhood are never granted because the recognition from the Lord is never

returned. This dialectical process is substantiated through the reality of wage-gaps, gender disparity in positions of power, and the discrimination and harassment women face no matter how much they assimilate in male-dominant spaces.

This exegesis of Hegel's account of the Lord and Bondsman has outlined the process by which a power discrepancy is created between two entities and how a lack of mutual recognition stagnates any progress towards realizing the Ethical Ideal. If there is no mutual recognition, people are not able to see others in-and-of-themselves as people worth respecting. As a result, an unhealthy and unequal relationship forms. In essence, if we are not able to respect the individuality of others and instead pressure them to express themselves in reference to a dominant definition of normality, we deny them moral status and make them susceptible to abuse by denying them human rights.

However, Hegel does not fully explicate the specific methods through which the Lord maintains his ignorance of what he does to the Bondsman. Therefore, an analysis of Michel Foucault's critique of the historico-genealogical creation of the Other and his description of clinical scrutiny of the Other may indicate how ideas of biological determinism maintain a paternalistic power differential through use of the neurosciences. Hegel's dialectical process of mutual recognition requires that the two self-consciousnesses be different while able to see themselves in the other and willing to sacrifice themselves, for the sake of the other. However, according to the stifled dialectic described in Lord and Bondsman scenario, the Lord need not direct any recognition to the Bondsman and see him as he is in-and-of-himself. The ability to reduce and objectify the Bondsman derives not from pure recognition, but by a reductive gaze that subjugates the Bondsman to morph into an exploitable *thingness*, as defined by the Lord. The power comes not from

objectively seeing the Bondsman for who he is, but instead from defining, scrutinizing, analyzing, and redefining the Bondsman to the subjective expectations of the Lord.

Foucault's Genealogical Process from The Madhouse to The Clinic

The reason I critique neuroscience is because it is a vessel through which empirical authority is combined with a connection to exploring and justifying intellectual capability. Therefore, it becomes a tool ripe to propagate 'othering' and marginalizing ideologies with authority. In the neurosciences specifically, this comes through statements of pathology, intellectual inferiority, and other language that places the mental and neural states of marginalized groups in normative reference to a dominant group or in reference to those who are considered societally 'normal.' Though such distinction may be valid when comparing brain states that strongly correlate to degenerating physical states that compromise an individual's agency and safety, at times the value laden comparisons become problematic when denigrating an 'othered' brain. We can better understand this concerning situation by looking at Michel Foucault's historico-genealogical critique of how an identity is created for those diagnosed as mentally ill, e.g. labeled as intellectually inferior and thus deserving of being institutionalized. This critique can be adapted to explain how neuroscience has historically formed and has been socially modulated to serve ideological priorities rooted in controlling and mastering the 'other'. Though the neurosciences and their predecessors have been culpable in taking part in scientific discrimination of marginalized groups such as non-white races, queer people, and those diagnosed as mentally ill, I will focus and explicate its problematic relation specifically to women. I believe, however, that this provides the framework of critique that can then be expanded to looking at other identities to see if and how they have been 'othered' through the neurosciences.

In *Madness and Civilization*, Foucault provides an historical account of how the modern institution of psychiatry has been produced. Though the neurosciences are mostly biologically based, the interdisciplinary nature of the current health system incorporates empirical findings, psychiatric diagnoses, and therapeutic tactics. This therefore blurs the lines of where neuroscientific research is primarily focused. I will also demonstrate below that neuroscience, as it stands today with its normative pretensions, is an extended manifestation of the institutions Foucault critiques. One point to consider is that Foucault's critique focuses on the development and pathologization of madness in a European context, and therefore I acknowledge that this may not provide a comprehensive critique outside the European cultural sphere. However, considering the effects of colonialism and the appropriation of western clinical and diagnostic techniques, the remnants of these ideological frameworks may still be relevant in a largely globalizing world.

Madness, to the degree it is currently stigmatized, was not always an apparent feature of European society. Until the 16th century, the main recognizable and pathological 'other' was the leper. Once leprosy began dying out in Europe, vagabonds, criminals, and the insane became the excluded.[23] They were driven out of society and some were set on Ships of Fools where they could be sent into the ends of the earth to find escape from their suffering in a potential holy land where they could be saved.[24] The critique of madness came in the modes of moral satire, and it was literally demonstrated with the framing of madness preceding death. In this process madness though still an

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[23] Michel Foucault, *Madness and Civilization: A History of Insanity in the Age of Reason*, trans. Richard Howard (New York: Vintage Books, 1988), 7.
[24] Ibid., 15.

object of criticism, was given a momentary liberation and at least a public acknowledgement of people's susceptibility to being mentally ill during the Renaissance. During the 17th century, madness was no longer a disturbance that could be exiled and kept at bay, instead it was tamed and privately separated through institutional confinement complimented with the guise of social benevolence through food and shelter.[25] This paralleled an economic shift in Europe, where, in the face of unemployment and resource scarcity, productivity was valued to keep away idleness, which was associated with the start of mental disorder.[26] The insane were labeled as animal-like monsters,[27] and therefore it was justified that they be mastered, disciplined, and forced into confinement to stay hidden.[28]

Madness was thought to derive from an imbalance of passions as represented by an eruption of black bile, the humor associated with melancholy.[29] This lays the foundation for a physical origin to madness, and an association of physiological imbalance to mental and behavioral inconsistencies. More specifically, the nervous system and its irregularities started being associated with mental dysfunctions and the loss of reason.[30] However, as Paul Zacchias, a 17th century Italian physician notes, there is still logical consistency among the mad except that their reasoning only functions within a language that accommodates the delirious perceptions that they produce and are convinced by.[31] Though the madman could suffice with his delusions, he was still in a state of unreason in relation to normative standards of morality. Thus during the 17th

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[25] Ibid., 48.
[26] Ibid., 53.
[27] Ibid., 75
[28] Ibid., 70
[29] Ibid., 86.
[30] Ibid., 93.
[31] Ibid., 100.

century madness, associated with physical correlations, was reduced to non-being instead of a mere descriptor of another world. This non-being quality of the madman justified his confinement, and with it his personhood was reduced to nothing, making him ripe for unapologetic and brutal correction through a normative and paternalistic control channeled via his incarceration.[32]

The historical development of madness as unreason that can be reduced to nothingness so that it may be corrected through confinement signifies the development of the psychiatric model we currently have. Though the brutality of 17th and 18th century mental institutions may seem outdated, current institutional practices modify its expression to be less of an explicit physical attack on the mad and more of a therapeutic practice that seeks to make the 'deviant' emulate the norm. In the late 18th century medicine, and not just behavioral corrections within madhouses, eventually became part of the moral dictum, and as a result clinical authority became a necessary qualifier in demarcating and then punishing the mad.[33] This shift signified a change where the notion that madness is a return to the primordial fall was abandoned, and instead an individual's immediate relation to those around them and their moral responsibility to contribute as a functional member was emphasized.[34] Unfortunately, the medical and therapeutic relation to madness is never truly pressured with any insistence on benefiting the madman. Instead the claims of benevolence or humane improvements to therapeutic approaches serve to occlude the paternalistic, but misguided, attitude inherited in the practice.[35] It is explicitly through the process of describing the madman as animalistic,

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[32] Ibid., 116.
[33] Ibid., 177.
[34] Ibid., 220.
[35] Ibid., 224.

and therefore appropriate to confine and tame, that current day neuroscience gains its authority to inform psychiatric therapies. For example, the language of hormone imbalance, neural deficiency, or some other measure that indicates a lack of stasis and control suggests an unpredictability to the brain, and therefore this resonates in the same vein as uncertainties presented by a threatening animal that cannot be domesticated. We are therefore driven by the suggestion of ambiguity to bring forth order. I will explore in the chapters below how the idea of making the neural 'other' predictable implies the possibility that the 'other' can be reconfigured to be normal.

With the birth of asylums in the 18th century, therapeutic interventions produced a guilt in the madman where he viewed himself as a vulnerable 'other' and as an object with the responsibility to reason and escape his destitute state. In this state of confinement permeated with the intent to correct, the madman was reduced to his visible surface and animality that was then observed and scrutinized clinically.[36] This is a non-reciprocal relationship, parallel to Hegel's Lord and Bondsman, where the ability to analyze the madman lies in the control of the psychiatrist through his prestigious authority to reason and judge.[37] The asylum was the arena where judgment could be passed, and it became a domain demanding homogenous morality and ethical uniformity from the madman.[38] In the doctor-patient relationship, the patient self-surrenders to the physician's knowledge and alienates himself by accepting the physician's authority, scientificness, and validity in everything he has to say and determine about the patient's inferiority.[39] It is this submission to the normative power of the physician and the weakness created in the

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[36] Ibid., 248.
[37] Ibid., 251.
[38] Ibid., 259.
[39] Ibid., 277.

unapologetic submission into analysis that gives the physician power over the madman and the moral justifications to control, subsume, and 'work' on correcting madness.

However, it is not only the psychiatric enterprise that is at fault in dehumanizing an 'other'. The clinical practice as well is susceptible to similar processes. For example, Foucault provides a historical account on the formation of the clinic. He is not as critical or suspicious of the enterprise under scrutiny as what he provided in *Madness and Civilization*, but this may be because empirical certainty of medicine is difficult to challenge, especially with current beliefs that statistical valuations are absolute and certain. I will elaborate this issue of viewing statistics an infallible informer of certainty in the final chapter, as it lies at the root of why and how the sciences gain its social authority.

The transition in attitudes towards cure happened with asking "Where does it hurt?" rather than "What is the matter with you?"[40] The pathological nature was depersonalized from being a holistic person to instead an isolated set of symptomatic features, which were targeted as the source of disease. However, a singular symptom as such cannot be isolated, nor are its effects universal.[41] Yet, physical features were systematically segregated, taxonomized, and attributed as markers of a disease. For example, Meckel, a physician in the Prussian Royal Academy, in 1764 described specific qualities to diseased brains. He wrote, "the brains of manics are light, dry, and friable because mania is a lively, hot, explosive disease; those of phthisis are exhausted and languishing, inert, anaemic, because phthisis belongs to the general class of the hemorrhages."[42] This descriptive connection made with externally visible symptoms of a

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[40] Michel Foucault, *The Birth of the Clinic: An archaeology of medical perception*, trans. Alan M. Sheridan (Oxford: Routledge, 2003), xxi.
[41] Ibid., 12.
[42] Ibid., 13.

disease to a brain state is a trend we see in modern day neurosciences as well, as I will explain in later sections. When the language turns from serving the individual to isolating only the pathological and universalizing that symptomology, the individual is treated as nothing more than an accident or negative element of the disease, irrelevant to its essence. An epidermal gaze that scrutinizes the body becomes the priority, and the patient is a secondary concern.[43] Because the physician is not able to bridge the gap of differing symptoms that are modulated and contingent on each individual's unique experience, there is a multiplicity of diseases that are taxonomized to account for variances observed.[44]

When health is viewed as a larger collective social and political concern, there is further deindividualization that happens. There are multiple physician's gazes that are needed. As a result, medicine was professionalized in order to control for the competing viewpoints and reach an authoritative consensus. Foucault argues this shift happened due to a need to alleviate physical misery that plagues the soul, replacing the clerical role of the church and her domineering authority.[45] Diseases in general seemed to reflect the historical context they occurred in. For example, fear and exhaustion rose out of the politically tumultuous and famine ridden Middle Ages. Sexually transmitted diseases and congestion peaked in a time of relaxation and plenty during the 16th and 17th centuries. Nervous mental diseases began to surface in a time where pleasure was brought over to the imagination such as in the age of theater and novels of the 18th century.[46] Carry this

[43] Ibid., 15.
[44] Ibid., 20.
[45] Ibid., 37.
[46] Ibid., 38.

thread over to the present, and the diseases that we see are rooted in our specific social concerns.

In the 19th century, the general bodily health was no longer a concern because most physically disastrous conditions were not as severe due to modernization and advances in medicine. Instead the priority became normality. Knowledge about organic structures, and how they are meant to normally function became the basis on which the pathological, as a deviation from the normal, could be corrected. Before the birth of the clinic, there was an immediate relationship between disease and cure, centered around the individual, before it was socially systematized.[47] In the clinic, a diseased person could be isolated and a physician's constant gaze could penetrate into the patient, who was just a hindrance to the source of pathology.[48] For Foucault, medicine does not become clinical until it subscribes to an encyclopedic knowledge of diseases.[49] The patient who 'benefits' from this clinical procedure is also pressured to publicize their pathology, further subordinating them to a medical gaze, so that the canon and taxonomy of diseases may expand and others may benefit, specifically the wealthy who may therapeutically benefit from the medical knowledge.[50]

What makes a clinical setting unique is that it gives the doctor the institutional authority to gaze, decide, and intervene.[51] Additionally, this drive to classify and reduce disease to a collection of symptoms allowed symptoms to be a signifier of the whole disease, i.e. the symptom became the signifier of the patient who was but an epidermal

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[47] Ibid., 65.
[48] Ibid., 70.
[49] Ibid., 87.
[50] Ibid., 102.
[51] Ibid., 108.

capsule embodying a total pathological state. In this objectified reduction, the patient could, and should, be manipulated like a machine till he is normal.[52] It was through statistical frequency and the repetitious inquiry and inscription of pathological symptoms in multiple patients that gave medicine its depersonalized and objective certainty.[53] The clinical gaze moves deeper into the patient as the all consuming drive to know the full structure and component of a disease. It moves beyond the directly visible to expose the pathological secrets hidden beneath.[54] In neuroscience, the penetrative nature of brain scans, lesion studies, neuronal staining, protein extractions, and other invasive and destructive processes to reduce and describe a pathological isolate is but a modern manifestation according to this critique.

The Necessity of a Foucauldian Analysis of Neuroscience and its Normative Aim

I have demonstrated above, evidencing *Madness and Civilization* as well as *The Birth of the Clinic*, that the tendencies of modern day psychiatry and therapeutics is rooted in a continually modulating genealogy that simultaneously suppresses, dissects, scrutinizes and most importantly occludes its explicit intent to power over the mentally aberrant. To suspect that the modern day neurosciences function independently from this clinical inheritance or is immune to such critique due to its empirical status would be fallacious. Like other sciences, neuroscience is undeniably an enterprise that is pressured by social and historical influences. A thorough historicist analysis, especially one focused on currently relevant identity politics or easily distinguishable marginalized groups, can bring to light how neuroscience can become a tool to further marginalize in the same vein as its

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[52] Ibid., 119.
[53] Ibid., 124.
[54] Ibid., 148.

disciplinary predecessors. This attempt hopes to explore the descriptive process by which the Hegelian notion of 'othering' occurs. I argue that neuroscience stands as a modulatory apparatus that facilitates the reduction of the Other into a *thinghood* devoid of recognition and ripe for pure exploitation. In-and-of-itself, neuroscience as an enterprise is not necessarily problematic in relation to power dynamics between social identities. Instead as a socially informed enterprise it is capable of misuse. Considering this, my main intention is to use a historico-genealogical framework, similar to Foucault's, to critique at how the neurosciences have participated in demarcating the rational and intellectual capacity of women.

Ultimately, through this thesis, I hope to show that human dignity prefaced by a requirement of rationality is concerning due to a faltering and under-described account of what rationality truly is. Though we have accounts, by Kant and Gewirth, that provide a normative necessity to extend moral worth to all rational agents and recognize human rights as universalizable on pain of contradiction, there is still an insufficient demarcation of what reason, as a necessity for moral worth, objectively looks like. Neuroscience, guised in empirical validity, may seem to be one of these socially approved enterprises that can objectively inform us on whether a person poses the capacities required for full moral personhood. By subscribing to the account of dialectical stagnation in the Lord and Bondsman relationship, and by providing a historico-genealogical account of neuroscience in relation to women, as a marginalized identity, I hope to show how neuroscience dehumanizes through an argument of defining rationality, without any substantial authority to do so. However, I will recognize that neuroscience does have social value because it provides information that may be viable in treating pathological effects that are not laden with social judgments. Therefore, neuroscience should be used

where it can be informative and socially progressive, instead of engaging in over extensive explanatory enterprises where it seems to do more harm than good.

Chapter Two

Limitations of Neuroscience

In this section, I will first focus on defining the scope of the neurosciences and then expand upon the limitations within this field. By first laying out the historical development, I hope to highlight that neuroscience, like any other human enterprise, is riddled with social biases and vested interests. Then, I will evaluate the overwhelming enthusiasm with which neuroscience attempts reduce lived experiences to brains states. Considering this, I will explore the philosophical implications of reductionist methods and highlight the actual limits to which such attitudes may work. Because neuroscience is attributed a powerful explanatory scope, there is a tendency, especially in the public eye, for generous arguments for its complimentary applications among disciplines and industries. I will analyze these trends, both historical and current, and then describe the implications for the integrity, scope, and more importantly the limitations of neuroscience. As I delve into the issues I have outlined above, I encourage the reader to keep in mind the concerns I have outlined in the previous section. Neuroscience, attributed with studying the physical substrates of mental phenomena, is by extension implicated in explanations of rationality. Rationality is a valued qualifier when defining human agency and moral worth. Therefore, evaluating whether neuroscience is appropriately able to inform us about rationality will be important in understanding where it could be misused to marginalize people.

First, we need to recognize that neuroscience is not isolated in an ivory tower where scientists are pursuing the mysteries of the brain simply for the sake of knowledge. This is clearer when you look into factors that lead to publication bias within

neuroscientific literature, and the rhetorical use of technology and ways to present data within the scientific community itself. There are factors such as financial sources, through research grants and other funding, that push research in specific directions.[55] Additionally, a corporate layer overlies the scientific community and manifests itself in pharmaceutical companies. These institutions may pressure research, and the presentation of research, in favor of medications they are trying to promote.[56] This may then compromise findings, they way those findings are publicized, and the true results of the efficacy of drugs. The above mentioned issues highlight many consequences that the neurosciences face, not only with scientific integrity, but also with social impact as well. One clear example that compromises the clinical sphere is where inappropriate reporting of drug efficacy may lead to unintended consequences. For example, the anxiolytic medication Xanax has many adverse side effects including sleep disturbances, hallucinations, rage, irritability, and aggressive or hostile behavior.[57] However, for many years this information was included in the Physician's Desk Reference (PDR). Such a listing is not legally required as PDR is a private non-governmental publication. In 2006, Upjohn, a drug company, removed Xanax from the PDR while continuing to sell the drug.[58] Many patients are not able to recognize or report the mental side-effects that affect one third of users during clinical trials, and therefore the problematic symptoms go

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[55] Suparna Choudhury and Jan Slaby, "Proposal for a Critical Neuroscience," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 39.
[56] Max Stadler, "The Neuromance of Cerebral History," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 142.
[57] Peter E. Breggin, "Tranquilized into Violence," in *Medication Madness: The Role of Psychiatric Drugs in Cases of Violence, Suicide, and Crime* (New York: St. Martin's Griffin, 2009), 157.
[58] Ibid.

underreported.[59] Benzodiazepines like Xanax act through $GABA_A$ receptors and act through midbrain dopamine neurons in both sedative and anxiolytic actions to modulate the mesolimbic reward system.[60] Because of the sedative effects and suppression, there is a compensatory mechanism that overstimulates the brain. When the benzodiazepines no longer can control this overstimulation the result is more anxiety, panic and psychosis.[61] Gerry Shannon is a patient who was prescribed Xanax to cope with anxiety. She had taken 0.25mg dose to help her sleep before visiting her husband who she suspected was having an affair.[62] She woke up early, and took another tablet on an empty stomach. When she arrived at her husband's trailer and found him with Angie, the woman she suspected her husband was having an affair with, she got agitated, found his gun, and shot Angie seriously injuring her. Gerry had not had previous history of violent acts, nor was she abusing her Xanax medication.[63] Yet, her actions were linked to the symptoms of the drug and her charges were reduced.[64] Gerry's story, combined with the underreporting and continued sales of a symptomatically dangerous drug, demonstrates the problems in the psycho-pharmaceutical companies where sales are prioritized rather than safely medicating patients.

Though the example above indicates an issue of poorly accounting for the social consequences of drug consumption, the extended consequence of the improper explanatory tendencies of neuroscience as a field, and how the public consumes it, is that certain people from marginalized communities may suffer as a result. One powerful way

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[59] Ibid., 158.
[60] Kelly R. Tan, Uwe Rudolph, and Christian Lüscher, "Hooked on Benzodiazepines: $GABA_A$ Receptor Subtypes and Addiction," *Trends in Neurosciences* 34, no. 4 (2011): 189, doi:10.1016/j.tins.2011.01.004.
[61] Breggin, "Tranquilized into Violence," 160.
[62] Ibid.
[63] Ibid., 161.
[64] Ibid., 162.

to negate the personhood of a marginalized group is to naturalize their differences, or give a scientific certainty to their inferiority. Neuroscience, or any study associated with the mind, can do this by attributing intellectual inferiority. I will develop whether this is true in the history of the neurosciences and the current literature in the next section with a focus on sexism. However, in this section, I hope to lay the foundations on why we should scrutinize the neuroscientific enterprise. I will demonstrate the limitations of neuroscience in what it can actually inform about rationality (though this may not be its primary goal) and more importantly outline the avenues through which such a socially impactful discipline can do more damage than good at times.

What Is Neuroscience?

In order to understand the issue here, we need to explore what neuroscience is, the boundaries of what it hopes to explore, its historical nature, and its current state of affairs. By connecting these points on analysis, we can better understand where to specifically target productive criticisms. To begin, neuroscience is a multi- and interdisciplinary science that attempts to find the biological basis of animal behavior. It has a long history with roots in anatomy, physiology, medicine, and more strongly in the meeting of biology and psychology.[65] Therefore, due to its varied influences and its attempts to influence other disciplines, the definition stays ambiguous, though it is mostly centered around the scientific study of the brain and its behavioral and mental implications.[66]

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[65] Eric R. Kandel and Larry R. Squire, "Neuroscience: Breaking Down Scientific Barriers to the Study of Brain and Mind," *Science*, no. 5494 (2000): 1113, http://www.sciencemag.org/content/290/5494/1113.full.

[66] Suparna Choudhury and Jan Slaby, "Introduction: Critical Neuroscience—Between Lifeworld and Laboratory," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience* ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 1.

Prior to the 20th century, most neuroscientific research was conducted using neuroanatomical analyses and electrophysiology. Neuroanatomy is the study of the physical symmetry, density, and distribution of tissue across the brain using cell staining methods. Electrophysiology is studying the electrical properties of cells by measuring the voltage changes as ions move across the cellular membrane. At the beginning of the 20th century, with the findings of Santiago Ramón y Cajal and the rise of the neuron doctrine,[67] there was a shift towards a more molecular biology focus and away from neuroanatomy and electrophysiology. In molecular biology, there was focus on protein expression and the effects of other organic molecules within a cellular matrix on the behavior of the cell. To circumvent this reductionist shift, a more global perspective was needed. With the rise of brain imaging in the 1980s, one could study pathways and anatomical regions correlated with larger conceptual frameworks such as sensation, perception, and memory.[68] Though this helped tighten the influence of both biological and psychological frameworks into the progress of neuroscience, the limitations of reductionist attitudes, technology, methodological barriers, and over-claim correlating biological and psychological states was left unaddressed.

Essentially, the interdisciplinary nature and the trend to incorporate different methodologies to study the brain ran rampant, and with it the arguments for what neuroscience could inform, not only about the brain but also about ethics, sociology, anthropology, economics, law. These are just a few of the disciplines where the ontological significance of findings and the compatibility of the disciplines are left

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[67] Stanley Finger, *Origins of Neuroscience: A History of Explorations into Brain Function* (New York: Oxford University Press, 1994), 48.
[68] Kandel and Squire, "Neuroscience," 1119.

unaddressed. This is currently where neuroscience lies. It has reached a point where it has bridged, unchallenged for the most part, into various disciplines. This is led by the assumption that neuroscience's power to 'unravel the mind', and by extension all of lived human experiences, makes it appropriate to reach into either explaining what was traditionally the domain of other disciplines, or incorporating those disciplines in some way to inform us more about the mind. At times this may be useful, but the ambiguous nature and agglomerate history of the neurosciences may be the reason why it tends toward the interdisciplinary. I will address these issues in the sections below by elaborating on the limitations of neuroscience, and the significance of over-claiming its potential when extending its influence into other arenas of study and systems that have the potential to affect people's view of themselves and others.

Neuro-reductionism

Reductionist attitudes to create a unified 'theory of everything'[69] are rampant in many empirical studies, especially physics, and are some one of the grandest challenges in philosophy facing issues of intelligibility, informativeness, and logical barriers of circularity with a theory having to explain itself. This challenge is rooted in the argument of Ockham's razor, which proposes that the shortest explanation for something is the most appropriate one.[70] Neuroscience attempts to do the same, but the issue is when such an enterprise would attempt to reduce personhood to neurological manifestations. The assumption here is that because the brain integrates external experience and acts upon it by stimulating our body, understanding the mechanism can reduce the experience to the

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[69] Nicholas Rescher, "Chapter 4: The Price of an Ultimate Theory," in *Studies in Metaphilosophy* (Piscataway: Transaction Books, 2006), 65.
[70] Armand A. Maurer, *Being and Knowing: Studies in Thomas Aquinas and Later Medieval Philosophers* (Toronto, Ont., Canada: Pontifical Institute of Mediaeval Studies, 1990), 432.

most concise and empirically valid, therefore less ambiguous, description of it. This is a much more difficult task than unifying the expression of fundamental physical elements, as personhood is a much more complex concept that carries with it social and historical factors along with a biological or psychological state.

This reductionist attitude, and its practical implications, are highlighted in the field of psychiatry where methodological, ontological, and epistemological neuro-reductionism leads to conceptual issues in framing treatment.[71] An example of methodological reductionism is exemplified when we expect animal and simple biological models to explain complex psychological processes in humans. Though there are appropriate uses for animal models in isolated frameworks, for example when inter-organismal analysis of identical protein expression within a very specific type of cell, the global expression and effects of experiments are not always consistent across species due to both quantitative and qualitative differences.[72] For example, a yeast model to study alpha-synuclein protein malfunction as it relates to Parkinson's disease pathology may give useful insight about dysfunction at a cellular level. However, a human model is needed to study the cognitive and larger behavioral implications due to the emergent effects of such a diseased state that go beyond cellular malfunction. A mammalian model may be a step closer, however there are limitations in studying higher level cognitive functions that may only be possible through human studies. Therefore, a methodological reduction fails to fully incorporate complex dynamics in a system by instead focusing on parts, and therefore overlooks larger biological or psychological features. Ontological

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[71] Laurence J. Kirmayer and Ian Gold, "Re-Socializing Psychiatry: Critical Neuroscience and the Limits of Reductionism," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 309.
[72] Ray Greek, "The Ethical Implications for Humans in Light of the Poor Predictive Value of Animal Models," *International Journal of Clinical Medicine* 5, no. 16 (2014): 986, doi:10.4236/ijcm.2014.516129.

reductionism attempts to reduce mental activity to the physical states in the brain. The reason this becomes an issue is because it begs the extrapolated assumption that recreating specific physical states in the brain should elicit related mental states. Though there are attempts to find specific biological markers to psychiatric disorders, the variability in brain states for similar behavioral output, for instance in schizophrenia, suggests such reductionist attitudes may not be valid.[73] What ontological reductionism leads to is potentially eliminative materialism, which argues that eventually with enough knowledge about the neural and biological processes, we will not need to discuss mental and other emergent properties in higher order language.[74]

Epistemological reductionism compliments the methodological and ontological reductionist attitudes to argue that all that can be known about higher order mechanisms can be known by our knowledge of lower order functions i.e. a certain brain pattern says that the person feels pain, instead of the subject themselves confirming that 'I feel pain'. Thus, if the representation of a neural state is taken as face-value to be the concept of pain or another emergent emotion there is a conflation and epistemic jump made misrepresenting the idea of pain to be set of neurons firing instead of the qualia experience of pain itself. Though not every neuroscientific enterprise may be culpable of reductionist attitudes, tendencies of such approaches disregards the current lack of consensus on how neural states are linked both mentally and behaviorally. Additionally, even if the scientist is aware of the limitations of their extrapolations or what they can conclude from their studies, when translating complex concepts to in layman's terms

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[73] Paul G. Nestor et al., "Neuropsychological Variability, Symptoms, and Brain Imaging in Chronic Schizophrenia," *Brain Imaging and Behavior* 7, no. 1 (2012): 73, doi:10.1007/s11682-012-9193-0.
[74] Kirmayer and Gold, "Re-Socializing Psychiatry," 310.

there may be a susceptibility to misinform the public with rhetoric laced with eagerness to reduce and explain anything and everything from fragmentary findings. Therefore, siding with a reduced neurological explanation may negate other elements such as social climate, personal views, and other factors relevant to providing appropriate treatment.

By not thoroughly accounting for discussions of how different factors play into personhood, neuroscience and its reductionist tendencies not only ignore these concerns,[75] but are also culpable, as a product of society, for perpetuating social ills by overextending its explanatory claims. For example, in the field of psychiatry, it is not just the neurological state of the patient that creates the disorder, instead it is the interaction of interpersonal interactions, familial and group dynamics, combined with an individual's psychological and biological state that modulates the psychiatric state. Therefore, implying a reductionist attitude that only focuses on the neurobiological state negates the social and psychological complexity of a mental state and undermines the multi-faceted therapeutic potentials.[76] Sociologists, design theorists, theologians, scientists, and even philosophers are at fault for believing that their pursuit of knowledge can explain almost everything that there is. The benefit of providing theories is that we can interpret information to our convenience until it fits our desired worldview. Neuroscience does the same when it attempts to provide a scientific solution to explaining humanity. But considering the large social weight neuroscientific claims can have, it is particularly in this enthusiasm to reduce that problems arise.[77]

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[75] Choudhury and Slaby, "Proposal," 33.
[76] Kirmayer and Gold, "Re-Socializing Psychiatry," 311.
[77] Choudhury and Slaby, "Introduction," 2.

Neuro-hype

One of the main sources for contention as to where neuroscience stands within its potential to explain personhood or humanity is around the issue of neuro-hype.[78] Neuro-hype is the phenomenon that insulates and perpetuates the explanatory power of neuroscientific findings to take it beyond what can arguably be said from an empirical finding. This leads to exaggerated and sensationalist claims of what neuroscience can do, due to the cultural expectations we place on the brain to not only explain 'what we do', but also to provide normative direction for 'what we should do'.

The interdisciplinary nature of the neurosciences extending its reach, some would argue to an inappropriate degree, into other disciplines may be where these issues can be brought to light. Interdisciplinary enterprises at times fail to acknowledge the epistemological and ontological contentions that arise in integrating conceptual frameworks,[79] even if its intentions are to gain useful insight and methodological approaches between different disciplines. Neuroscience has expanded into integrating various fields such as medicine, law, engineering, politics, economics, computer science, philosophy, sociology, and anthropology, to name a few of the multitude of 'neuro-' related disciplines that have surfaced recently.[80]

Complimenting this interdisciplinary trend is the cultural impact neuroscientific explanations seem to have in being able to explain next-to-almost everything. Popularization of neuroscience has led to simplistic accounts of findings and its real-life

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[78] Ibid., 3.
[79] Choudhury and Slaby, "Proposal," 41.
[80] Amir Muzur and Iva Rinčić, "Neurocriticism: A Contribution to the Study of the Etiology, Phenomenology, and Ethics of the Use and Abuse of the Prefix Neuro-," *JAHR-European Journal of Bioethics* 4, no. 7 (2013): 548.

implications. The impact of such misinformation is further perpetuated by the media, and its readiness to consume the explanatory comfort of the 'your brain made you do it' claims.[81] The novelty of neuroscience, especially in its unexplored potential to explain within medicine, science, and technology, has powerful social weight and authority.[82] The appeal of the new, the modern, and the 'hip' in neuroscience is founded in the belief that all social phenomena and realities of the human experience can be understood.[83] Neuroscience is not new in this respect; it is part of a continued trend of empirical inquiries that propose that understanding the mechanisms underlying humanity can tell us about human nature at large.[84]

However, it's not just the sensationalist claims made by the popularizers of science that are at fault. Starting from the laboratory the foundations of ambiguity and uncertainty are constructed through methodological limitations from experimental procedure, frameworks that don't fully encapsulate the full nature or sufficient understanding of what is being studied, and the limitations of technology. For example, a colorful image of a positron emission tomography (PET) scan, and the way certain voxels in an image are calibrated, can communicate much larger significance than the numbers would suggest.[85] The ability to localize and point to a part of the brain and say 'that is why I do what I do!', may be helpful in articulating an otherwise indescribable

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[81] Choudhury and Slaby, "Proposal," 39.
[82] Martyn Pickersgill, "The Social Life of the Brain: Neuroscience in Society," *Current Sociology* 61, no. 3 (2013): 326-328, doi:10.1177/0011392113476464.
[83] Steven Rose, "The Need for a Critical Neuroscience: From Neuroideology to Neurotechnology," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 65.
[84] Stadler, "Neuromance," 143.
[85] Joseph Dumit, "Critically Producing Brain Images of Mind," in *Critical Neuroscience: A Handbook of the Social and Cultural Contexts of Neuroscience*, ed. Suparna Choudhury and Jan Slaby (Chichester, West Sussex: Wiley-Blackwell, 2012), 213.

phenomenon. It may also benefit a rhetoric of validity when communicating to a larger public, but this simplistic claim does not account for the methodological uncertainties that preceded the creation of such an image. We have to realize that the final product, no matter how aesthetically convincing, is still a two-dimensional representation. Thus we have to be cautious when extrapolating the implication of such a blob superimposed on the structure of a brain. However, the communication of easily noticeable 'difference', and by extension significance, within an image makes it an easy tool to help hype-up what neuroscience tells us. The attractiveness of neuroscience is not only rooted in our cultural expectations that the brain can explain things, but it is also accentuated by the air of 'scientificness' the presentation of neurological findings provides. Neuro-hype is generated when this fine balance of scientific digestibility and the semblance of empirical accuracy meets.

Sampling Issues

One of the major epistemological barriers in knowing the significance of a neuroscientific finding lies in the distance created through indirect measurements of neural matter. From the framing of the experimental concepts to the publication of results, there are a lot of uncertainties that plague neuroscientific inquiry. These concerns stem from limitations of conceptual frameworks, indirectness of testing methods, and finally rhetorical biases in data presentation. Therefore, I will explicate how at each step, from experimental design, to measuring brain activity, to comparing data, and finally to producing results, there are limitations as to what can be said for a given set of findings.

The first step before conducting an experiment comes with the selection of participants. In the empirical sciences, this requires demarcating who falls under the experimental and control condition. To do a brain scan, a 'normal' brain must be

determined for the experimental brain to be calibrated in reference to. But this definition can vary depending on what condition is being studied, and whether or not other uncontrolled factors may be a confound to the degree of normalcy.[86] Additionally, small sample sizes, generally 4 to 20 subjects, are used due to the cost of running such experiments and availability of participants. To circumvent this problem, factors such as race are removed by using only white participants, further limiting the extrapolatory potential of findings.[87] For example, simple labels such as 'schizophrenic' and 'normal' occludes the fact that in a group of only right-handed white male participants in a certain age range, a non-white left-handed female participant's brain may look 'abnormal' as well.[88] Therefore, it might not be solely the 'schizophrenic' brain that looks different under those conditions, but any brain would be different if it was not in the range of traits attributed to the control or 'normal' subject.

When comparing data, the differences measured would suggest a region of activity, and therefore a place of significance when relating the experimental and control conditions. However, this aim for difference assumes that if a region is not activated, it is not involved in the neural process.[89] Thus, this subtractive approach and the ambiguous use of words like significance and difference, may yield misleading interpretations of a study by those outside the realm of experts.[90] The ability to normalize and then generate a comparative analysis from observed differences between a control and experimental brain needs to be carefully scrutinized before we give any enthusiastic interpretation of the findings.

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[86] Ibid., 198.
[87] Ibid., 201.
[88] Ibid., 204.
[89] Ibid., 207.
[90] Ibid., 209.

Once results are taken from the 'normal' and the 'abnormal' brain, they are averaged to do comparative analyses. In each group, the brain sets are normalized to each other, and an average group voxel is determined, to map a brain atlas showing an "average group brainset."[91] Comparing the 'normal' and 'abnormal' brain sets, via a subtractive method, would suggest the difference between these averaged voxels are essentially the difference between the groups. This ignores individual variability that might be of greater interest. When averaging is done before subtraction, the 'diseased' brain is averaged together, and then the differences between them are filtered out, then the same is done with a group of 'normal' brains. The resultant brain set would be the 'super-abnormal;' and the 'super-normal' brain. These extreme brain sets are subtracted from each other, and the difference incurred is interpreted as the significance between the 'normal' and 'abnormal' though they were taken from the initial differences within those sets themselves.[92] What difference is found through such a method is attributed to the areas involved in forming the 'abnormal' state.

Not only does this inappropriate extrapolation of significance from arithmetic difference by varied methods of averaging and subtraction happen at the level of individual experiments, but such information is also stored in databases of "human brain anatomy and function."[93] For example, The Human Brain Project was set-up with such a project in mind, with funding for BrainMap and the Probabilistic Atlas. The BrainMap integrates information from various studies that can be referred to for identifying anatomical locations, while the Probabilistic Atlas is used to reference brains without

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[91] Ibid.
[92] Ibid.
[93] Ibid., 210.

medical conditions across handedness, age, and gender among different populations.[94] Averaging, subtraction, and creating cross-referenceable databases remove individual variations, emphasizing similarities, and treating differences between a group as irrelevant.[95] The issue with such an approach is it assumes that these differences must be significant to the treatment or variable being explored. It negates the complex ways the brain functions whereby the same region may be involved in a varying number of behaviors.

Visualizing Differences and Exaggerating

Once voxels are averaged and subtracted the statistically significant differences need to be made visible. This is done by assigning a number to a shade of gray within a PET image: for example, 0 for black and 100 for white. However, when it may not be possible or be preferred to show varying shades of gray, a process called 'windowing' is applied whereby 0-10 would be black, 11-20 a dark gray, and so on. There are limitations if a majority of the variation occurs in a small range of 51-60 for example. This would be controlled for by adding gray variation to the smaller bands of 51-52, 53-54, and so on, while keeping the ranges of 0-50 black, and 61-100 white. For presentation purposes, windowing and color coding ranges of variation help the differences stand out. However, this overemphasizes the difference and may negate the overall similarity between two images.

To ease this issue, color may be used in the ranges where a majority of the variation occurs to make subtle differences visible. A sub-range can be set up as 1-20 is

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[94] John C. Mazziotta et al., "A Probabilistic Atlas of the Human Brain: Theory and Rationale for Its Development: The International Consortium for Brain Mapping (ICBM)," *Neuroimage* 2 (April 1995): 94.
[95] Dumit, "Brain Images," 210.

black, 21-40 is red, 41-60 is blue, 61-80 is green, and 81-100 is yellow. Depending on how each sub-range is colored, the same brain-set can look very different. Additionally, demarcating the place where a new color begins creates sharp boundaries instead of showing the more diffuse nature of change from one state to another. Unlike a heated-object color scale, the color-order used in PET image presentations are pseudo-colors that may not indicate whether transitioning from one color, such as from blue to yellow, may mean more intensity or difference.[96] Between labs, there may be preferred color schemes, emphasizing the lack of standardization to indicate where the variation is deemed significant, thus leaving it to the discretion and intention of the researcher to determine what they would like to emphasize.[97] Brian Murphy, a PET clinical physicist in the Department of Nuclear Medicine at State University of New York at Buffalo used copper plate 4 color scheme images on the same brain set to show that the same brain can be shown as normal, having a tumor, or indicating a stroke simply by using a different color scale.[98]

The tension is more apparent when significance is considered within the limits of an image and what is signifies, compared to a picture of differences at large. Though a difference may be visually presented or actually be a statistically different expression on a brain scan, there may not be any behaviorally significant consequence. However, publication of images that seem contrasting or visually suggest major difference can lead to misinterpretation about what the differences actually suggest due to the allure of the imagery. This can lead to issues where imaging technology is used to provide skewed

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[96] Ibid., 213.
[97] Ibid., 214.
[98] Ibid., 215.

accounts of the world at large. An expert may be able to contextualize the significance indicated in a study, but its more problematic when such information travels to the public. For example, a researcher may calibrate a brain image in order to show contrast between an experimental and control subject to clarify points of interest. However, if the image is taken out of context, the contrasts may be misleading.

The varying types of rhetoric used to describe McCann et al.'s research on MDMA users brings to light this issue. The study compared PET scans of 14 heavy MDMA users to 15 non-users. The authors' conclusion was, "these data suggest that human MDMA users are susceptible to MDMA-induced brain 5-HT neural injury ... Our data do not allow conclusions about reversibility or permanence of MDMA-induced changes in brain 5-HT transporter."[99] The brain images show the MDMA and non-user brains as heavily contrasted especially suggesting a deficiency in the MDMA brains. Robert Mathias, a staff writer for the National Institute on Drug Abuse (NIDA), in the caption of the image suggested causality by writing, "Dark areas in the MDMA user's brain show damage due to chronic MDMA use."[100] When presented to the US Senate Caucus on International Narcotics Control, the director of NIDA, Alan I. Leshner, testified, "Through the use of positron emission technology (PET), we can actually see that the brain images on top belongs to an individual who has never used MDMA… Clearly the brain of the MDMA user on the bottom has been significantly altered."[101]

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[99] Una D. McCann et al., "Positron Emission Tomographic Evidence of Toxic Effect of MDMA ('Ecstasy') on Brain Serotonin Neurons in Human Beings," *The Lancet* 352, no. 9138 (1998): 1436, doi:10.1016/S0140-6736(98)04329-3.
[100] Robert Mathias, "'Ecstasy'" Damages the Brain and Impairs Memory in Humans," Nida *Notes* 14, no. 4 (1999): doi:10.1151/V14I4bedtba.
[101] *Ecstasy, Underestimating the Threat: Hearing Before the Senate Caucus on International Narcotics Control*, 106 Cong., (July 25, 2000) (statement of Alan I. Leshner, Director of the National Institute on Drug Abuse), http://archives.drugabuse.gov/Testimony/7-25-00Testimony.html

This stands counter to what the authors of the paper initially argued in terms of "reversibility or permanence". The researchers never said such generous extrapolations could be taken or that ecstasy left unchangeable damage to the brain. However, the rhetoric of the contrasted brain states was powerful enough. In fact, the image was further altered with an artistically inverted and even more stunningly contrasted image in the "your brain on drugs" campaign propelled by the NIDA with full support from the US government. As a result, a movement began to control MDMA using faulty arguments taken from a rhetorically powerful publication of the study. Though this is not specifically the result of the authors falsifying their data or making egregious claims, they still created the potential for misuse through the visual rhetoric when presenting their data.

The study above, its initial evidence, and the exaggerated claims that ensued should indicate the power images and associated words, especially about brains, can have on the psyche of the public. Even though the authors acknowledged the limitations of their study, the control they have on media consumption and sensationalist consequences and even what can be done in public policy, such as with the NIDA, is limited. Even then, when it comes time to publish, at times for the purposes of making a point, scientists may tend to use extreme images and words.

Kuhn et al. (1982) admitted that in their experiment studying the effects of aging on the brain, the two comparative images they used were chosen because they were "the extremes of [the] ratio."[102] Dumit interviewed Phelps, one of the authors of the article, who admitted, "See we take the extreme cases for the readers to be able to see them. You

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[102] David E. Kuhl et al., "Effects of Human Aging on Patterns of Local Cerebral Glucose Utilization Determined by the [18F]Fluorodeoxyglucose Method," *Journal of Cerebral Blood Flow and Metabolism* 2, no. 2 (1982): 168, doi:10.1038/jcbfm.1982.15.

have the tabulated data to look at all cases. It is fine."[103] No, it is not fine. As exemplified by the consequences following the brain on ecstasy evidence used in the rhetoric by the NIDA, the public does not have the expertise, or for that matter the patience, to delve through the statistics to critically evaluate a study. Richard Haier admits that though research conclusions are based on statistics, "Most of the time, although not all the time, we include a color picture, because journals like color pictures, everybody likes color pictures- and that is what they remember."[104] For the lay-person, as Phelps and Hair admit, the contrasting, direct, simplified, and colorful images are what will communicate what they should know or even care about when looking at a brain study.

The benefit of producing such extreme images is not simply for the sake of making research findings digestible. There is usually a monetary benefit to be gained as well. Science unfortunately does not function in an ivory tower where researchers pursue their interests independent of practical concerns or consequences. Pharmaceutical companies, the Food and Drug Administration, and the National Institute of Health are just a few agents that provide grants and regulate the scope and direction of research that scientists pursue. Dumit cites a researcher at a pharmaceutical company who admits "...we found that most of our pharmaceutical contracts really came through the PR departments, the advertising departments, not through the science departments. And they were after pretty pictures to put in the ads, which apparently worked, and worked well."[105] There are a lot of issues that can be delved into critiquing neuroscience and medicine on this point alone. However, I will do this more substantially in a later section on how capitalistic tendencies

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[103] Dumit, "Brain Images," 219.
[104] Joseph Dumit, "Twenty-First-Century PET: Looking for Mind and Morality through the Eye of Technology," in *Technoscientific Imaginaries: Conversations, Profiles, and Memoirs*, ed. George E. Marcus (Chicago: University of Chicago Press, 1995), 105.
[105] Dumit, "Brain Images," 220.

in the sciences benefit from demarcating the 'normal' and 'abnormal' through neuro-hyped rhetoric that is rooted in a push to medicalize a public that strives for 'normality'. We see that the researcher's confession above highlights one of the sources which places pressure to submit attractive images in order to strongly communicate a certain message which may consciously or unconsciously have affected the author's choice of rhetoric. This may go beyond what is scientifically valid and then overshadow the limitations indicated by the more formidable, though arithmetically dull statistics.

So far I have described how beginning from the selection of participants, to testing methods, to publication, to consumption, neuroscience is riddled with problems that prevent it from living up to the explanatory authority it is conferred with. The main issue I hoped to highlight was the concern around seeking difference and going to great lengths to ensure that people are convinced that such differences exist. Additionally, I hope to indicate that differences that are being sought and communicated are influenced by the social agendas of scientists and their funders. I am not denying that there are going to be different brain states that manifest in the varied anatomical and behavioral phenotype between two brain samples from different groups. However, a maintained effort to look for difference, where that difference may not be relevant or not as extreme as one might expect, can lead to a poor empirical enterprise. There seems to be an underlying assumption that if no difference is found in a study, or if the presentation of information is not 'significant', eye-catching, or enlightening, then there must be an issue or the study was incorrect, not worthwhile, or good enough. This aim for difference is not only present in the experimental and publication procedure in the neurosciences, but also drives decisions about what is left unpublished and unsaid as well.

Publication Bias

In the scientific community, the drive to publish studies that find significance can lead to a shift in the arguments made in the literature at large. Therefore, a shift in a biased attitude that looks at differences may result in meta analysis suggesting that certain findings are more important than they may actually turn out to be. This issue then manifests itself in publication bias. One type of publication bias familiar in the empirical sciences is the case of the file-drawer study, where studies are left incomplete or are not published because no-significant or hypothesis confirming results are found. However, there are many other ways the integrity of scientific literature can be compromised, and I will outline them below. Publication bias is a concern not only where it may be a threat to clinical practice and practical applications. Neuroscientific research that explores social identities such as gender, sexual orientation, and race may be compromised by biases looking for difference-reaffirming stereotypes and giving opportunity to further marginalize groups. Though the analyses on the current state of publication bias outlined below looks at medical publications at large, I would argue neuroscience as well is susceptible to such issues because neuroscience is an empirical enterprise closely tied with clinical enquiry.

With the pressure to find difference there is a tendency for grey literature, i.e. research that is not-conclusive or does not agree with a widely held hypothesis, to go unpublished. The Health Technology Assessment (HTA) program as part of an initiative of The National Institute of Health Research looked into whether or not these tendencies affect the current state of literature in medicine. They analyzed literature from MEDLINE, EMBASE, AMED, CINAHL, PubMed, PsycINFO and Open SIGLE. In the first part, they classified studies either as evidence or method and separated them

according to the types of dissemination bias or methods to deal with it.[106] In the second part 200 review articles were randomly selected from MEDLINE and their methods to confront biases were assessed as well.

In general, what the authors of this paper found was that studies with positive, hypothesis-confirming, instead of negative results were more likely to be published. As a result, when such papers were aggregated into review articles, a condensed publication of all relevant literature in a topic, the result was that such reviews were biased as well. Research with significant results were published earlier than those with non-significant results, and these earlier papers also suggested greater treatment effect as well, further biasing the literature. These biases can generally be controlled through locating unpublished studies, funnel plots analyses, sensitivity analysis modelling, and confirmatory large scale trials. Unfortunately, these precautionary methods are not fully able to account for contradictory research that may not be easily accessible, and more powerful analysis methods may need to be applied or devised to detect and control for such biases. Even then, it may be too late to retract literature before it can bias the general attitudes both in the sciences and in the public view in terms of policy and the capabilities of science.

The researchers found evidence of various types of bias affecting the literature. Outcome reporting bias is when there is incomplete reporting due to reporters only showing some of the outcomes measured to get statistical significance.[107] Chan et al. recorded reported and unreported outcomes on approved protocols by the Canadian

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[106] Fujian Song et al., "Dissemination and Publication of Research Findings: An Updated Review of Related Biases," *Health Technology Assessment* 14, no. 8 (2010): iii, doi:10.3310/hta14080.
[107] Ibid., 21.

Institute of Health Research from 1990 to 1998, and did a meta analysis to see the completeness of outcome reporting within the study. They found that of the 48 published, only 22 trials provided information about the statistical significance of unreported cases.[108] Many other cohorts analyzed in the HTA study found similar results showing exclusion of trial studies before publication.

Time lag bias is when the direction and strength of results determine how quickly something is published. Reasons for this include time to develop a proposal, ethics committee approval, funding, participant recruitment time, follow-up with participants, submission to journals, and peer-review time.[109] One of the cohorts in this analysis included a survey of 218 studies by Stern and Simes approved by a hospital Ethics Committee in Australia. They found that the median time for granting ethical approval was 4.8 years versus 8.0 years for studies with significant vs. null findings respectively (HR 2.32; 95% CI: 1.47 to 3.66). Four of the five cohort studies on time lag bias did not find a significant association for time to publication and study results, but this may be due to a small and diverse sample size. For the six studies of time from abstract presentation to full publication, three of the studies found significant time lag bias. With this, the authors conclude that studies with significant results are generally published before studies with nonsignificant findings.[110] The reason this is an issue is that it could put pressure on researchers to publish only significant results so as not to compromise the potential for funding and financial growth necessary to maintain their labs. Knowing that there may be delayed support from publication and approval committees could result in non-

[108] Ibid., 138.
[109] Ibid., 24.
[110] Ibid., 26.

significant findings being unpublished or delayed in publication. One of the consequences could be that a false positive may be published earlier, and may affect a policy that may then have to be retracted once the delayed null results show that such claims made by an earlier paper may not be as conclusive as once presumed.

Grey literature may be published or unpublished research which includes material that is not controlled by commercial publishers, including brochures, conference abstracts, ongoing research, dissertations, etc. The authors ran multiple meta-analyses and reviewed case studies on gray literature to find indications of bias.[111] They found that the most common form of unpublished literature comes from conference abstracts. Grey literature effect in meta-analysis is generally small, there are occasions in which its presence or absence could introduce bias. Therefore, it is still a concern when evaluating effects of unpublished or generally uncontrolled work on the scientific climate.[112]

Citation bias is when the study's result is associated with the probability that it will be cited. In one of the cohorts, Chapman et al. analyzed citation frequency of studies of smoking among schizophrenia patients.[113] They found a 10% increase in smoking prevalence was associated with 61% increase in citations. Niemien et al. (2007) looked at 368 papers in psychiatric journals and found that the ratio of citation was 1.63 for studies with significant results, and found that citation rate was related to *p*-value.[114] By analyzing the various cohorts evaluating citation bias, the authors found that generally positive results were associated with higher frequency of citation. In the sciences, the integrity of a

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[111] Ibid., 26.
[112] Ibid., 27.
[113] Simon Chapman, Mark Ragg, and Kevin McGeechan, "Citation Bias in Reported Smoking Prevalence in People with Schizophrenia," *Australian and New Zealand Journal of Psychiatry* 43, no. 3 (2009): 278.
[114] Pentti Nieminen et al., "Statistically Significant Papers in Psychiatry Were Cited More Often than Others," *Journal of Clinical Epidemiology* 60, no. 9 (2007): 942.

journal and a laboratory is associated with the number of citations it gets. If there is a self-perpetuating cycle where those with more citations rising to the top of a database search, further research could be skewed toward a certain topic and undermine contradictory results could be undermined.

Duplicate publications are when similar articles or data are submitted to more than one journal.[115] An estimated 10-25% of biomedical publications are redundancies sharing similar hypotheses, methods, results, or discussion. These may be covert, without reference to parallel literature, or overt, with proper referencing to original reports.[116] Easterbrook et al. (1991), found that studies with significant results, in contrast to non-significant results, were more likely to have multiple publications and show up in 'high citation impact factor' journals.[117] Additionally, the muddled nature of poor citations and repetition of information was admitted by Huston and Moher (1996), who had difficulty finding single centers of multicenter trials of risperidone for schizophrenia, because of poor transparency and citations of abstracts and unpublished reports.[118] They found a North American trial for risperidone had been cited in six publications using different author names and had been cited in many unpublished forms.[119]

Data indexing bias is when there is a biased indexing of studies in literature databases. Some databases such as MEDLINE and EMBASE may not index all studies on a particular topic. Zielienski (1995) estimates that 98% of indexed journals are from

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[115] Song, "Dissemination," 32.
[116] Ibid., 33.
[117] Phillipa J. Easterbrook et al., "Publication Bias in Clinical Research," *The Lancet* 337, no. 8746 (1991): 867, doi:10.1016/0140-6736(91)90201-Y.
[118] Patricia Huston and David Moher, "Redundancy, Disaggregation, and the Integrity of Medical Research," *The Lancet* 347, no. 9007 (1996): 1024, doi:10.1016/S0140-6736(96)90153-1.
[119] Ibid., 1025.

developed western countries.[120] Nieminen and Isohanni (1999) found a bias against Finnish journals where 27% of psychiatric research published in English was not indexed in MEDLINE.[121]

There are various recommended methods for reducing publication bias. These include literature searching to identify all the studies relevant to a specific review question, locating unpublished trials through careful internet searches, assessing the risk of bias such as by identifying if all trials are funded by a single entity, and using a funnel plot which would skew in shape if chance of publication is greater for statistically significant results. Additional statistical methods similar to the funnel plot may be used as well. Another way to reduce bias is by updating systematic reviews with new findings and controlling for biased literature in meta-analyses.[122] Though these preventive methods may be used, it is difficult to control the pressure to publish significant results and the skewed perceptions and beliefs that may occur once information is popularized and demanded in its biased perspective by the public.

Because the general public gets its information through popular media, the press and how it presents developments in the sciences can have a powerful influence. This phenomenon is called media attention bias and is perpetuated by newspapers, magazines, radio, television and the internet.[123] Whiteman et al. (2001) assessed the citation frequency of studies in popular media that either do or do not support an association between hormone replacement therapy (HRT) and breast cancer. Of the 32

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[120] Christopher Zielinski, "New Equities of Information in an Electronic Age," *BMJ* 310 (June 1994): 1480.
[121] Pentti Nieminen and Matti Isohanni, "Bias Against European Journals in Medical Publication Databases," *The Lancet* 353, no. 9164 (1999): 1592.
[122] Song, "Dissemination," 57-68.
[123] Ibid., 35.

publications, 63% had positive conclusions about HRT and breast cancer association. However, of the 203 citations in popular media 82% showed positive studies, signifying an excess of citations ($p < 0.01$).[124] Koren and Kelin (1991) looked at American newspaper coverage for both a positive and negative study reporting association between radiation exposure and cancer. They found that nine of the 19 reports covered only positive studies, and the other 10 reports that covered both positive and negative had on average 354 words pro positive results versus 192 for negative ones.[125]

The varying sources of publication bias and the way it can be fueled by public perception is concerning because it weakens the trust we can have in available empirical evidence. Unfortunately, a startling number of scientific studies may be susceptible to such bias and may push the trajectory even further. It is more likely for a research enterprise to be false than true. Therefore, its perceived accuracy, through citation increase and enumerated publications, may just be accurate measures of a prevailing bias. John P.A. Ioannidis published an essay titled "Why most Published Research Findings Are False" and drafted an outline suggesting the possible sources that promote such biases. He found that the smaller the studies conducted and the smaller the effect size, the less likely the findings are true.[126] The greater the number and the less variety in the types of tested relationships, the less likely the findings are to be true.[127] Even the more flexibility, therefore ambiguity with less standardization, in design, definitions, outcomes,

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[124] Maura K. Whiteman et al., "Media Coverage of Women's Health Issues: Is There a Bias in the Reporting of an Association between Hormone Replacement Therapy and Breast Cancer?," *Journal of Women's Health & Gender-Based Medicine* 10, no. 6 (2001): 573-75.
[125] Gideon Koren and Naomi Klein, "Bias Against Negative Studies in Newspaper Reports of Medical Research," *The Journal of the American Medical Association* 266, no. 13 (1991): 1825-1826.
[126] John P. Ioannidis, "Why Most Published Research Findings Are False," *PLOS Medicine* 2, no. 8 (2005): 0697, doi:10.1371/journal.pmed.0020124.
[127] Ioannidis, "Why Most Research," 0698.

and analysis you give the more likely you can make a negative result into a positive one. And to confirm what I have illustrated above with the financially driven pressures, Ioannidis described that the more financial and other interests/prejudices invested, the less likely the findings are true. The reason may be because of research priorities being tied to marketing and advertising rather than finding sound research that supports an honest treatment effect. Even when research is booming in a field, the more scientific teams involved, the less likely the research is true. Though this may seem paradoxical, this may be because of the competitive nature reducing the stringent rigor and constant analytic precaution that should be taken to ensure accurate results. This may then suppress negative results, unless a competing team has produced a 'positive' result worth countering. The reason evaluating the state of such biases is important is to realize the not-so-perfect nature of the sciences. I hinted at various ways research may be compromised with rhetoric, financial concerns, and publication biases exist in current literature. When I explore how research into gender, sexual orientation, race, or by extension any marginalized identity, is approached, I hope to highlight integral issues in such findings further below. By doing so, I hope to show that extrapolated arguments from such biased research can perpetuate issues instead of bringing liberation to certain identities. This would be just one of the limitations of neuroscience, as an empirical enterprise, when considering how it can inform us, if at all relevantly, about social identities.

I have illustrated the varying ways neuroscience, as a scientific field, may be susceptible to major issues in its empirical enterprise. It is not a study that has the luxury of being isolated in an ivory tower. Instead, the enterprise is fueled by social concerns in medicine, psychology, designing artificial intelligence, and understanding of the self.

Therefore, there is money to be gained by exploiting such research, and unfortunately it is these money-churning machines and industries that provide the resources to scientists to pursue their work.

At a clinical level, where most applications of neuroscience end up, the concerns of poorly controlled and biased studies are apparent. For example, the overrepresentation of positive results in basic research studies in animal models show discrepancies when compared to efficacy demonstrated in clinical studies. Macelod et al. (2004) did a systematic review on nicotinamide research. The effect size in animal studies was larger (effect size 0.306; 95% CI: 0.241 to 0.371) than was shown in abstract form (0.162; 95% CI: 0.066 to 0.258).[128] This means that the treated animals showed more improvement in comparison to the treatment effect on control animals in terms of tissue volume and other neurological scores. Epidemiological studies have found issues with inconsistencies as well in terms of risk of using items like hair dyes, coffee, and presence of DDT metabolites in the blood stream, Ioannidis and Trikalinos argue that this may be because "highly contradictory results are most tantalizing and attractive to investigators and editors."[129] In clinical settings, a new intervention that may be considered more efficacious due to publication bias would cost more even if it provides little in terms of improvement

In clinical trials, a study showing a treatment is harmful that is left unpublished may lead to such trials being repeated by other investigators on other patients, putting them at risk. For example, a trial of using lorcainide in patients with myocardial

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[128] Malcolm R. Macleod et al., "Pooling of Animal Experimental Data Reveals Influence of Study Design and Publication Bias," *Stroke* 35 (April 2004): 1205-06.
[129] John P. Ioannidis and Thomas A. Trikalinos, "Early Extreme Contradictory Estimates May Appear in Published Research: The Proteus Phenomenon in Molecular Genetics Research and Randomized Trials," *Journal of Clinical Epidemiology* 58, no. 6 (2005): 543, doi:10.1016/j.jcline pi.2004.10.019.

infarction found that the treatment group suffered more deaths than the placebo.[130] The trial was not published due to the disbandment of commercial lorcainide use. However, a decade later patients treated with related chemicals of the same Ic antiarrhythmic family, encainide and flecainide, showed greater mortality rate. If the original study had been published, those following trials could have been avoided. In 2004 Rofecoxib was withdrawn because of increased risk of myocardial infarction and stroke indicated by unpublished data. Similarly, Pasty and Kronmal found biases on clinical trials of rofecoxib for cognitive impairment and Alzheimer's disease. The drug, with its dangerous side-effects, had been distributed to 80 million patients before the study. In 2003 GlaxoSmithKline faced legal charges due to concealing unpublished clinical findings of an increase in suicidality and aggression induced by paroxetine, an SSRI antidepressant, on children with depression.[131] These cases indicate the grave clinical effects of publication bias over-representing the positive efficacy of certain drugs and treatments. Additionally, the integrity of scientific research is undermined in the public eye. However, these issues still plague the scientific community even after large pharmaceutical companies are revealed to manipulate the industry, falsely advertise, or research is shown to be either incomplete, skewed, embedded with vested interest, or inconclusive. The consequence on the health care system, public policy, and our idea of what science can do for us and answer about the mystery of the universe is also skewed. Though I have elaborated on the clinical consequences of biomedical research, I am more interested in the underlying issues as to why science is seen as the 'explanatory holy grail', the power it

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[130] A. J. Cowley et al., "The Effect of Lorcainide on Arrhythmias and Survival in Patients with Acute Myocardial Infarction: An Example of Publication Bias," *International Journal of Cardiology* 40, no. 2 (1993): 163, doi:10.1016/0167-5273(93)90279-P.
[131] Owen Dyer, "GlaxoSmithKline Faces US Lawsuit Over Concealment of Trial Results," *British Medical Journal* 328, no. 7453 (2004): 1395.

can wield with its air of truthfulness, and more importantly how that truthfulness can be skewed in favor of encouraging certain social biases.

Stereotype Threat

The sciences, as I have elaborated above, have the ability to reduce issues and naturalize them while negating overlying phenomena that may not be fully accounted for or be informed about within empirical evidence. Additionally, sometimes this claim to explain phenomena that is outside the reach of scientific research can have problematic consequences. I would consider social biases against marginalized groups to be a phenomenon that is reaffirmed by neuroscience's perceived explanatory power. Below, I will elaborate how neuroscience is used to power over marginalized groups by naturalizing their differences as biological fact, while negating the social effects that may come into play.

Stereotype threat is a predicament where people feel at risk of conforming to social stereotypes.[132] Stereotypes are informed by public assumptions of a social groups ability to perform on certain tasks. Therefore, if neuroscience participates in demarcating where certain groups, either males or females, excel at certain cognitive functions, it can affect the performance of each group based on the expectations placed on them. Nosek and Banaji (2002), found that there are associations between self identity based on sex and personally associating or identifying with mathematics. They gave Implicit Association Tasks (IAT) to evaluate identity, implicit attitudes in relation to mathematics,

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[132] Toni Schmader, Michael Johns, and Chad Forbes, "An Integrated Process Model of Stereotype Threat Effects on Performance," *Psychological Review* 115, no. 2 (2008): 336, doi:10.1037/0033-295x.115.2.336.

and stereotypes.[133] They found that both males and females showed strong identification with their gender group, and both showed negative attitudes with math.[134] However, men showed less negative attitudes and stronger identification with math and science concepts compared to women. This then translates to gendered major choices in college, with men more present in the hard sciences and women in the arts, due to weak personal association of one's gender identity with specific fields[135]. Nosek et al. argue that this may be because once one strongly identifies with their gender and are socialized into gendered preferences, they follow through with performance and expectations of their social group.[136] Therefore weak and negative personal association of women with mathematics may affect their ability to see themselves perform as well as men because of gendered expectations.

Schamder et al. (2008) conducted experiments to see the what psychological mechanisms are implicated in stereotype threat scenarios. They argue that stereotype threat impairs prefrontal processing, leads to monitoring performance and overall self-regulation.[137] In essence the stress of being cognizant or in the presence of stereotype inducing situations leads to disruption of cognitive performance. In one of their experiments they tested the negative stereotypes of math performance on women. Participants were given a working-memory task where they counted the number of vowels in a sentence followed by a 20-minute math test. In the control-condition women

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[133] Brian A. Nosek, Mahzarin R. Banaji, and Anthony G. Greenwald, "Math = Male, Me = Female, Therefore Math ≠ Me," *Journal of Personality and Social Psychology* 83, no. 1 (2002): 47, doi:10.1037//0022-3514.83.1.44.
[134] Ibid., 52.
[135] Ibid., 57.
[136] Ibid., 58.
[137] Schmader, Michael Johns, and Chad Forbes, "An Integrated Process," 350-52.

learned they would preform the task in an all female setting, while in the experimental, stereotype threat condition they learned they would be performing in an all-male setting. In the stereotype threat condition women performed significantly more poorly compared to the control, suggesting a compromise on working memory that is needed for math performance.[138]

There have been multiple experiments that show similar effects of stereotype threat affecting performance. Krendal et al. (2008) used fMRI to study the neural mechanisms underlying women's underperformance in math. They used 28 right-handed female participants from Dartmouth College, with half in the experimental and half in the control.[139] They were first given an Implicit Association Task (IAT) to categorize words such as 'flowers' and 'pleasant' or 'insects' and 'unpleasant' respectively.[140] Then they were given 50 difficult math equations and had 5 seconds on each question to determine if they were true or false via key press.[141] After finishing the first set of problems, the participants were told either "'research has shown gender differences in math ability and performance'" for the experimental condition or "'individual differences in how personal attitudes. . . modulate performance on cognitive tasks'" which had no reminder of gender stereotypes.[142] With this they were given an IAT corresponding to either math/arts or liberal/conservative respective of their experimental condition and then given another 50 math problems.[143] The participants performed the task while

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[138] Ibid. 341
[139] Anne C. Krendl et al., "The Negative Consequences of Threat: A Functional Magnetic Resonance Imaging Investigation of the Neural Mechanisms Underlying Women's Underperformance in Math," *Psychological Science* 19, no. 2 (2008): 169, doi:10.1111/j.1467-9280.2008.02063.x.
[140] Ibid.
[141] Ibid.
[142] Ibid., 170.
[143] Ibid.

inside an fMRI scanner. The results showed that women who were reminded of sex differences in math ability underperformed when compared to women in the control condition, who improved, in the second test. This was consistent with findings in previous literature. The fMRI analyses showed that women in the control condition showed activation in regions associated with mathematical computations, calculations, spatial representation of numbers, and mental rotation.[144] These regions were mostly in left angular gyrus, and in the caudate, thalamus, and cerebellum for difficult tasks. Women in the stereotype threat condition did not show recruitment to the above mentioned areas. Instead, they showed activity in the ventral Anterior Cingulate Cortex (vACC)[145]. This region is implicated in emotion-regulation, social feedback, social rejection, and generally in processing negative social information.[146,147] Krendal et al. suggest that activation of the vACC during stereotype threat may compromise recruiting other neural networks, specifically those involved with working memory in mathematical learning. Thus, the issue may be there is a cognitive load from being made aware of stereotypes that compromises performance rather than an innate incapacity to perform.

Likewise, Wraga et al. (2006) looked at fMRI scans to see which brain regions were implicated in stereotype-induced shifts in mental rotation performance. Fifty-four right-handed women from Dartmouth College were tested on a mental self-rotation task where they had to imagine themselves rotating in relation to a 3D multi-cubed object and

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[144] Ibid., 172.
[145] Ibid.
[146] Ibid.
[147] Leah H. Somerville, Todd F. Heatherton, and William M. Kelley, "Anterior Cingulate Cortex Responds Differentially to Expectancy Violation and Social Rejection," *Nature Neuroscience* 9, no. 8 (2006): 1008, doi:10.1038/nn1728.

indicate at which rotational point they would be able to see the cue.[148] Eighteen participants were placed in a positive-stereotype condition where they were informed women performed better in imagined self-rotation tasks.[149] Nineteen participants were in a negative-stereotype condition where they were informed men perform better on imagined self-rotation tasks. And 17 participants were placed in a control condition where they received neutral information. RT was measured on correctly identifying the spatial-rotation, and the participants were scanned in an fMRI scanner during the tasks. They found that the mean-proportion error on the self-rotation trials was the best for the positive message, average for the neutral message, and the worst for the negative message.[150] The fMRI results showed that the negative stereotype activated the left rostral-ventral anterior cingulate which, as mentioned in the study above, is associated with processing negative emotions. Additionally, the right orbital gyrus, which is associated with storing knowledge of interpersonal relations such as gender stereotypes, and emotions of embarrassment and shame, was implicated.[151] In the positive-control the superior occipital gyrus, implicated in visual imaging, and the anterior PFC, implicated in complex cognitive processing showed increased activity.[152] Wraga et al. argue that this poorer performance may be due to increased emotional load in the negative-control, with neural processing expended in coping with stereotype threat and not at performing the task at hand.[153]

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[148] Maryjane Wraga et al., "Neural Basis of Stereotype-induced Shifts in Women's Mental Rotation Performance," *Social Cognitive and Affective Neuroscience* 2, no. 1 (2006): 13, doi:10.1093/scan/nsl041.
[149] Ibid.
[150] Ibid., 15.
[151] Ibid., 16.
[152] Ibid., 18.
[153] Ibid.

Considering the effects of stereotype threat on cognitive functions, the issue becomes whether neuroscientific studies that hope to compare the differing mathematical or spatial-ability capacity between men and women are measuring innate differences or varying performance induced by gendered stereotypes. If neuroscientific evidence that suggests women, or any other marginalized identity, are inferior in some mental capacity, that information may then feed into stereotypes further exacerbating the issue.

An Inquiry into Difference

The evidence provided when naturalizing differences may have scientific validity, in the sense that it has been conducted in accordance with scientific standards. However, this does not mean it is free from being riddled with biases, such as those mentioned above, due to a neuroscientifically ambitious endeavor to explain why certain people are the way they are. My goal will be to exemplify this by looking into neuroscientific literature that argues that these natural differences, if there are any, suggest the discrimination, powering-over, and dehumanizing effects society perpetuates. I will specifically focus on naturalistic arguments used against women.

I suspect that the inconsistencies, methodological weaknesses, rhetorical biases, and publication biases are not only indicators of a need to explore difference. Additionally, because these concerns are already prevalent, the scenario can be further exacerbated through a self-cycling and self-intoxicating process that exaggerates more biases within the sciences. By exploring the historical trend of both cultural, medical, and neuroscientific literature surrounding how marginalized identities have been naturalized, I will hopefully indicate that this trend to look for difference is present. I also want to show that not only does it exist, but that it is especially damaging because it uses an

empirical evaluation to 'other' someone, due to the power the infallible tinge and explanatory power associated with science.

There are social realities that define difference between people. When looking at the 'other' there are qualities that make them different. Not only is it the spatial, temporal, and physical difference from the self and the other, but there are also more corporeal factors such as sex, phenotype, skin color, physical ability, mannerisms and other phenotypically visible identifiers that create difference. In addition, there are less visible differences that may occasionally manifest themselves through social interaction such as queer genders and sexualities, and the mentally deviant. The reason such social stratifications that arise are relevant is because their defining factor that makes them the different from those in power, the normal, or the majority, leads to their being marginalized and powered over.

The way the marginalized are powered over can come through many arguments that propose their innate inferiority. This inferiority can be described as an illness or an unchangeable, and dooming difference. If the 'other' is inferior, the dominant identity have power over them. Therefore, the dominant identity can do what it is in the 'other's' best interest with a paternalistic attitude or they can determine that the 'other's' difference is so debilitating that they be exterminated, controlled, or enslaved for the benefit of the dominant group. I will engage the historical process of how this has worked in the past as I delve into specific identities that I will cover in sections below. Therefore, by arguing inferiority, power can be gained. Specifically, intellectual inferiority can be used to power-over. By describing the 'other' as intellectually or mentally inferior, the dominant group can strip them of their agency, which is traditionally rooted in rationality.

The reason neuroscience is relevant to this dynamic of creating the the 'other' is because neuroscience is assumed to have the ability to empirically demarcate who is intellectually superior and who is intellectually inferior by describing brain states. We already do this by citing evolutionary stages of cephalous development to determine which animals are superior and which ones are inferior. And more importantly, this translates into how we prioritize the treatment of some animals. Likewise, for those who wish to argue to power over a marginalized group, this would therefore be a powerful tool to negate the full humanity of the 'other'. Considering the methodological issues, rhetorical biases, publication biases, the competitive nature of the field, ambitious enterprise to explain beyond the questions appropriate for the sciences, and the quest for novelty and difference, neuroscience may be a useful tool for those who wish to confirm their arguments against the marginalized. By exploring the historical trend of the neuroscience and the current state of literature that explores difference between a dominant and a marginalized group, I will hope to demonstrate that neuroscience is a powerful social force that helps power over the 'other'.

Chapter Three

Neurosexism

In this section, I will first explore the origins of gender, and what gender theorists have to say about this social identity. Considering this I will focus on the two clearly identifiable and globally acknowledged binary genders, woman and man. Recognizing that other genders may exist, I will focus on the specific binary power differential between men and women that dominates the larger discourse around gender inequality. However, I will highlight the ambiguity in defining gender as I elaborate some theories to argue that gendered qualities are mostly socialized and cannot be naturalized purely to biological states. Of course, women and men also are assigned to the major biological sexes of female and male respectively. Because of this, arguments of biological variations between sexes may be used to reaffirm gendered stereotypes and propagate sexism, specifically targeting women. My goal is to explore if this trend in neuroscience currently exists, and if it does, what is the impact it can have on the lived experiences of women.

I will elaborate the historical trend of sexism in the sciences and its predecessors, to demonstrate the impact such work has had on naturalizing gender differences. I will then explore modern-day research in the neurosciences and the public consumption of such information to demonstrate how sexist stereotypes are reaffirmed. I will distinguish between productive scientific literature that explores sex-specific neural variances and the studies that further complicate things to argue for either the inferiority of women or the differential treatment of the sexes in places where such difference may not even be necessary, or could possibly be detrimental. By bringing to light some distinctive qualities between these two approaches within research, I hope to demonstrate how current

neuroscience, and the social power it has to naturalize and claim normative authority, could be a dangerous tool that may be misused to oppress women. I will acknowledge that though a majority of the research exploring sex does not intend to be sexist, the susceptibility is still there to propagate biases. Neuroscience can be argued to suggest intellectual superiority or inferiority by comparing brain states between the sexes. Additionally, though the current research will most likely not be as explicitly sexist relative to the arguments made in the age of medieval anatomy, physiology, psychiatry, phrenology, craniology and other such fields, once you get past the neuroscientific jargon, the underlying biases and implications become clearer.

What is Gender?

Sex is distinct from gender, though it is easy to misconstrue them. Some feminist theorists would say that sex denotes biological female and male as defined by producing large (eggs) or small (sperm) gametes, differing sex organs, and other dimorphic physical features. Gender on the other hand denotes men and women based on their social upbringing as defined by their roles and behavior. The word gender was previously exclusively used to define words and whether they were feminized or masculinized. An example of this would be the *el* and *la* articles used in Spanish to indicate masculine or feminine noun respectively.[154] When psychologists started doing research on trans-people in the 1960s, the distinction needed to be made to demarcate biological versus the masculine or feminine attributes of a trans person.[155] Therefore, sex began to be used for biological traits, while gender expressed femininity or masculinity in behavior. The

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[154] Linda Nicholson, "Interpreting Gender," *Signs: Journal of Women in Culture and Society* 20, no. 1 (1994): 80.
[155] Robert J. Stoller, *Sex and Gender: The Development of Masculinity and Femininity* (London: Karnac Books, 1984), 177.

confusion between these terms comes from the fact that in general a person's assigned or identified gender matches their biological sex.

There are undeniable physical differences between the sexes, be it gametes or more macroscopic with sex organs and secondary sexual features. The reason some feminist theorists have pushed to make a distinction between sex and gender is to avoid the limitations for female liberation that can be made through arguments of biological determinism. Biological determinism is the belief that someone's genes or physiological makeup determines their behavior.[156] And this defines their appropriate opportunities and roles in society. This claim limits the amount of political and social progress women could make to improve their social status in society if their feminine condition is considered biologically inevitable. Considering the natural facts of sex differences, Gayle Rubin, an anthropologist, proposes that gender occurs in the social intervention and shaping of the interactions between the biological sexes in what she calls the sex/gender system.[157] Because gender is the social layer imposed on sex, by potentially eliminating gender, but not sex, we can eliminate how women are oppressed into taking the subordinate role in society.[158] This proposal recognizes sex as an immutable difference, but calls to eliminate the social difference that is not a necessary component to one's physical identity.

If differences exist between two categories of people, they do not become a problem until there is a power differential that arises, and one group faces inappropriate discrimination for being part of a marginalized category. If sex is that category on which

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[156] Stephen Jay Gould, *The Mismeasure of Man* (New York: Norton, 1981), 52.
[157] Gayle Rubin, "The Traffic in Women: Notes on the 'Political Economy' of Sex," in *Toward an Anthropology of Women*, ed. Rayna R Reiter (New York: Monthly Review Press, 1975), 165.
[158] Ibid., 204.

one is discriminated against, it would be called sexism.[159,160] The belief in biological determinism is one of the major hindrances to the social liberation of women due to the resulting arguments that can be made concerning why women may not deserve certain rights or opportunities. This is the main argument that plays out in the sciences where research seems to propose a normative end on what to make of sex differences between males and females. The information gained from such explorations can be used to further perpetuate gender norms. In the section below, I will show how biological determinism as a historical phenomenon has continued into modern day scientific programs and affects neuroscientific research that explores sex differences.

The History of Misogyny from Myth to The Early Sciences.

Before I go into early arguments of sex differences, I will outline the epistemological heritage of the Western world to demonstrate that sexist beliefs have existed since the beginnings of this culture, and are deeply rooted in various belief systems. Acknowledging this history is important because the culture we are socialized into shapes the concerns, assumptions, and beliefs we apply in our daily life. Even if a researcher is trying to be empirically sound, the cultural context of a scientific enterprise is still susceptible to biases.

Ancient Western creation mythology is riddled with misogyny. A closer look at such stories highlights the foundations from which the inherent intellectual inferiority of women was argued. In the Abrahamic tradition, the story of Adam and Eve demonstrates

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[159] Ann E. Cudd and Leslie E. Jones, "Sexism," in *A Companion to Applied Ethics*, ed. R. G. Frey and Christopher Heath Wellman (Malden, MA: Blackwell Publishing Ltd, 2003), 104.
[160] Again, the word sexism and its social usage may not always encompass the nuances of discrimination faced by non-binary or even trans people. However, as I mentioned above, the focus here will be on how women as a gender in the classical gender binary model face discrimination.

women's secondary position. Eve is made from Adam's rib, always to be at his side. She is not much more than a component of the larger part that he is. Her status in society is further reduced when she succumbs to the serpent's temptation and eats from the Tree of Knowledge. The result of her persuadability, arguably a mental weakness, leads to the exile of mankind from paradise.[161] This theme of women's intellectual weakness is seen in Greek mythology as well. Pandora, the first woman, is given a jar containing all the evils of the world. She is instructed not to open it, but her curiosity gets the better of her. She opens the jar, releases all the evils, and thus dooms mankind to a life of suffering.[162] Again, the theme of disobedience, temptation, and by extension intellectual inferiority seem to be the foundations on which the modern-day views of women have emerged. I would argue, based on ancient social practices, that these were the first attempts to subordinate women calling to the ethos of creation and divine dictate to naturalize woman's place in society. With such stories ingrained into Western culture, the intellectual superiority of men and the inferiority of women is believed to be the natural norm which fortifies a patriarchy requiring women to be under the custody and 'superior' decision making capacity of men.

If divine command and the rhetoric of creation mythologies are not enough to demonstrate the belief in women's mental weakness and their need for man's supervision, then Aristotle's early biological inquiry into the anatomical source of mental function might satisfy a more empirical taste. Aristotle argued that the heart was responsible for our mental faculty, and the brain was responsible for keeping the heart cool and

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[161] Bernard P. Prusak, "Women: Seductive Siren and Source of Sin?," in *Religion and Sexism; Images of Woman in the Jewish and Christian Traditions*, ed. Rosemary R. Ruether (Eugene, OR: Wipf and Stock Publishers, 1998), 97.
[162] Hesiod and Homer, *Hesiod, the Homeric hymns, and Homerica,* trans. Hugh Evelyn-White (London: W. Heinemann, 1920), 9.

functioning. This was one of the first attempts to associate the brain with mental involvement, though in this case it was done as an indirect function. Though inaccurate about the bodily locus of mental function, we can see a misogynistic tint to his anatomical claims when he says that women's brains are smaller and therefore incapable of properly regulating the mental heart.[163] These creation mythologies and Aristotelian arguments continued well into Medieval scientific rhetoric and even until the birth of modern science.

When ancient science and religious myths became outdated, people turned to argue for the natural inferiority of women where the ambiguity and uncertainty of myth could not be brought into question. One of the early feminine diseases attributed to the mind was hysteria. Early accounts suggest that this pathology came from the ancient Greek idea of the "wandering womb".[164] The uterus was said to float freely as an entity of its own, and as a result there were a myriad of ailments that affected women including sleepiness, vertigo, knee problems, and death.[165] Thomas Sydenham, a 17th century English physician, acknowledges that hysteria, a mental disorder associated with women, may not be of uterine origin as previously supposed.[166] However, his language still suggests the inherent inferiority and susceptibility to nervous disease of the feminine body. He argues that hysteria originates from, "the female being endowed by Nature with a more fine and delicate habit of body, as being destined to a life of more refinement and

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[163] Charles G. Gross, "Aristotle on the Brain," *Neuroscientist* 1, no. 4 (July 1995): 248, doi:10.1177/107385849500100408.
[164] Mary R. Lefkowitz and Maureen B. Fant, *Women's Life in Greece & Rome: A Source Book in Translation* (Baltimore: Johns Hopkins University Press, 1992), 248.
[165] Kirstin Olsen, *Chronology of Women's History* (Westport, Conn: Greenwood Press, 1994), 22.
[166] Thomas Sydenham, *The Works of Thomas Sydenham*, ed. R. G. Latham (London: Printed for the Sydenham Society, 1848), 85.

care."[167] The inherent weakness in the female body not only indicates her behavioral and intellectual inferiority, but is also why she needs to be protected and taken care of.

Jessie Allen Fowler describes the phrenological and neuroanatomical works of the early 1900s and elaborates the differences between male and female brains. She first describes the cranial variations, the difference in brain mass, and physiological differences between men and women. From these findings, she argues, "man, as a result of this brain development of a differentiated character, shows a mind endowed with judgment, creative power and philosophic reasoning ability; and woman, on the other hand, shows an insight into the domestic relations, home life, and the social well being of mankind."[168] These natural attributes are accentuated when each sex is in its appropriate environment. Fowler adds, "[s]he is certainly in her element when she has her family around her, is giving them advice, and is superintending domestic work."[169] Fowler, however, recognizes that women have achieved intellectually and excelled in traditionally masculine realms. But how can this be argued for about women without the concern that mental exercise would make them sick?[170] Fowler argues that these differences do not mean superiority, but that there are natural fields where they do excel. In essence men are good at certain things, while women at other, but arguable this does not mean either of these gendered capabilities are inherently superior to that of the opposite gender. It should then be the responsibility of society to, "[e]ducate woman up to the masculine standards of thought, and fire her soul with love of God, husband, children, neighbor,

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[167] Ibid., 91.
[168] Jessie A. Fowler, *Brain Roofs and Porticos: A Psychological Study of Mind and Character* (New York: Fowler & Wells, 1908), 72.
[169] Ibid., 73.
[170] Ibid., 74.

home, country, and the world will find in the expression of woman's opinion on every subject a new fountain and oracle of wisdom hitherto unknown."[171] Though this stream of thought would seem a liberating and a progressive approach to optimize on strong feminine traits, all it does is support gendered roles and suggests that women in their inherent weakness should aim for the stronger masculine traits to empower themselves, while at the same time embrace their domestic drives.

Scientific sexism is a concern because of the potential social consequences that can result from such determinist arguments. For example, Tori Moi, a literary critic and theorist, evaluated the claims made in the book *The Evolution of Sex*, by Scottish researchers Patrick Gedde and J. Arthur Thomson, which was published in Britain in 1889.[172] Gedde and Thomson argued that men were anabolic and tended to expend energy, while females were catabolic and tended to conserve energy. They derived this argument from studying protozoa, which they paralleled to the sperm and ovum. Because the protozoa is believed to indicate the active or passive nature of the sperm and ovum, respectively, in the size of their cellular structure and how they respond to their environment, this would then indicate a primordial signifier about the true nature of the sexes.[173] In addition to making this derivative claim about maleness and femaleness from studying gonadal cells, Gedde and Thomson also lay claims to what the social and political implication of their finding should be. They argue that giving women the right to vote, involving them in competitive industry, or even paying them a fair wage would be contradictory to their innate passive nature.[174]

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[171] Ibid.
[172] Toril Moi, "What is a Woman? Sex, Gender, and the Body in Feminist Theory," in *What Is a Woman?: And Other Essays* (Oxford: Oxford University Press, 1999), 17.
[173] Ibid., 18.
[174] Ibid., 19.

In essence, because biological facts justify social norms, it would be counterintuitive to go against the state of nature. Not only has there been a jump made from the nature of a single cell, the ovum, to what a woman can and cannot be, but they also make a commitment to the naturalistic fallacy.[175] The greater concern comes from the arguments for the state of social rights and treatments that are made from this extrapolation proposed by Gedde and Thomson. This trend in scientific argumentation is not antiquated. The essence of aiming towards the dominant qualities, while accepting one's natural inferiority, seems to be the paradoxical pressure which naturalizing social differences creates. I will elaborate in the section below on how prematurely normative claims on the implications of sex-differences is still carried on in modern day neuroscience.

Neurosexism

I have detailed above the historical use of the sciences to defend gender roles. In this section, I will explore whether neuroscience has anything informative to tell us about sex differences and also if it is susceptible to the historical trend of naturalizing gender differences. The range of research around gender differences spans from arguments of genetic predispositions, variation in hormonal levels of fetuses, analyses of brain structures for people with sex inconsistent phenotypes, to animal research on toy preference. I will show below that we know that there are physiological differences between males and females. These differences may have behavioral effects in reproductive terms, or they might not affect behavior at all, even if the neurological behavior may vary. In addition, I will show that there are potential therapeutic benefits that could be sex targeted.

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[175] Ibid., 20.

Knowing this, one might wonder where the issue might rise in studying sex differences in the neurosciences.

We must first acknowledge that there are indeed anatomical differences in organ size between males and females, due to general difference in body size, as well as the physical differences in reproductive organs between them. At the fetal stage, the mammalian brain shows an abundance of estrogen, androgen, and progesterone receptors which can then be specifically sex targeted based on the presence of the fetus' own gonadal hormones, uterine maternal hormones, or other environmental factors.[176] The brain thus sexually differentiates in the concentration of types of receptors in regions such as the hypothalamus, preoptic areas, spinal nucleus of the bulbocavernosus (SNB).[177] Mostly testicular hormones are responsible for such changes, because the default anatomy is female.[178] Perinatal effects of estradiol, and its precursor testosterone, are crucial for setting up the potential for pubertal changes and development of secondary sex characteristics. The release of gonadotropin releasing hormones (GnRH) by GnRH neurons at the onset of puberty leads to release of steroid hormones.[179] This affects the sex differentiated receptors, as mentioned above, and this then leads to the independent restructuring of neural circuits for sexual development of gonads, motivation, behavior, and performance respectively.[180] Thus, the fetal variation in receptor sites between males

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[176] Charles E. Roselli, John A. Resko, and Fred Stormshak, "Expression of Steroid Hormone Receptors in the Fetal Sheep Brain During the Critical Period for Sexual Differentiation," *Brain Research* 1110, no. 1 (2006): 76, doi:10.1016/j.brainres.2006.06.070.
[177] John A. Morris, Cynthia L. Jordan, and S. M. Breedlove, "Sexual Differentiation of the Vertebrate Nervous System," *Nature Neuroscience* 7, no. 10 (2004): 1034, doi:10.1038/nn1325.
[178] Philippe Berta et al., "Genetic Evidence Equating SRY and the Testis-determining Factor," *Nature* 348 (November 1990): 448, doi:10.1038/348448A0.
[179] Andrea C. Gore et al., "Gonadotropin-Releasing Hormone and NMDA Receptor Gene Expression and Colocalization Change During Puberty in Female Rats," *The Journal of Neuroscience* 16, no. 17 (1996): 5281.
[180] Douglas L. Foster and Cheryl L. Sisk, "The Neural Basis of Puberty and Adolescence," *Nature Neuroscience* 7, no. 10 (2004): 1045, doi:10.1038/nn1326.

and females sets-up the possibility of secondary sexual characteristics. Therefore, the brain structures may be relevant in the production of behavioral features associated with sex-specific behaviors. For example, prolactin, in addition to inducing lactation in the mammary gland, is known to increase neurogenesis in the subventricular zone of the lateral ventricle (SVZ), which is implicated in mediating nurturing maternal behaviors in females.[181] This is not a process males go through.

In addition to reproductive differences and variations in neural circuits and regions involved in the process, there could be structural variations between males and females, though the behavioral output may not be affected.[182] This idea that structure may vary but the behavioral output or the realization of a phenomenon may be in essence the same is called multiple realizability (MR).[183] Though this concept is mostly explored in studies within philosophy of mind, there is empirical evidence that suggests that different brain states may produce the same behavioral results, suggesting different integrative processes may be involved. We have to recognize that the brain sizes do differ between men and women, but the brain is capable of completing the same function in various different ways.[184]

Keller and Menon conducted a study to see if there were structural and functional differences in the neuroanatomy between males and females when doing mathematics. They used an fMRI on 25 females and 24 males, age of 18 to 36 years, during an

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[181] Caroline M. Larsen and D. R. Grattan, "Prolactin, Neurogenesis, and Maternal Behaviors," Brain, Behavior, and Immunity 26, no. 2 (2012): 207, doi:10.1016/j.bbi.2011.07.233.
[182] Larry Cahill, "Why Sex Matters for Neuroscience," *Nature Reviews Neuroscience*, May 2006, 2, doi:10.1038/nrn1909.
[183] Carl Gillett, "The Metaphysics of Realization, Multiple Realizability, and the Special Sciences," *The Journal of Philosophy* 100, no. 11 (2003): 603.
[184] Fine, *Delusions of Gender,* 143.

arithmetic task involving addition and subtraction.[185] Then they analyzed differences in brain states using voxel-based morphometry (VBM).[186] What they found was there was no significant difference in terms of accuracy between males and females on trials, and neither was there a significant difference in reaction time between the sexes.[187] However, the brain images told a different story. There was more activation during the mental arithmetic task in males than females in the intraparietal sulcus and adjoining superior parietal lobe, the right angular gyrus, the right lingual gyrus, and the right parahippocampal gyrus, which are regions implicated in the dorsal and ventral visual stream.[188] In general, however, there was considerable overlap in brain regions activated between the sexes as well. Keller and Menon tried to account for this discrepancy where different brain states accounting for the same behavioral output by proposing that males and females may use different cognitive strategies or that different structural processes for women have greater gray matter density in areas where males showed greater functional activation.[189] This study demonstrates that there could be structural differences between two people without there being a necessary functional difference. A similar cognitive performance was observed, though the brain activity observed through the fMRI was different. Yet arguments are made that because males and females have different brain states when engaging in an activity, there may be fundamental differences between them that justify differential treatment between the sexes. This again is an underlying issue

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[185] Katherine Keller and Vinod Menon, "Gender Differences in the Functional and Structural Neuroanatomy of Mathematical Cognition," *NeuroImage* 47, no. 1 (August 2009): 343, doi:10.1016/j.neuroimage.2009.04.042.
[186] Ibid., 345.
[187] Ibid.
[188] Ibid., 346.
[189] Ibid., 351.

rooted in the belief that physical difference translates to a different function, and therefore justifies different treatment.

If there is relevance to considering anatomical differences between the sexes, the most useful application would be in sex-specific therapeutic targets. Considering males and females are physiologically different, the receptor distribution, neural circuitry, and hormone levels need to be considered to properly target a disease, especially if it is expressed differentially between the sexes. A study was conducted by Fleisher et al. on the role of Apolipoprotein E ε4 (APOE*E4) allele on mild cognitive impairment in males and females.[190] They evaluated the effect on hippocampal volume and memory performance on a delayed word recall task of those with the APOE*E4 allele, in 86 women and 107 men.[191] For men neither the presence of one APOE*E4 allele nor two genes was a significant predictor of hippocampal volume. While for women, having one or two APOE*E4 alleles were both significant predictors of hippocampal volume.[192] This difference may be associated with menopause in women and endocrine changes in estrogen availability as a result. Estrogen tends to protect from plaque formation in the female brain, while in men testosterone may be playing this protective effect.[193] Therefore, introducing estrogen in this hippocampal region of the brain may alleviate or prevent the genesis of such cognitive symptoms or reduce hippocampal mass in women who are past menopause. In this study, the intention to provide a functional therapy for a sex-specific disorder demonstrates a productive use of neuroscience that isn't ridden with biased intents or extrapolations.

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[190] Adam Fleisher et al., "Sex, Apolipoprotein E ε4 Status, and Hippocampal Volume in Mild Cognitive Impairment," *Archives of Neurology* 62 (June 2005): 953, doi:10.1001/archneur.62.6.953.
[191] Fleisher, "Sex, Apolipoprotein," 954.
[192] Ibid., 955.
[193] Ibid., 956.

The problem of studying sex differences emerges when differences are used in ways that reiterate gender stereotypes and ignore the social, cultural, environmental, and other non-biological factors that may play into perceived differences and, by extension, neurological variation between the sexes. I argue that this attitude is rooted in a patriarchal society where values such as determination, logical skills, and objectivity that are prioritized and are strongly associated with masculinity. Thus, in a society determined by male-dominated values, those who embody male-associated characteristics gain power and social worth. When stereotypes of femininity such as weakness, emotionality, and an inability to be logical are socially reaffirmed and then claimed to be biologically naturalized, the consequence is the disenfranchisement of women. I will show below that modern day neurosciences have such effects not only by arguing for a necessary locus for social weakness in the feminine brain, but also by extending such an argument to propose a normative place for women in society.

If we start at the beginnings of neurological and physiological differences in sex differentiation, we would return to the fetal environment where variations in receptor distribution and gonadal release of hormones regulate the male and female brains. Due to the ethical implications of gene-modification research with human subjects, most of the work has been done on fish, birds, rats, and monkeys. There is already the issue of extrapolating to human brains and behavior from animal models. Hormonal comparisons on genital tissue may be reasonable as they have shown to have similar functions in both human and non-human species, but at a cortical level, functions may drastically vary.[194] What may be present in other animals may not have been preserved in

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[194] Melissa Hines, *Brain Gender* (Oxford: Oxford University Press, 2004), 81-82.

human subjects, therefore more research needs to be done before conclusions are made. Additionally, the cortical structure variations may be due to environmental factors and socialization and not entirely based in biologically determined factors. Through the process of bio-looping, a concept I will elaborate further in the final chapter, the external environment, including information about prior research affecting the behavior in question, may affect the organisms' internal behavior. Thus their behavior will be modified by that knowledge, and then they may play out the behavior reaffirming the research findings.[195] This cycle is self-feeding, and might help explain the perceived stereotypical gender differences between males and females. The concept of bio-looping may be especially relevant to the phenomenon of stereotype threat in women, where being made aware of 'scientific' variances between genders may lead to performing poorly in examinations where men, not women, are expected to excel.

The concept of gender generally plays out postnatally, where gender is confirmed more as a performance that either does or does not align with what is normatively set and expected from each sex. Judith Butler argues that gender is sustained through "the tacit collective agreement to perform, produce, and sustain discrete and polar genders as cultural fictions is obscured by the credibility of those productions— and the punishments that attend not agreeing to believe in them; the construction 'compels' our belief in its necessity and naturalness."[196] When the gendered person is not visible, such as during pregnancy, there is a strong sense to label the fetus through some indication of gender. Through analysis of pregnancy folklore before the age sex-determination via ultrasound,

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[195] Ian Hacking, *The Social Construction of What?* (Cambridge, MA: Harvard University Press, 1999), 109-12.
[196] Judith Butler, "Bodily Inscriptions, Performative Subversions," in *Feminist Theory and the Body: A Reader*, ed. Janet Price and Margrit Shildrick (Edinburgh: Edinburgh University Press, 1999), 420.

we can see the application of stereotypes to unveil a baby's gender. For example, "If he is active it is a boy; calm, it is a girl." or "If you carry the baby low, it is a boy, and high, a girl."[197] Much of this folklore has been abandoned with the rise of ultrasound analyses, but regardless, the need to gender is still present. This may be because the family can give the first indication of a social identity to the fetus and mentally prepare for how it will be socially received once born.

This need to label gender carries on even for differentiating newborns who have not been socialized yet. The argument is that if there is a difference in newborns, then the reason may be biological. For example, Connellan et al. studied the time 102 neonates (males n=44, females n=58) spent looking at a face (social stimuli) or a physical-mechanical mobile, to see if there were behavioral differences between males and females.[198] Prior to this study, the earliest sign of sexual dimorphism in sociability (measured by eye-contact) was studied at 12 months of age.[199] Connellan et al. matched the stimuli for color, size, shape, contrast, and dimensionality.[200] The time spent, in seconds, looking at the stimulus was recorded and coded by judges blind to the infant's sex. A χ^2 analysis showed an association between sex and stimulus supporting the hypothesis of male preference for the mechanical and female preference for the social. And a *t*-test confirmed the suspicions with males looking longer at the mobile ($t = 2.3$, df $= 100$, $p = 0.02$), and females looking longer at the face ($t = 2.4$, df $=100$, $p = 0.02$).[201]

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[197] Lucile F. Newman, "Folklore of Pregnancy: Wives' Tales in Contra Costa County, California," *Western Folklore* 28, no. 2 (1969): 132.
[198] Jennifer Connellan et al., "Sex Differences in Human Neonatal Social Perception," *Infant Behavior and Development* 23, no. 1 (2000): 114.
[199] Svetlana Lutchmaya, Simon Baron-Cohen, and Peter Raggatt, "Foetal Testosterone and Eye Contact in 12-month-old Human Infants," *Infant Behavior & Development*, 25 (January 2002): 333, doi:10.1016/S0163-6383(02)00094-2.
[200] Connellan, "Sex Differences," 115.
[201] Ibid., 116.

This was statistically significant, meaning that the probability of males disproportionately focusing on the mobile and females disproportionately focusing on the face is not due to chance. With these findings of statistical significance, the authors argued that unlike previous work that was done at 12 months of age, and thus may be confounded with socialization, this neonatal study is more valid to argue for an innate biological sex-differentiation. Conellan et al. concluded, "At such an age, these sex differences cannot readily be attributed to postnatal experience, and are instead consistent with a biological cause, most likely neurogenetic and/or neuroendocrine in nature."[202] The authors' intent when pursuing this study was to find evidence for biological substrates in sex-stereotypical behavioral differences that are observed later in life.

Though the authors do not explicitly state it as such, the implications of this study are clear: women are not made for math and physics, and therefore should amplify their innate social skills/preference for more feminine friendly careers. Though this seems like a gross extrapolation, such reasoning has been widely disseminated based on this study. For example, Peter Lawrence, an academic at Cambridge University, has argued that we cannot expect women to be well represented in more masculine fields like physics. Additionally, Baron-Cohen reaffirms this belief suggesting that these are the beginnings from which gender differences are amplified from innate foundations. Therefore, he argues that appropriate female representation in traditionally masculine fields is not something to be expected.[203]

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[202] Ibid., 117.
[203] Fine, *Delusions of Gender*, 113.

Unfortunately, the study suffers from many methodological issues and confounds. For example, a neonate's visual capacity and attention is not optimal during the few days following birth, and short-term attention does not even show significant development until past about 3 to 4 months of age.[204] Additionally, the trial conditions were not consistent concerning where the infant was positioned when the measurements for attention were taken. The extrapolations that can be made from this study are clear, and it parallels the arguments of its predecessors that gender-stereotypic behavior is innate. As with the arguments of the Gedde and Thomson from the 19th century, such research can be misused to advise social and political policy around gender.

Another area of inquiry, brain lateralization, is said to be associated with variation in cognitive and mathematical performance between men and women. Differences in interhemispheric interaction has been found to indicate varying intellectual ability between mathematically gifted adolescents and other controls. The findings suggest better cortical coordination between hemispheric activity may be associated with the superior mathematical performance.[205] Therefore, people have looked into male and female lateralizations to see if there was a difference. Initially arguments were made that males' hemispheric unilateralization was responsible for their more 'focused' spatial ability and superior mathematical skills.[206] However, when contradictory findings came through, such as the one mentioned above that suggested more lateralization and coordinated interhemispheric activity, arguments started shifting to say that men in fact had more

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[204] John Colombo, D. Wayne. W. Mitchell, and Frances D. Horowitz, "Infant Visual Attention in the Paired-Comparison Paradigm: Test-Retest and Attention-Performance Relations," *Child Development* 59, no. 5 (1988): 1207, doi:10.2307/1130483.
[205] Harnam Singh and Michael W. O'Boyle, "Interhemispheric Interaction During Global–Local Processing in Mathematically Gifted Adolescents, Average-Ability Youth, and College Students," *Neuropsychology* 18, no. 2 (2004): 336, doi:10.1037/0894-4105.18.2.371.
[206] Fine, *Delusions of Gender*, 105.

bilateral activity than females. This should already indicate some of the biases within the sciences that tries to accommodate findings that place males as predestined for superiority. Leonard et al. found that the variation in physical size between males and females is responsible for why cerebral volume differs. They found that 21% individual differences were accounted by variations in cerebral volume, and 4% due to sex differences.[207] But still there is no fully conclusive global trend. Similar to the concept described above, men and women may structurally vary, but their cognitive functions may still be the same.

When consumed by the public, such sex-stereotyping research can have drastic effects. A study conducted by Victoria Brescoll and Marianne LaFrance evaluated 209 articles from 29 U.S. newspapers concerning whether the cause of sex/gender differences were innate or acquired.[208] They found that conservative newspapers, compared to liberal ones, more often tended to attribute gender differences to biological causes. Scientists who also act as popularizers, such as Baron-Cohen mentioned above, tie in their own beliefs on sex and further exacerbate the issue.[209] The consequence of this is attitudes to educational policy and public policy may change in order to accommodate the sex-based findings.

Some would argue that if sex differences do exist, why do we not help nurture more feminine traits such as strong contextual verbal ability or empathy? This would

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[207] C. M. Leonard et al., "Size Matters: Cerebral Volume Influences Sex Differences in Neuroanatomy," *Cerebral Cortex* 18, no. 12 (2008): 2926, doi:10.1093/cercor/bhn052.
[208] Victoria Brescoll and Marianne LaFrance, "The Correlates and Consequences of Newspaper Reports of Research on Sex Differences," *Psychological Science* 15, no. 8 (2004): 519.
[209] Rebecca M. Jordan-Young and Raffaella I. Rumiati, "Hardwired for Sexism?: Approaches to Sex/Gender in Neuroscience," in *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*, ed. Robyn Bluhm, Joap Jacobson, and Heidi L. Maibom (New York: Palsgrave Macmillan, 2012), 118.

mean capitalizing on the natural inclinations of the sexes to make society more efficient instead of pushing women to do what would not be ideally profitable for them. The first issue with this assumption is that sex research in the neurosciences is conclusive on the point of what behaviors are maximized in each sex.[210] Unfortunately, neuroscience is riddled with ambiguities and are not fully conclusive in their findings to the point of informing social policy. Replication studies need to be conducted, and confounding variables and poor experimental structures need to be reevaluated before stronger proclamations about sex or gender can be brought forward. The second issue is the belief that women should value their feminine traits and make the most of what nature has given rather than fighting an uphill battle in a world dominated by masculine values. Unfortunately, this heavily underestimates the impact the patriarchy has had in defining what social values are at the top (the masculine), and which ones are considered socially weak or detrimental or less important (the feminine). One solution could be that we work within the social context we are given and try to negate false claims of female inferiority within scientific literature. Another option may be to dismantle the current value system and construct one where both feminine and masculine traits are equally valued, so that even if there is a natural difference between the sexes, it would not be relevant in terms of social power differentials. Additionally, who is to say that even if male-attributed values, such as rationality, spatial ability, or mathematical skills, are not optimized for the female brain that women are inherently incapable of embracing these values?

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[210] Ibid.

Why Is This Relevant? What Can Be Done?

There are inarguable sex differences that exist between males and females in terms of their neurobiology. From the chromosomal beginnings, there are already genetic markers that set for phenotypic dimorphisms later in life. Additionally, the fetal environment and the hormonal changes that occur during this period bring forth the presence of primary sexual features. During puberty, secondary sexual features develop as a result of hormones released from the brain acting with the genitals. Behaviorally, this may pan out to differing sexual behaviors as well as cognitions, such as maternal behavior, depending on what has been evolutionarily conditioned to favor reproduction. However, this all begs the questions, why does one sex gain more power in society than the other? How do certain sex-related behaviors or cognitive patterns that we see lead to differential treatment, in the sense of creating a dominant and subordinate?

The issue that I highlighted at first was that our society and culture has a propensity towards sexism. Whether the subordination of women is the natural order of things is not something we can know for sure unless we return to the genesis of mankind to see the way things were in the beginning. However, this is not possible. Instead, we should be aware that the process of 'othering' is a relentless enterprise that benefits those who dominate. Though at a surface level, social language, policies, and behavior may change to seem more progressive, underlying biases continue to find a way to covertly affect the marginalized. Even if there is a biologically determinant condition as to why women in some ways behave differently than males, it does not justify social policy differentially acting on such claims. Because we live in a male value-laden society, women who embrace these values can have social mobility and a certain degree of liberation. But the woman's body has been marked as inferior and at times incapable of achieving these

male-attribute values. They are then encouraged to pursue more feminine tasks. This propels the primary stereotypes, and then misinforms the empirical sciences on what they should be looking for in their research.

Inherently, male-associated and female-associated values may not be present in the sexes, however through association and socialization they become linked. Therefore, whenever I use these phrases of masculine, male-associated, feminine, or female-associated I am not arguing that they are necessary qualities of either sex. My hope was to highlight the historical trend of sexism as it progressed into modern day neuroscience, to highlight the problematic arguments for the inferiority of women. Such arguments have changed from the explicitly sexist claims in the past. They become subtler and nuanced in their appearance as time progresses and people abandon more brute sexist language. However, this does not negate the psychological effects it can have on women and their ability to progress. Additionally, it makes it more difficult to address institutional and systematic problems that overlay social systems and still hinder women. What this means then is that a more nuanced approach must be taken to evaluating the ways sexism can weave itself into seemingly objective disciplines. The consequences are seen in the public consumption of such information, and the response in social policy that limit women's access to resources and realizing themselves in fields traditionally dominated by men. It may seem progressive that we encourage women to maximize feminine traits that they may be innately suited for, but that language is no less impactful than sexist arguments that limit the roles of each gender. In a culture normed in male-associated values, it would be very difficult to redefine what values are culturally celebrated and to make feminine traits be equally respected. Therefore, women have to work within the system and a culture rooted in stereotypically masculine values, and thus need to maximize such

skills in order to advance socially. There are many obstacles that women face on the way to socially advance, but neuroscientific findings should not be one of them.

Chapter Four

The Significance of Normalcy

Thus far, I have provided a historical account of neuroscience and its relation to women. The reason I did so was to replicate and continue the critique Foucault provided in *Madness and Civilization* and *Birth of the Clinic*. Foucault looked into the history of mental treatment in European history and analyzed the shifts in attitudes and the consistencies in dehumanizing practices over the centuries. Through this critical lens and historicist approach, he was able to develop a thorough criticism of both the ideologies surrounding therapy and the ideas of sanity. I hoped to apply a similar approach and framework by looking at trends of sexism in the neurosciences and its predecessors. Additionally, I hoped to highlight how through this historical process, the incomplete and stagnating dialectic of the Lord and Bondsman is realized. However, I have not given a thorough account for what specifically is motivating a dominant identity to power-over another. I will argue below that in the process of reducing the other for the self, in order to gain recognition, there is also pressure put on the 'other' to modify themselves to be 'normal'. I will explore this concept and argue the idea of normalcy, as it has been developed through statistical distributions, is what has given neuroscience the power to articulate mental normalcy, and who either fits or does not fit within those bounds. In essence, this gives those who have the ability to statisticize brain states the power to 'other' those who are not within the limits of what they define as normal. Above, I have demonstrated this through the analysis of previous neuroscientific literature comparing both male and female brains, and describing female brains as outliers from the range of normalcy in relation to brain states signifying socially favored behavior.

I will then look at Herbert Marcuse's idea of one-dimensional thinking and how social progress is stifled as a result of technological advances that give rise to the false belief that more choices mean more freedom. I will build on his arguments to suggest that that neuroscience should challenge its own assumptions in order to aid social progress rather than subscribing to an established, marginalizing, and bias-ridden ideological framework. Finally, I will recapitulate earlier philosophical concerns that I raised, and I will suggest that a similar historico-genealogical process is present among other marginalized identities. Therefore, neuroscience and its social implications must be taken seriously if we are to make any progress in using the information we gain for the benefit of society.

Normalcy and Its Relation to Pathology

Before the birth of statistics, the idea of normal was contrasted with the pathological. Considering my critique rests on the biomedical implications of neuroscience research, I will elaborate on the distinction Georges Canguilhem makes in his book, *The Normal and The Pathological*. Normal is etymologically defined as that which conforms to the regular, and does not bend to the left or to the right, and from there two definitions are produced: 1) how something ought to be, and 2) the average or majority standard of a measurable characteristic.[211] When these two definitions are conflated it generates the issues we see with the way arguments of normalcy become problematic. In medicine this translates to the ideal habitual state of the body. Additionally, this state incorporates a self-healing processes aimed to return the body to stasis when distressed, or

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[211] Georges Canguilhem, *The Normal and the Pathological*, trans. Carolyn R. Fawcett (Dordrecht, Holland: D. Reidel Publishing Company, 1978), 69.

at least indicates where therapeutics can be targeted.[212] Biological pathology, or a diseased state, deviates from bodily normality as it pertains to maintaining life. Anomalies are variations from what is considered normal, simply by fact that they deviate. However, difference does not necessitate pathology.[213] Pathology etymologically suggests a diseased state, implying life gone wrong.[214] One way of defining the pathological is by defining normal and abnormal (abnormal being an adjectival form of anomaly) in terms of statistical frequency.[215] Then the normal person becomes the normative ideal, and sets the values for organic norms.[216] Therefore, an anomaly, when described as deviant and statistically charted in comparison to a majority notion of normal, can be driven into the realm of pathology and thus necessitate therapeutic adjustment.[217]

In addition to the ambiguous nature whereby someone who deviates from the norm can be deemed pathological, the environment and its relation to the normal is also conditional. For example, a trait may be considered normal in one environment as necessary compromise for survival. An example is sickle cell trait, which provides a protective feature for those living in malaria ridden areas, while otherwise compromising health.[218] Another issue is that what would be considered an abnormal feature may not interfere at all pathologically, such as an extra digit on a hand or foot.[219] Yet there is a tendency to attribute a normative value to these irrelevant deviations from what is considered normal. Canguilhem points out that the human body is not only a product of

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[212] Ibid., 70.
[213] Ibid., 76.
[214] Ibid., 77.
[215] Ibid., 77.
[216] Ibid., 79.
[217] Ibid.
[218] Ibid., 99.
[219] Ibid., 88.

our relationship to nature and the environment, but is also a social creation as well. Therefore it might not just be that something is determined as normal because of its frequency, but it is very likely that it is seen as frequent due to normative pressures in a certain social environment.[220] This social environment may be predicated on a dominant group's attributes being valued as 'normal'. What I have hoped to elaborate by analyzing the distinction that Canguilhem provides etymologically for the normal and the pathological is that it is not just a difference in life-states of an organism. Instead, the distinction is very ambiguous and is determined either through charting statistical distributions, environmental relevance to an organism, and also more importantly through normative pressures due to the social influence in creating the human organism.

Statistical Determinism and Normalcy

In order to better elaborate the influence of statistics in demarcating normality, we need to look into the history and paradigm shifts in attitudes towards statistical validity, to better conceptualize how statistics aids neuroscience in passing judgment on marginalized groups. As I mentioned above, the idea of normalcy, especially when statistically labeled, puts pressure on those who are deviant to aim towards a more normal or majority expression. In essence what happens is that the idea of chance and anomalies are controlled for by the pressure to be normal. Ian Hacking, in his book *The Taming of Chance*, explores these ideas by accounting for the shift from concepts of human nature to a model where human variation was charted on a normal curve.[221] This nurtured the idea of chance, and eroded the idea of determinism.[222] With a greater indeterminism, we could

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[220] Ibid., 92.
[221] Ian Hacking, *The Taming of Chance* (Cambridge, MA: Cambridge University Press, 1990), 2.
[222] Ibid., 3.

have the potential to control variations and move away from what otherwise would have been a determined teleology. However, the new statistical laws gained an objective validity, and the right to not just describe frequency, but also to explain and provide understanding for a natural phenomena.[223]

Instead of exploring the full extent of the politico-historical development of statistics in the Euro-American context, I will begin where the development of the normal curve impacts concepts of normality and paves the way for a statistical infallibility. As I mentioned above, in my account from Canguilhem, the impact of the normal curve is critical in demarcating normalcy. Adolphe Quetlet, a 19th century Belgian statistician, was one of the strongest proponents of using the normal distribution in anthropometry, social analysis, and criminology.[224] Before his application of the normal curve to bio-social metrics, it was seen as a distribution with a mean and standard deviation that was fixed on real quantities from a binomial coin-toss where we expect a fixed distribution around how many heads and how many tails we can get.[225] However, in humans, the mean is not a real quantity. Quetlet transformed the mean into a real quantity by charting features of the average man, or *homme type.*[226] This resulted in a massive growth in recording human metrics, from moral attributes to the ability to write poetry, that were then fit under the normal curve.[227] This provided room for eugenic ideas where social policies could be installed to either preserve or alter attributes in a population.[228] The major issue with the leap of applying the normal curve to human variance is that the

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[223] Ibid., 10.
[224] Ibid., 105.
[225] Ibid., 106.
[226] Ibid., 107.
[227] Ibid., 110.
[228] Ibid., 108.

normal curve is derived from accounting for the errors in a single coin toss. The complexity that produces human traits from the genetic, cultural, social, environmental, and biological is not fully accounted for when passing normative judgments from a distribution of a single attribute.[229] Though, there may be some benefits in predictive potential when measuring variance in human metrics, acknowledging that human social and biological traits are not simply a conglomeration of a number of random processes, like coin tosses, like coin tosses, may control the drive to misconstrue statistical findings.

Considering how the normal curve was applied to human metrics, I wish to describe how this then ties into the idea of normalcy. As mentioned above, the idea of normal is intertwined with the pathological in a medical sense, but in the 1820s, the word normal began to be used more widely to describe behaviors, diplomatic relations, and even the state of molecules.[230] The power of the word 'normal' came from its dual ambiguity where it accounts both for what is typical and also for what something 'ought' to be.[231] Additionally, as I described in my analysis of *The Birth of the Clinic*, a similar shift around the 1800s happened where the pathological was isolated to the malfunction of a single organ rather than excess or deficiency in a sick individual as a whole.[232] This compartmentalization paralleled the demands of the industrializing world, where components could be replaced as long as there was an easily exchangeable standard in the cogs of a machine.[233] Though the distinction between the normal and the pathological originated in a medical context, in a rapidly industrializing world that

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[229] Ibid., 112.
[230] Ibid., 160.
[231] Ibid., 163.
[232] Ibid., 164.
[233] Ibid., 165.

profited from standardization and predictability, the argument of Auguste Comte and the distinction he made between normal and pathological societies, supported by statistical accounts, demanded that revolutionary positivism and normalcy be something we should strive for.[234]

Therefore, the understanding that the idea of normalcy is related to a concept of disease, to a statistical average or majority, and moral demands outlines why it is concerning. With the shift towards statistical determinism and evaluating statistical laws as objective predictors, and not just an account of expected variances, the pressures to be normal become an obligation. Therefore, we are obliged to tame chance and variation and return it to a standard state of what a person should be. In neuroscience, charting brain states and averaging the neural physiology as they do in brain map databases leads to the creation of deviations that may not necessarily be pathological. A false sense of normalcy is created that still has the capacity to place normative pressures on those who deviate neurologically. Thus there needs to be a greater suspicion of statistical distributions that account for human metrics, especially where if falls within such a value laden organ as the brain.

Considering the distinction made above, I hope to explore a specific instance of how social expectations influence ideas of normalcy. Ian Hacking, in *The Social Construction of What*, describes how the Intelligence Quotient (IQ) test was developed and eventually became a test for normal intelligence from those who were mentally deficient on one end, and geniuses on the other. Alfred Binet and Lewis Terman developed this test believing that biological characteristics should be modeled on a normal probability curve.[235] When

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[234] Ibid., 169.
[235] Ibid., 173.

Terman discovered that women did better on the IQ test than men, and considering women "couldn't" be more intelligent, the questions were revised. It was considered a synthetic *a priori* fact that women cannot be more intelligent than men. Thus this should hint at the issues surrounding a dominant identity positing themselves as the threshold of normalcy. Additionally, this critical factor in the formation of the IQ test indicates the biases that precede statistical standards, and the human element responsible in the social construction of what intelligence looks like. Considering the IQ test is at times taken as a valid evaluator of intelligence, and then conflating that with its sexist roots, the claims the test makes to be able to measure certain attributes of intelligence need to be taken with a grain of salt.

What Should We Do with Neuroscience?

The issue of social marginalization via the neurosciences is multifaceted. Firstly, there are underlying social biases and assumptions feeding the research inquiries as well as how results are presented. Secondly, the statistical determinist attitudes give undue validity to brain averages and concepts of normalcy charted from neuroscientific research. Considering this, what should neuroscience do? Below, I will explore Herbert Marcuse's concept of one-dimensional thinking in his book *One-Dimensional Man*. This should indicate how repression is produced when social change is not possible because people identify with an oppressive system by subscribing to one-dimensional thinking. Additionally, this will lay out the ideas that provide a normative marker for the neurosciences to consider to more appropriately contextualize the brain, body, and mind in light of technological advances.

Marcuse starts by critiquing our sense of complacency and near universal acceptance of our unfreedom as a result of technological progress.[236] This is the result of one-dimensional thinking that does not critique or challenge social assumptions, and thus leads us to ignore liberating possibilities. Two-dimensional thinking on the other hand is negative thinking, that comes through a dialectical process where there is crucial intent that enables us to recognize forces of domination.[237] The problem with one-dimensional thinking is that people believe they are freer than they really are due to homogenous complacency. It requires a obedience to a system that satiates and preserves such thought.[238] When people's physical needs are met, and whatever material goods they demand is available, they stay satisfied with what they are given.[239] Similarly, people are not apt to question neuroscience because it provides productive insight into neuropathologies and the research does help in identifying viable therapies. If people identify with their oppressors and are apt to gain from the goods given to pacify them, the result is the stifling of political discourse.

To overcome such one-dimensional thinking, Marcuse suggests that we embrace two-dimensional thought that liberates through a dialectical process of critiquing society. Through self-determination and by embracing ourselves as individuals liberated from indoctrination and manipulation, we can know the facts and evaluate what our true options can be.[240] This is not a false sense of individual potential, where the celebration of potential is still under the subscription of dominating forces of normalcy and

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[236] Herbert Marcuse, *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (London: Routledge, 2002), 3.
[237] Ibid., 139.
[238] Ibid., 50.
[239] Ibid., 53.
[240] Ibid., 256.

complacency. According to Marcuse, the ultimate form of domination is when the dominator administrates avenues for mass consumption and deludes those who are dominated into thinking that such a life is a good life.[241] The notion of neuroplasticity and the routes for therapeutics and neural modulations replicates such demands on those who are considered abnormal. The potential for cure and the ability to be normal can create a large surgical or pharmaceutical market for therapeutics that profit off this constructed insecurity. Therefore, if Marcuse's critique is applied, and the only way to liberate oneself from a domineering and oppressive system is through critique, neuroscience needs to be open to criticism where its assumptions fail to provide support for the normative judgments based on neuroscience and thus may participate in oppression.

My hope through this paper was not to deny the benefits neuroscience has to offer society, but instead to scrutinize the enterprise and its social consequences, to highlight the ways it can be used to propagate social marginalization. I applied a hisotrico-geneological critique extending the concerns Foucault set out to look at in both the psychiatric and clinical practice. This was rooted in the Hegelian Lord-Bondsman framework, where I argued that there is a stagnating dialectic between those who dominate and those who are oppressed. The capacity to scrutinize, reduce, dissect, and analyze gives an observer power to define and objectify whoever they observe. Arguably, the male-dominated historical enterprise of the sciences has done this with biological determinist arguments for a woman's innate inferiority, stemming from some deficiency in her intellectual apparatus. I looked at the history of the neurosciences and demonstrated that this sexist trend did, and currently, continues to exist. This is primarily

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[241] Ibid., 259.

because the neurosciences are inextricably tied to social values, for it serves the medical demands of society. Additionally, the use of statistics has been crucial due to the quantitative and metric objectivity needed in the rhetoric of presenting scientific evidence. However, in the process of quantifying neural metrics, the argued average brain states have been conflated with the ambiguous definition of the word 'normal' as indicated by my account of statistical history. Due to a paradigm shift with a newly adopted attitude towards statistical determinism, people are accepting their neural or psychometric variance as dooming them to an inferior status as 'abnormal'. The complexity of human nature is not fully considered in such statistical distributions, however the objective and numerical allure buffers neuroscientific evidence from full scrutiny about the implications of their findings.

Additionally, even where neuroscience seems to provide liberatory benefits, the enterprise is still susceptible to propagate domination and marginalization. This is not because of any inherent issue in the idea of neural possibility, instead it is because social assumptions of what a normal or desirable brain should look like go unchecked. For example, in a society dominated by male-centric values, women would be pressured to emulate such attributes. If the argument could be made that certain brain states lead to the expression of masculine traits, then women would be pressured to emulate similar cognitive states predicated on a gender-biased valuation. To compliment this, Marcuse's critique of one-dimensional thinking and how it stifles political discourse and social progress is relevant. Unless we challenge ourselves to participate in two-dimensional thinking that critiques society and social institutions as they are, we cannot know out true options and would be susceptible to be complacent and thus subscribe to the delusion of freedom that dominating forces impose on the oppressed. Therefore, it would be better if

those who engage in the neurosciences recognize this issue, and are ready to address how their endeavors are informed and influenced by underlying social biases.

What Is the Greater Significance?

If the ethical implications that I framed in the first chapter are considered, there needs to be a respect for individuality as it is. However, there is a clear line, based on potential harms to self or others, about when certain notions of individual expressions become concerning in a seriously pathological or socially dangerous way. It is therefore inappropriate to interfere or denigrate those who have different brain states to the margins if their neural differences do not interfere with leading their lives and social well being. Though I did not explore the relationship between the neurosciences and other easily recognized socially marginalized identities, the trends of 'othering', by arguing neural deficiency and therefore intellectual or social inferiority, do carry over.

For example, the superiority of the White race had been attributed to their larger cranium.[242] Arguments for the animalistic and therefore necessarily subordinate nature of people of color, particularly of African peoples, had been attributed to a perceived disproportionate distribution of nerves to primal organs and a size reduction in the brain.[243] Additionally, refusing to subordinate to white people was even given psychiatric diagnoses such as drapetomania: the mental illness that leads slaves to run away.[244] Even current literature reflects how social biases can feed into the interpretation of

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[242] Josiah Clark Nott et al., *Types of Mankind: Or, Ethnological Researches: Based Upon the Ancient Monuments, Paintings, Sculptures, and Crania of Races, and Upon Their Natural, Geographical, Philological and Biblical History, Illustrated by Selections from the Inedited Papers of Samuel George Morton and by Additional Contributions from L. Agassiz, W. Usher, and H.S. Patterson* (Philadelphia: J.B. Lippincott, Grambo, 1854), 208.
[243] Arthur L. Caplan, James J. McCartney, and Dominic A. Sisti, *Health, Disease, and Illness: Concepts in Medicine* (Washington, D.C.: Georgetown University Press, 2004), 30.
[244] Ibid., 34.

neuroscience. For example, the book *Bell Curve: Intelligence and Class Structures in American Life*, by Richard Herrnstein and Charles Murray has been criticized in aiding racist ideologies.[245] Other books, such as the *Mismeasure of Man* by Stephen J Gould, argue in support of social darwinism and biological determinism to explain the differences among social groups. The antiquated arguments of brain size and neural mass correlations have not died either, with scientists such as Rushton and Ankney using MRI scans and cranial measurements to argue racial differences.[246] With the advent of social awareness of racist language and biases, my arguments look for stricter scientific and empirical validity while avoiding the blatant linguistic signifiers of racism from the past.

Queer and transphobia transitioned from a dogmatic stigma, to psychiatric diagnoses,[247, 248] and eventually to neuroscientific claims[249] that describe the mental attributes that lead to deviation from heteronormative and gender normative behavior to be '"excess', 'deficiency', or 'imbalance'"[250] in the expression of neural matter. In essence, queer and trans people were considered to be psychiatrically ill, and therefore our obsession of looking for differentiation through neurological imbalance compliments the

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[245] Joseph L. Graves, "The Pseudoscience of Psychometry and The Bell Curve," *Journal of Negro Education* 6, no. 3 (1995): 278.
[246] J. P. Rushton and C. D. Ankney, "Brain Size and Cognitive Ability: Correlations with Age, Sex, Social Class, and Race," *Psychonomic Bulletin & Review* 3, no. 1 (1996): 33, doi:10.3758/BF03210739.
[247] Stephen A. Mitchell, "Psychodynamics, Homosexuality, and the Question of Pathology," *Studies in Gender and Sexuality* 3, no. 1 (2002): 6, doi:10.1080/15240650309349186.
[248] Peggy T. Cohen-Kettenis and Friedemann Pfäfflin, "The DSM Diagnostic Criteria for Gender Identity Disorder in Adolescents and Adults," *Archives of Sexual Behavior* 39, no. 2 (2009): 500, doi:10.1007/s10508-009-9562-y.
[249] Ivanka Savic, Alicia Garcia-Falgueras, and Dick F. Swaab, "Sexual Differentiation of the Human Brain in Relation to Gender Identity and Sexual Orientation," *Progress in Brain Research* 106 (2010): 43, doi:10.1016/B978-0-444-53630-3.00004-X.
[250] Eve Kosofsky Sedgwick, *Epistemology of the Closet* (Berkeley and Los Angeles: University of California Press, 1990), 43.

need to naturalize their sexual or behavioral 'perversions'. Additionally, the search for the 'gay brain' or 'gay gene' is the most recent manifestation of a continued trend in the pathologizing of queer and trans people.[251] Antiquated theories of homosexuality, such as sexual inversion, are present in the comparative analyses of gay and straight brains.[252] Gay male brains are correlated to feminization, while gay female brains to masculinization. These studies also extend the gendered stereotypes to the respective inverted sexual orientations. For trans people, the neuroscientific and medical bias is more apparent with diagnosis of Gender Identity Disorder (GID) necessitating a validation of their identity.[253]

The above mentioned social categories are easily recognizable identities that have been historically marginalized. However, considering the diagnostic tactics in modern day psychiatry, those who are labeled through diagnoses of behavioral and mental disorders may be a less visible group more directly affected by the diagnoses and therapeutic pressures associated with their 'diseased' state. Thus the implications of my proposal that neuroscience is susceptible to being a propagator of social marginalization can be tested by evaluating its effects on multiple identities.

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[251] Peter Hegarty, "Materializing the Hypothalamus: A Performative Account of the 'Gay Brain'," *Feminism & Psychology* 7, no. 9 (1997): 355-361, doi:10.1177/0959353597073009.
[252] Melanie A. Taylor, "'The Masculine Soul Heaving in the Female Bosom': Theories of Inversion and The Well of Loneliness," *Journal of Gender Studies* 7, no. 3 (1998): 289, doi:10.1080/09589236.1998.9960722.
[253] Heino F. Meyer-Bahlburg, "From Mental Disorder to Iatrogenic Hypogonadism: Dilemmas in Conceptualizing Gender Identity Variants as Psychiatric Conditions," *Archives of Sexual Behavior* 39, no. 2 (2010): 464, doi:10.1007/s10508-009-9532-4.

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