Objectivity Through The Social Lens

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Abstract

Objectivity is a vital feature ascribed to scientific methods, beliefs, individuals, and theories. In this thesis, I argue that social processes within scientific communities secure objectivity in Science. Scientific objectivity is a result of the social nature of the inquiry and not an individual enterprise. Scientific inquiry is a social activity that is practiced by scientific communities. Using objective scientific procedures, scientists make use of each other's perspectives and viewpoints for their hypotheses and theories. The social processes are also reliable for ensuring diversity, equality, and epistemic fairness in scientific communities. I argue against the value-free ideal by claiming that scientific inquiry is a value-laden one, and it offers more than a single absolute perspective of the way things are in the world. I show that it is not free from contextual values and subjective preferences as we would wish it to be. However, the process of interaction and criticisms defuse the problem of contextual values and subjective preferences.

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Introduction

In the thesis, I argue that the social processes within scientific communities offer a kind of objectivity in Science. Scientific objectivity is a result of the social nature of the inquiry and not an individual enterprise. Scientific inquiry is a social activity that is practiced by scientific communities. Several philosophers attribute objectivity to beliefs, individuals, theories, observations, and methods of inquiry (Rudner, 1953 and Longino, 1990 have argued more articulately). In this project, I focus on objectivity as a method of inquiry. The scientific method refers to the steps involved to arrive at accurate theories that describe and explain a scientific phenomenon (Longino, 1990; Freedman, 2009; Reiss & Sprenger, 2017). To ascribe objectivity to the scientific method entails asserting that the criteria for generating a scientific claim are intersubjectively determined. I take the meaning of objectivity to be a first approximation – to be further analyzed in the thesis. Moreover, such criteria are reliable for ensuring diversity, equality, and epistemic fairness in scientific communities. Using objective scientific procedures, scientists make use of each other's perspectives and viewpoints for their hypotheses and theories. The objective scientific method is undoubtedly as important as the scientific world picture (i.e., the products of Science).

My thesis offers a different and refined conception of scientific objectivity. I argue that value-free scientific inquiry is unattainable. Scientific inquiry is a value-laden one, and it offers pluralist perspectives within scientific communities. Some philosophers of Science have a pessimistic assumption about the rejection of value-free ideal. Lacey (1999) warns that it would be disastrous for scientific objectivity if values are allowed in the core stages of science and that the value-free ideal is rejected. The worry is that if we accept political, socio-cultural, and economic values in the experimentation, testing, and evaluation stage, we will lose track of "proper" Science (Douglas 2007). I disagree with the assumption and instead argue that the core stages of Science (outlined above) are not free from normative values and subjective preferences as we would wish it to be. I assert that the acceptance of value-laden Science does not make Science a bad one. However, we can accept the tenets of value-laden Science and keep track of proper Science through the intersubjective interactions and criticisms offered by scientific communities. The kind of scientific objectivity I defend, then, is achieved rather than 'given.'

Scientific objectivity has several traditional connotations: disinterestedness (detachment, lack of bias), universality (independent from any particular perspective or viewpoint associated with knowledge of a mind-independent world), value-free ideal (absence of non-epistemic values), and historically includes complex meanings (Lloyd, 1995; Porter, 1992; Fine, 1998; Daston and Gallison, 1992; Daston, 1992). Reiss and Sprenger (2017) identify two categories of scientific objectivity: process objectivity and product objectivity. The former means that social, ethical, and political values should not influence scientific methods and processes (Reiss & Sprenger, 2017, Product and Process Objectivity section, para. 2; Longino 1990, 62). The steps involved in formulating scientific theories and laws do not depend on any contingent values (i.e., social, ethical, or political). The latter means that human desires, wishes, guesses, capabilities, or experience do not play any role in the formulated theories and laws of scientific research. A natural suggestion is that in order to achieve objective scientific theories and laws (i.e., product objectivity), we need the process objectivity (Longino, 1990, 63). If I compare the two conceptions (given by Longino 1990 and Reiss & Sprenger, 2017), process objectivity underscores the value-free ideal because the value-free ideal emphasizes the absence of contingent values in the core scientific reasoning process (i.e., gathering data and accepting and analyzing scientific theories).

Since my thesis primarily focuses on the social dimension and activities of Science, it is useful to tease out the two categories of objectivity and to situate the discussion on the process objectivity.

To better appreciate the nature of objectivity, it may be useful to start with the opposite term: subjectivity. Jones (1949) rightly discusses the link between the subjective claims and the fact about our experiences of the world. He argues that the truth about subjective claims depends on our subjective experiences as opposed to any external conditions. Suppose I make a claim, "Coca-cola is the best non-alcoholic drink in the world!" This claim does not point to any fact about the world, because it is a fact about my experience and not someone else. It is solely an issue of opinion about Coca-cola. Again, this is not a fact in the world that we could verify independently. The verification of this claim depends on my words. However, the general intuition is that there should be something other than a subject's opinion. It was crucial for scientists, in the quest to attain a mind-independent reality, to oppose the "subjective preferences and individual idiosyncrasies" (Longino, 1990, 64; Douglas, 2007, 120) because, at this point, subjectivity serves as a "barrier to obtaining the objective truth" (Tannoch-Bland, 1997, 165). Daston & Gallison (1992) rightly linked the development of devices and scientific instruments to the elimination and suppression of subjective interpretation. These measures form a crucial part of the process objectivity.

Science is seen as the discipline to deliver that which is beyond mere opinions. It can give us an accurate representation of facts in the world without dependence on a subject's idea. An accurate representation depicts the world as opposed to how it appears to a subject. This account of objectivity is referred to as "faithfulness to facts" (Reiss & Sprenger, 2017, Product and Process Objectivity section, para. 4). Other terminologies include Nagel's *The View From Nowhere* (1986) and Williams' notion of absolute conception in his famous work, *Ethics and the Limits of*

Philosophy (1985). Therefore, to attribute objectivity to Science in this sense is to claim that the accurate description of the facts out there and their relations with us are correct and reliable (Longino, 1990). If we can depict the world without projecting human needs and values into it, such depiction reflects a mature human intellect.

Objectivity is not only an essential feature of Science, but it also provides the grounds for attributing epistemic authority to the scientific field (Reiss & Sprenger, 2017). However, it largely depends on the kind of objectivity in question. Douglas (2007) argues that the critical aspect of scientific objectivity to keep up with the notion of epistemic authority is the value-free ideal. The basic tenet is that Science is objective insofar as it is free from political, moral, and social values (Ruphy, 2006; Douglas, 2007; Biddle, 2013). There are two issues concerning value-free Science. One of the issues is that it is not always clear the kind of values science should be free from, and the other has to do with the particular stage (s) in Science that should be free from these values. Moral, political, and social values are the kind value-free Science contend against (the moral, social, political values constitute non-epistemic values). Some philosophers of Science (Haack, 1993; Kitcher, 2001) argue that if these values are present in the justification stage of science, they tip the scales in favor of one outcome over another. If a scientist intentionally tips the scales in favor of one result over another, it shows a fundamental failure on the scientists to achieve objectivity. This line of reasoning follows that the essential stages in Science should be insulated from moral and political values. I hope to show that having social, political, and moral values in the context of justification can serve a better purpose than the usual doubt about them.

The plan of the present discussion is as follows. In chapter 1, I discuss the traditional notions of objectivity, i.e., the value-free science ideal. Chapter 2 discusses the value-laden Science. The aim of discussing value-laden Science is to dispel the claims of value-free Science and to provide a better account for value-laden Science. I do so by showing that value judgments can play a role in the justification of Science. In chapter 3, I discuss the shift from subjectivity to intersubjectivity. Intersubjectivity sets the stage for the discussion of the social character of Science. Chapter 4 is the pivot of the paper in which I argue for a proceduralist conception of the social dimension of Science. I show that the social processes of Science, i.e., critical interaction and criticism, have intrinsic value and can serve as objective-procedures for Science.

Chapter 1
The Traditional Notion of Objectivity – Value-free Science

In this chapter, I discuss the value-free notion of Science. I argue that the value-free ideal is unattainable. In section 1.1, I identify the stages of the scientific method. After situating the stages, I present the contexts of discovery-justification distinction, and I identify the stages and the kind of values science should be insulated. I argue that contextual values play a role in both the context of discovery and the context of justification. In section 1.2, I examine the relationship between values and dishonest inquiries. In section 1.3, I explain the main argument for value-free Science.

1.1 The Stages of Scientific Research and Discovery-Justification model

The debate over value-free Science concerns whether social, moral, and cultural values should influence the justification stage of the scientific method (Reiss & Sprenger, 2017). Defenders of value-free Science argue that non-epistemic values should not influence the justification of Science (Longino, 1990, p. 64; Intemann, 2001, p. S506; Douglas, 2007, p. 120). Weber identifies the steps in the scientific model for all scientific inquiry. Weber (1917/1988) outlines four stages of scientific research: (i) selecting a scientific research problem; (ii) the gathering of data; (iii) the assessment and acceptance of the scientific hypotheses or theory; (iv) the application of the research results. Consistent with Reichenbach's distinction between the context of discovery and the context of justification (1938) is the claim that (i) and (iv) can be or are laden with non-epistemic values. It is true that discovering an idea; hypotheses are different from how the ideas or hypotheses are justified. Curd (1980) intended to use the "discovery machine objection" (207) to argue that the logical method only serves questions of justification or validity of scientific hypotheses and theories. Similarly, in his *Logic of Discovery*, Popper writes:

> The initial state, the act of conceiving or inventing a theory, seems neither to call for logical analysis nor to be susceptible to it. The question of how a new idea occurs to a man—whether it is a musical theme, a dramatic conflict, or a scientific theory—may be of great interest to empirical psychology, but it is irrelevant to the logical analysis of scientific knowledge. This latter is concerned not with questions of fact, but only with questions of justification or validity. Its questions are of the following kind. Can a statement be justified? And if so, how? Is it testable? Is it logically dependent on certain other statements? Or does it perhaps contradict them (Popper 2002 [1934/1959], p. 7)?

Popper examines that it is impossible to subject the psychological dimension of scientists to logical scrutiny because the logical method seeks answers for the validity of scientific knowledge in matters of testing and experimentation. Unlike the creation of concepts and ideas at the discovery stage, the formal rules and standard of logic can be applied to the evidence, experimental design, and testing of scientific hypotheses. There is consensus on the identification of (ii) the gathering of data and (iii) the assessment and acceptance of the scientific hypotheses or theory as the core scientific reasoning (Reiss & Sprenger 2017, Epistemic and Contextual Values section, para. 2). The two stages characterize the context of justification. Reichenbach (1938) argues that the design of experimental testing of hypotheses, the characterization of data, the evidential bearing the data have on the hypotheses constitute the context of justification. According to the traditional view, these empirical activities aim to attain the correct hypothesis or theory.

It will suffice to cite the reasons for the context-distinctions. First, it was in the context of justification that the pursuit of truth and correct theories were possible. Second, it shows the non-epistemic values play a role in Science. Based on the distinction, it is uncontroversial for one to claim that non-epistemic values play a role in the first and fourth stages of Science identified by Weber, namely, the selection of scientific research projects and the application of the research results. Third, Churchman (1956) and Levi (1962) identified epistemic values as additional guiding standards for theory evaluation apart from the evidence and the logical rules. For Douglas (2007), the epistemic values that accompany testing and assessment have predictive success, explanatory power, and a single unified account of the world. Justification, by the epistemic values, is the means to achieve accurate account of the world. There is, therefore, no legitimate role for contextual values to play in the context of justification.

What in Science should be free from these values? It is generally undisputed to argue that moral and political values influence the choice of scientific research topics and the practical aims of embarking on such research. However, it is problematic (so the argument goes) to suggest that moral and political values are allowed to justify hypotheses and theories.

Scientific knowledge is value-free insofar as empirical evidence, logical reasoning, and the "norm of epistemic values grounds it in the internal stages of science" (Douglas, 2007, p. 121). The value-free thesis states that scientists should not taint the core scientific reasoning with social, moral, economic, and political values (Ruphy, 2006; Biddle, 2013). Longino (1995) calls these values contextual and alternative. She termed them as contextual values to juxtapose the difference between them and what Kuhn (1970) listed as traditional values for justification and choice of scientific theories: simplicity, accuracy, and internal and external consistency. Kuhn argued that these cognitive or epistemic values are the formal standard and justifiers of scientific theories. They are epistemic values because they lead to the likelihood of truth and acceptability of theories, and traditionally, the scientific investigation aims to attain truth. The aim of the inquiry determines the type of value the scientists allow in their practice. Reichenbach (1938) and Carnap (1937) had rightly connected the epistemic values to provide empirical and logical justification between the evidence and the theory.

1.2 Science, Values and Dishonest Inquiries

One of the critical dangers of value-laden Science put forward by advocates of value-free Science is that when scientists allow contextual values to enter the core scientific reasoning (i.e., testing of hypotheses and acceptance of hypotheses), to the extent that value judgments affect justification of theories, it will lead to dishonest scientific inquiry (Lacey, 1999). Dishonest Science allows scientists to pay keen attention to politically motivated scientific theories (Haack, 1993). Proponents of value-free Science argue that the dangers of contextual values in Science are evident in the history of Science.

Consider negative eugenics in Nazi science. According to Proctor (1988), negative eugenics became a state-sponsored science. Nazi science promoted the practice and advocacy of improving the Aryan race through laws. The enacted law prevented genetically diseased offspring through forced sterilization, and there were cases of depriving reproduction. Proctor (1988) further argued that the Nazi government showed commitment and leadership in this practice through laws and the creation of concentration camps. They reached the foregone conclusion that eugenics is the surest means of achieving a superior race, the ideal society, or citizens. A science program informed by values is, by that very fact, considered as "bad science." I consider Nazi eugenics in the way that it was practiced as "bad Science". The reason is that it led to distorted outcomes. The Nazi regime justified their research on the assumption that the Aryan race was superior insofar as the more Aryan race would dominate through the forced sterilization policies and the scientific practice itself. The results of the practice misrepresented facts about the Aryan race in comparison with other races.

We can cite a similar example in Lysenko's genetics. According to Graham (2016), Lysenko was a Soviet agronomist and biologist. As a student, he got interested in agriculture. His interest in agriculture sparked up some of his projects/research in plant genetics. His ideas on plant genetics stood in sharp contrast to the existing Mendelian genetics. Rossianov (1993) points out that Lysenko preferred the doctrines of the communist revolution to the evidence from Mendelian genetics. His hostility and mistrust of Western Science led him to reject the Mendelian genetics in favor of his politically motivated Soviet Science.

Typically, Lysenko, according to his law of the life of species, forced farmers to plant seeds very close together. Lysenko's law stated that plants from the same class do not compete with each other (1954). Most of the crops he planted died and got rotten. He also educated the peasant farmers about Soviet crops sprouting at different times of the year by soaking them in freezing water, among other activities. However, as noted by Graham (2016) and Hagemann (2002), according to traditional plant genetics, it was impossible.

Rossianov (1993) further remarked that Lysenko attacked the traditional plant genetics, which stated that plants and animals have stable characteristics. These characteristics are encoded as genes, which plants and animals pass down to their offsprings. He considered such an idea unreceptive and evil since he saw them as strengthening the status quo and rejecting the spirit of Soviet Science. The critical issue is that he rivaled the dominant genetic literature by his politically-motivated Soviet ideologies. He did that by displacing the existing evidence from Mendelian genetics.

It suffices to say that Lysenko's claims about genetics were not consistent with the available norms of empirical justification in the mainstream biological research on genes. Hagemann (2002) noted that Lysenko's politically-assumed Science was not reproducible, and consequently, even German genetics avoided the claims by Lysenko. His political influence and desire for power had a significant impact on many areas of Soviet Science and politics. Lysenko was a tyrant who used politics and public admiration to suppress free scientific thinking and those who opposed him. The problem then is that Nazi science and Lysenko's genetics were done for the wrong reasons. Although its Science (in terms of testing was impeccable), it derived from unjustified assumptions. It is the kind of justification we do not accept. We accept theories not because they yield true beliefs but also they meet specific value requirements. The worry for value-laden Science is that if political interests are allowed to influence the domain of justification (acceptance of theories), then politically oriented researchers will be permitted to favor the facts they would like to attain. Although there is a matter about the pessimistic view on value-laden Science, not all value-laden Science is politically abusive. Some value-laden scientists argue that the purpose of some contextual values is to keep track and eliminate values that serve to displace evidence. If I compare the views of Longino (1990) and Anderson (1995), social and political values do not displace evidence; instead, they clarify claims about the nature of evidence.

1.3 Evidence and Values

A proponent of value-free Science will suggest that empirical facts, observation, and empirical evidence are the "province of the sciences" (Crumley, 1999, p. 192). If empirical facts and evidence are the elements in the domain of Science, then value judgments need not figure in the relation between the evidence and the hypotheses or theories. Consistent with the above claim is the statement that "science deals only in facts" (Dupré, 2007, p. 27). Dupré's assertion is consistent with the logical empiricists' proposals. In his *Testability and Meaning – Continued*, Carnap writes:

> It seems to me that it is preferable to formulate the principle of empiricism not in the form of an assertion – "all knowledge is empirical" or "all synthetic sentences that we can know are based on (or connected with) experiences" or the like – but rather in the form of a proposal or requirement. As empiricists, we require the language of Science to be restricted in a certain way; we require that descriptive

> predicates and hence synthetic sentences are not to be admitted unless they have some connection with possible observations, a connection which has to be characterized in a suitable way (Carnap, 1937, 33).

Carnap is expressing some reservations about the properties or objects that constitute scientific hypothesis or theory. He argues that the properties or objects must be genuine properties of nature; properties that figure in observation. Science is also in the empirical business, and thus, adopt operational concepts and terms that fit the description. For Carnap, there is no room for value judgments in Science.

Crumley (1999) explains that value judgments express the way things ought to be or standard that determines what ought to be. Value judgments do not have the formal properties that can stand in evidential relation. The relation between empirical evidence and theory forms a particular model of justification for value-free Science. This model of justification presupposes that value-judgments cannot serve as reasons to believe a hypothesis or theory is true. An argument concerning the role of value judgment in justifying theories is below. Haack (1993, p.5) and Anderson (1995, p. 33) provide some propositions for the argument. Anderson argues against premises 1 and 2, whereas Haack argues for premises 4 and 5.

1. The sole aim of scientific theories is truth.
2. The features that are truth-apt justify scientific theories. Justification is dependent on evidence that the theory is correct. A true theory is that which is supported by empirical evidence.
3. The kind of support comes in the form of valid inference from the evidence to the theory.
4. "Value judgments are akin to normative claims about what ought to be the case.
5. We cannot move from what ought to be the case to claims about what is the case. There is no valid inference involved in deducing 'is' from 'ought' (Haack, 1993, p. 35)."
6. There is no evidential support from value judgment to theories.
7. Value judgments have no role in indicating the truth of theories.
8. Therefore, value judgments play no role in justifying theories.

From premises 4 and 5, Haack assumes that supporters of value-laden Science typically assert factual claims from the value judgments they hold. The assumption rests on the assertion that there is no deductively valid inference from factual to value judgments. Haack's reservations are by no means conclusive in ruling out the role of value judgments in scientific justification. On Haack's reservation, one would have thought that value judgments serve as reasons for believing that a hypothesis or theory is true. We need not discuss value judgment as providing direct support or reasons to a theory. Instead, we should deploy them as standards for judging the relevance of the evidence we have for a hypothesis/theory.

Anderson (2004) argues that it is equally true that statements of evidence alone do not deductively support scientific theories. The scientific theories logically do more than the evidence specified in support of them (p. 5). Kristen Intemann suggests that value judgment can be background assumptions that judge the relevance of the evidence (2001, p. S508). It will be absurd for a proponent of value-laden science to argue for the direct inference that the "is-ought" assertion seems to put across. Anderson writes:

> Let us not be deceived by the suggestion that non-neutral investigators will be tempted to illegitimately infer "P is true" from "P ought to be true,"… This is a red herring. Feminists believe that women ought to be free from rape, forced reproduction, and material deprivation. This does not give us the slightest interest in believing that we already live in a feminist utopia, where women enjoy these freedoms! On the contrary, it heightens our awareness of when these feminist values are not realized (Anderson, 2004, p. 7-8).

Again, factual claims are not descriptive all the way down. They can be valuationally assessed. Suppose I claim that Covid Organics (CVO) is a drug for COVID-19. For the claim about the drug to be accepted, one needs to generate additional information. I need to evaluate the potency of the drug through clinical testing. By evaluation, the drug has to meet the World Health Organization's criteria for decision making such as the recommendations from the Strategic

Advisory Group of Experts (SAGE) on immunization; the drug should meet the demands in the respective UN supplied markets, and suchlike (World Health Organization, 2018). If it is granted that the drug passed the evaluation test, then the normative standards play a crucial role in determining the acceptance of the drug into the scientific fold. “The precision of the criteria is given point by the interest in evaluation” (Dupré, 2007, p. 30).

Anderson (2004) points out that the narrow conception of value judgment rests on an instrumentalist view. In this view, value judgments cannot a priori tell us about whether our values are right or wrong. We can only identify the means that would realize the value we want to achieve. This view implies that value judgment cannot count as evidence that our values are good or bad. For this reason, “value judgments are thought to be held dogmatically” (2004, p. 8). People can hold on to their value judgments, notwithstanding the facts around them. According to Anderson, the assumption that value-laden Science leads to dogmatism will hold only if people who hold value judgments are “blind to good arguments and are unwilling to revise their opinions or values” (1995, p. 35). The supporters of value-laden appeal to tolerance, diversity, and openness in Science. They are willing to revise their values in the face of counter experience. It is the attitude of openness, tolerance, and diversity that validate value-laden Science.

Moreover, “some experiences provide evidence for value judgments” (Anderson, 2004, p. 9). For instance, there is a fact of the matter about emotional experiences. I can specify a token pain event, namely toothache, by way of its qualitative aspect to me. If I claim that having a toothache is a bad experience, I am justified in believing that my toothache is a bad experience. I have a fact and a value judgment. The fact is that I experienced a toothache. The value judgment is that it was a bad experience for me. Moreover, when we encounter a traumatic experience, it leaves afterimage in our memories. It does appear that there is a connection between our emotional experiences and the situation we encountered. Like empirical hypotheses, value judgments stand in an evidentiary relation to factual claims about our experiences (Anderson, 2004).

In sum, the value-free ideal is unattainable. The empiricists' model for distinguishing the context of discovery-context of justification, and preserving the justification stage from contextual values does not hold. I explained the role value judgments play. They offer additional conditions for justification. I argued against the claim that value judgments do not stand in evidentiary relation to factual claims. We have seen that there are real cases of politically motivated Science. But these are few cases of dishonest scientists, and as I argue in chapter 3 and 4, dishonest sciences are put in check by the social organization of Science. Now I turn to the value-laden Science.

Chapter 2
Value-laden science

There seems to be some consensus on the role that contextual values play in setting a research agenda for scientists and applying scientific theories in a sociological context (Kitcher, 2001). In other words, the consensus is that contextual values influence the discovery stage of Science. However, the concern is whether we can account for the role of contextual values in the actual work that establishes the scientific hypotheses and theories (i.e., the context of justification). In what follows, I will attempt to assess the argument against value-laden Science in the previous section. I will cast doubts about some of the premises and to assess some cases of scientific practice in which contextual values are relevant to how it is practiced. I finish by driving home the point that value judgments play a role in assessing scientific theories (Anderson, 1995, 2004; Longino, 1990; Wylie, 1992). For purposes of argument, I use the term value judgment as an expression of contextual values.

The central issue of the argument for value-free are premises (1 and 2): the aim of scientific theory and justification. To be consistent with the empirical methodology, Longino (1987) argues that value-free scientists hoped to model the truth-justification relation in the case of evidence-theory relation. If this model is successful in Science, we can form a generalization of the evidence relative to the hypotheses/theories. However, as Intermann (2001) has reiterated, background assumptions mediate between the data and theory. The background assumptions serve as auxiliary hypotheses. Scientific theories are justified through the validation of the auxiliary hypotheses.

Furthermore, these auxiliary hypotheses can be motivated by value judgments (Longino, 1987; Intemann, 2001). Consider the theory of natural selection by Darwin in 1859. For Darwin's theory to hold, he relied on observational data of specific variations in traits in organisms of different species (Darwin, 1859). He assumed the specific traits were relevant to the survival of the organism, and subsequent offsprings were inheriting such traits to the extent that the absence of the traits led to the extinction of the organism. He must have judged that the lack of variations in traits reduces the quality of life of the organism. Judgment about the quality of life relative to the presence or absence of variations implies extinction and how a sustainable life should be. In this sense, the claim that certain traits constitute the quality of life forms the auxiliary hypothesis. Moreover, judgments about the quality of life is a value judgment (Intemann, 2001, p. S509). It presupposes a normative commitment to some standard of life. The value judgment confirms the evidence from the observational data. Roush states that auxiliary hypotheses make the evidence relevant relative to the hypothesis/theory (2007, p. 171). It is misleading to claim that the data by themselves, display their evidential significance. The data need to display some more productive structure in order to become relevant. Proponents of value-free Science often suppress these auxiliary hypotheses from justification by licensing direct inference from evidence to theory. They do not account for the role of value-laden auxiliary hypotheses in scientific justification.

2.1 Truth is Insufficient

Premise 1 of the argument against value-laden Science rests on the assumption that the aim of scientific inquiries is truth. It presupposes that for any adequate theory to hold, we must test the truth-value for each proposition within the theory (Anderson, 1995, p. 33). The claim about truth in this context seems too simplistic of the actual scientific practice. For Darwin to offer natural selection as an adequate theory to account for the origin of species or evolution (Darwin, 1859), he purports something more than accumulating true propositions in his theory (Anderson, 1995, p. 39). His theory aimed at organizing the observational data into patterns that are adequate to address problems in his theory and to offer an explanation. He aimed at offering a relevant theory that provides answers to problems about the origin of species, a theory that can be accepted as adequate. For Anderson (1995), empirically adequate theories imply relevant truths. If the sole aim of Science is to attain truths, then it follows that one could be justified in believing every proposition of Darwin's theory but not justified in accepting it as an adequate theory. In her *Philosophy of Science after Feminism*, Kourany expresses a similar idea:

> And finally, like the empiricist ideal of Science, the ideal of socially responsible Science recognizes that scientific rationality must be defined in terms of scientific success, but unlike the empiricist ideal of Science, the ideal of socially responsible Science also recognizes that scientific success must be defined in terms of social success – human flourishing, what makes for a good society – as well as an empirical success (Kourany, 2010, p. 68).

We judge theories as adequate if it purports to provide answers to human problems in our social context. Such an account characterizes not only truth as a scientific success, but also usefulness and relevance to human needs. Judgment about significance, relevance, and usefulness requires a value judgment.

In the case of medicine, we can discuss the goal of scientific research as not merely pursuing truths, but also significant truths relative to good health. Anderson rejects the notion of truth as the sole evaluative factor for assessing theories. She suggests that it is a minimal view of the aim of scientific inquiry. I agree with her view that truth alone is necessary but not sufficient for theory evaluation; “essential truths are relevant to accepting a theory”(1995, p.39). To justify a particular set of symptoms as schizophrenia, we judge that the symptoms constitute dysfunctional elements that are essential to human health (Intemann, 2001, p. S511). The goal of scientific research is not to generate clusters of truth but to arrive at a significant solution to some medical phenomenon (Anderson, 1995; Intemann, 2001; Kourany, 2010). Moreover, the significance is determined in almost all cases of scientific research by value judgment and interests, for example, by our interest in human health; in finding a cure for schizophrenia. Potter (2006) shares a similar commitment to the social success of Science. If we concede that social values, namely good health and moral interests, do not lead to bad Science but are necessary in order for the theory to be socially relevant in curing, say, schizophrenia, then instead of merely accumulating true propositions we go further to achieve moral and social values.

There is an objection that one might raise against the role value judgments plays in the justification of scientific hypotheses/theories. One might argue that value judgments attain to the stage of goal-setting of Science. They are irrelevant to the justification stage of Science: whether a theory is justified is determined solely by the evidence that the theory is true. The underlying assertion here is that justification solely depends on truth. Both proponents and opponents of the value-free ideal of Science could agree that there are other epistemic virtues besides truth. For instance, they could cite simplicity and explanatory power.

Moreover, theories with strong explanatory power and simple account of phenomena are more justified even if such theories are not more likely to be true. However, I would like to explore the issue of whether value judgments can provide reasons for accepting scientific hypotheses. Value judgments influence the degree of rational confidence we can have in a scientific hypothesis, even when they do not make the hypothesis true. Justification does not solely depend on truth.

Weber (1917/1988) insists that the justification stage constitutes the gathering of data and the assessment and acceptance of scientific hypotheses. At this stage of scientific inquiry, the evidence cited in support of the hypotheses is scrutinized to check whether indeed the hypotheses are justified based on the evidence provided. The assessment of the hypothesis is done to check whether the new hypothesis coheres or is consistent with the existing body of hypotheses. To make my case of value judgment, I will consider the role of value judgment in assessing the reliability of some scientific claims.

Scientific communities rely on evaluative standards for research (Anderson, 2011). Members of the scientific community trust and believe in the expertise of each other. According to Intemann (2001), what makes scientific claims reliably justified are the evaluative judgments. And evaluative judgments can be value judgments about a person's capabilities (p. S516). For instance, if Jane, a new member of the community suggests that she had found a vaccine she will rely on the expertise of the scientific community for assessment and acceptance. She is expected to offer some explanations and relevant methodological approaches in her research. The community will evaluate the explanations and methodological approaches. Through the processes of evaluation, the community of scientists will either accept her approach as reliable or not. (She might even be judged on competency).

It would not be prudent for the community to make a decision unless some minimal standards of inquiry are present. To judge reliability or competency, the community depends on the following background assumptions regarding the criteria for judging some level of expertise and honesty: (i) evidence of consistency with the existing methodological approaches and (ii) evidence of conflict of interest, such as receiving funds from institutions who have interest in pushing agenda (Anderson, 2011, p. 147). Value judgment can play a role in whether or not the scientific community has good reasons to judge competency. The criteria serve as good reasons for the body of scientists to either accept or reject the research claims from Jane.

This is a case in which value judgment is relevant to assessing and accepting scientific hypotheses/theories. If scientific theories are partially justified by testimony, value judgment can be essential to the justification of such scientific theories.

2.2. The Underdetermination of Theory/Hypothesis by Evidence

One of the objections against the value-free ideal is the underdetermination argument. There is a complex relationship between evidence and theory. No evidence by itself sufficiently confirms hypotheses or theories (Duhem, 1954; Quine, 1953). The underdetermination argument stresses that more than one theory is consistent with the available evidence, that is, accepted theories have empirically equivalent competitors. The empirically equivalent theories entail the same evidence, that is, the same observational data (Quine, 1975, p. 316). If we take a theory that we accept (for example, some theory in evolutionary biology), there will be another theory that is empirically equivalent. If there are two competing theories that cannot be both true at the same time, how do we rationally decide which one to accept?

Consider the theory about sex differences in evolutionary biology. According to Milam (2012), Darwin's mate-choice hypothesis in his theory of sexual selection presupposed that females had the same cognitive capacity for aesthetic appreciation and decision making that males enjoyed. Some biologists deny the notion of female choice based on sexual selection because the acceptance of female choice implied ascribing cognitive powers to female animals (Wallace, 1877; Fisher, 1930; Huxley, 1938). They appealed mostly to the mechanical assumption of evolution. After observing the coloration of birds, Wallace, for instance, explained that male birds were more active than their female counterparts, and that accounted for the differences in coloration of birds. The body exuberance of the male bird causes beauty in its plumage. The alternative hypothesis states that female birds do possess much agency in their behavioral choices as males. Trivers (1972) argued that parental investment should be the theoretical basis evolutionary biologists appeal to in order to explain the difference in behaviors among male and female animals. Females evolved to choose males prudently and mate with only superior males. He reasoned that females invested more energy into producing eggs, giving birth, and raising offspring. The ascription of cognitive agency in female animals mainly came in the late twentieth and twenty-first centuries.

One of the hypotheses recognizes the cognitive capacity of the female animal, while the other hypothesis does not. However, the two hypotheses predict the same observational evidence (i.e., sex difference between male and female). We can construe the two hypotheses as being incompatible but empirically equivalent. If one is to appeal to the evidence to adjudicate in such matters, then it does not seem the evidence we have in the above case can help. The evidence itself underdetermines the choice of the hypothesis. We might need further observation or some other considerations to decide which of the hypothesis is more rational to believe.

In assessing further considerations about the evidential reasoning, we can appeal not only to epistemic values but also contextual values (Longino, 1995). On the one hand, simplicity, as an epistemic value, will treat male-female differences as unidirectional (Anderson, 1995; Longino, 1995). It will only appeal to the traditional dichotomy of males as aggressive and females as passive with less or no cognitive agency. Considering further observation of female primates that are able to socially organize their families (even to invest in their offspring) and to show aggressive behavior toward other organisms, the traditional narrative cannot hold (Goodall, 1979). Altmann (1974) argues that simplicity, in principle, does not value theories that treat relationships between organisms as complex and diverse. At best, simple models often make one party a passive object rather than a subject. Such relationships translate into cultural perceptions and social structures of today. If the intrusion of contextual values, on the other hand, will naturalize the cognitive asymmetry in the male-female discourses, then social considerations will have more explanatory power over simple theories.

Proponents of value-free Science might argue that there are good reasons for preferring epistemic values such as simplicity and explanatory power to contextual values. Kuhn, in his essay on *Objectivity, Values, and Theory Choice*, is explicit on the use of cognitive values, and he identifies simplicity and explanatory power as providing an objective basis for assessing theories (1977). We want our scientific theories to predict the real phenomenon if we appeal to its explanatory power. A simple scientific account with its explanatory power offers an empirically adequate explanation of the phenomena we face in the actual world. In this sense, we can consider both theories as true. As remarked by Quine (1975), a theory is true if its empirical content is true. However, if the underdetermination argument holds, we cannot have genuine evidence for underdetermined theories. It is the evidence that gives support to the theory in question. It seems that we will still appeal to some contextual values in order to make decisions on the theory to accept.

The reason for appealing to the underdetermination argument is to show how the argument introduces contextual values into the acceptance stage of the scientific method. It introduces contextual values into the justification stage through auxiliary hypotheses. Scientists must make judgments and offer background information to choose one theory over the other. The values provide alternative criteria for considering one theory over the other. The function of the extra element best explains the role of auxiliary hypotheses. I assume that a typical scientific practice will further support the claim about value judgments serving as auxiliary hypotheses.

The following example shows that value judgments are relevant to classifying certain medical conditions. Intemann (2001) remarks that the classification of diseases requires value judgment of a sort. The example below is attributed to her example of depression (S508). Let us consider an example of a medical condition. Suppose Smith is diagnosed with Schizophrenia. It is a chronic and severe mental disorder that affects how a person thinks, feels, and behaves. According to the World Health Organization (2019), there are sets of symptoms of schizophrenia, which include: delusions, hallucinations, distortions in thinking, reduced feelings of pleasure in everyday life, indecisiveness, among others. The symptoms serve as criteria for diagnosing schizophrenia.

On this basis, we can outline two hypotheses for schizophrenia: (1) Schizophrenia involves a set of symptoms, (2) the symptoms affect the patient badly. The justification of these hypotheses depends on value judgment. The symptoms by themselves do not determine the type of diseases. It is the value judgment that serves as conditions for determining Schizophrenia. The diagnosis of medical doctors and practitioners depends on some assumed normal functions which constitute proper human functioning.

The patient (Smith) might describe experiencing feeling a continuously depressed mood. A depressive mood is virtually the same as the reduced feeling of pleasure. To classify a continuous depressive mood as a symptom of schizophrenia, you need to rely on value judgment. The value judgment concerns the quality of life the disease seems to undermine (Intemann 2001). As correctly remarked by Intemann (2001), Anderson (2004) and Kourany's idea social success of applied Science (2010), it is also about the normative facts about the good life that make the diagnosis of schizophrenia accurate. Facts about human health are mostly empirical, but normative facts about the symptoms (i.e., standard about the good life) justify the process of the classification.

This section basically assesses arguments for value-laden Science. The example of Jane shows how value judgments can play a legitimate role in justifying scientific hypotheses and theories. The normative criteria justify the reliability of testimony about what constitutes good evidence for research action. Relating to the example from medicine, value judgments can serve as auxiliary hypotheses or as background assumptions. They are relevant to the classification of certain medical conditions. The classification becomes lore on which doctors rely to diagnose certain diseases. The underdetermination argument is to show how the argument introduces contextual values into the acceptance stage of the scientific method. Value judgment can play a role in whether or not we have good reasons to trust a scientific theory, and further accept it. Truth is not the sole guiding principle for justifying hypotheses/theories. The arguments I have discussed in these sections show that the value-free ideal is unattainable and that value-laden Science is inevitable due to our human situations. The practice of Science involves humans and how we can theorize and find solutions to our needs. Value-laden science enables us to recognize the positive functions of contextual values in Science. It emphasizes the need for scientists to be transparent about the values embedded in their research. Recognizing the transparency of values implies the need to have proper interaction, discussions, and criticisms in the scientific communities. Moreover, it implies that we strive for greater diversity in the scientific communities as well.

Chapter 3
The Individualistic Notion of Scientific Practice and Intersubjectivity

This section focuses on the individualistic nature and intersubjective approach to scientific practices. It discusses the traditional idea that Science is a one-man activity. It explains the nature of subjectivity and intersubjectivity in Science. I will discuss the need to see science as a social practice. It includes social activities on the part of the individuals involved in the research. Not only should Science aim at its product (scientific knowledge), but it should also emphasize the collective efforts of the individual scientists who take up different responsibilities at the various stages. "Refocusing on science as a practice involves regarding scientific method as something practiced not primarily by individuals but as social groups" (Longino, 1990, p. 67). The individual scientists depend on one another due to the conditions under which they practice Science. The hypothesis formulation stage depicts the need for subjective minds because of how ideas are generated. Nevertheless, individual scientists form a scientific community that uses a specific paradigm to investigate a phenomenon (Kuhn, 1970). They also engage in complex interactions among themselves as well as with the models they use in their work. I will discuss the shift from the individualistic conception in Science to the interdependent relationships among scientists. The main idea is to emphasize and set the stage for the intersubjective approach that features in scientific practice.

According to Crumley (2009), Descartes defended the idea of the epistemic agent as a single individual who pursues the truths about herself and her environment. The solitary epistemic agent is further guided by reason, free from non-rational tendencies (emotions and values). The solitary nature of epistemology diffused into the sphere of Science. Science, at least in the traditional notion, depicted two features "(i) Science is a rational endeavor, and (ii) Science is an individual enterprise" (Crumley, 2009, p. 212). These two features are construed as the subjective tendencies of the epistemic agent. By rational inquiry of Science, the individual scientist is supposed to do Science, which is free from her subjective preferences, that is, her cultural and psychological assumptions (Carnap, 1937). In the traditional analysis of scientific investigation, the individual scientists kick start her scientific investigation, but her evidence and assessment of hypotheses should be devoid of any subjective preferences which have roots in her social conditions (Crumley, 2009).

Longino (1990) argues that it is uncontroversial to emphasize that scientists are humans and that they are not beyond their subjective components: individual psychologies, interests, ideologies, among others (p. 64). These subjective components shape their motivation and curiosity in finding out the nature of the world. The discovery stage comprises the circumstances leading to the initial identification and recognition of the hypotheses. The initial formulation of the hypotheses typically has its roots in the mental states and the social settings of the scientists. Sandra Harding (2015) argues the point about the social conditions of the knowledge capacity of people, typically, those marginalized. The psychological and social elements promote creativity and novelty that are believed to be features of the scientific inquiries. Beyond creativity, it provides available social literature scientists can rely on for research. Grinnell (2009) states that individual scientists, by their subjective preferences, make decisions about when a phenomenon is recognized as a research problem, the methods for investigating the phenomenon, and the methods for justification and application to solving the phenomenon.

The characteristics of the subjective minds of the scientists cannot be disputed at least looking into the history of Science. Some scholars have attributed the birth of modern Science to Galileo. According to Chalmers (1999), the general idea shared was that the observable facts were not taken seriously as the foundation for scientific knowledge. Instead, knowledge was based mainly on authority. For Chalmers (1999), Aristotle was the epistemic authority. By epistemic authority, I mean to say that many scientists deferred to Aristotle and referenced the Aristotelian framework in their postulations. Galileo was a pioneer who championed the shift from relying on authority to facts and experience. His experiment mostly targeted the Aristotelian framework. Galileo's experiment of the leaning tower of Pisa is mostly cited in this case:

> Galileo's first trial of strength with the university professors was connected with his researches into the laws of motion, as illustrated by falling bodies. It was an accepted axiom of Aristotle that their respective weights regulated the speed of falling bodies: thus, a stone weighing two pounds would fall twice as quick as one weighing only a single pound and so on. No one seems to have questioned the correctness of this rule until Galileo gave it his denial. He declared that weight had nothing to do with the matter and that two bodies of unequal weight would reach the ground at the same moment. As the body of professors flouted Galileo's statement, he determined to put it to a public test. So he invited the whole University to witness the experiment, which he was about to perform from the leaning tower. On the morning of the day fixed, Galileo, in the presence of the assembled University and townsfolk, mounted to the top of the tower, carrying with him two balls, one weighing one hundred pounds and the other weighing one pound. Balancing the balls carefully on the edge of the parapet, he rolled them over together; they were seen to fall evenly, and the next instant, with a loud clang, they struck the ground together. The old tradition was false, and modern Science, in the person of the young discoverer, had vindicated her position (Chalmers, 1999, p. 2).

We can separate the actual experiment from the initial formulation of Galileo's hypothesis in the sense that the initial creative thought and the unique nature of his observations changed scientific discourse from the authority-based Science to Science of fact-based personal observations.

The creative nature of the personal discoveries in Science primarily motivates individual scientists to discover more novelties. As Grinnell (2009) rightly puts it, the scientists learn new things at the discovery level. But at the justification stage, she tries to convince other groups of scientists about her new finding (Grinnel 2009, p. 4). At least, the public (including scientific communities, general academic societies, and the larger society) recognizes novel discoveries and grant intellectual recognition. Coupled with the intellectual recognition and appraisal of novel discoveries, individual scientists would design experiments, choose relevant topics to investigate (topics that need urgent attention, say, finding a vaccine for COVID-19 pandemic). The discovery stage also involves a decision about how to spend the available resources of time and money. In some cases, the discovery stage involves changing one's research program due to noticing an outcome the initial program did not anticipate to notice. In such situations, the individual scientists had to decide whether or not it is worth rethinking her whole approach. They must select a particular methodological approach. They make decisions on how to outline their observations for recording. They also decide how to interpret their results. The discovery stage enables scientists to assess their choices for credible inquiry subjectively (Douglas 2007).

The justification stage involves evidence-gathering, hypotheses acceptance, and assessment of background assumptions (Longino 1990, Grinnell 2009; Harding, 2015). In this stage, the subjective elements in the discovery stage are disregarded. The justification process made the formation of scientific communities and "communicable knowledge or shared public imperative" (Tannoch-Bland, 1997, p. 159) possible. The distinction between the discovery and justification stages enables scientists to acknowledge the role of subjective elements in the initial postulation of the hypotheses and theories "while guaranteeing that their acceptance remains untainted, determined not by subjective preferences but by observed reality" (Longino 1990, p. 65) and validly inferred from the observation which will inform the acceptance of the hypotheses/theories. Longino refers to the subjective elements as contextual values. Defenders of the value-free ideal in Science rely on justification untainted by subjective components of the scientists by appealing to logical deductions and experiments. Heather Douglas considers the term value-free Science to be the "norm of epistemic values only in the internal stages of science" (2007,

p. 121). The sources of the non-epistemic values are social, economic, and political settings. According to the defenders of value-free ideal, the internal stage (justification) of Science without contextual or nonepistemic values is objective.

Reiss and Sprenger (2017) insist that the objective account of Science that is concerned with the internal justification is the process objectivity, which features an objective scientific method devoid of non-epistemic values. Defenders of value-free Science argue for an individualistic project of Science to the extent that the scientist is supposed to perform the rigorous deductions and controlled experiments. However, the assessment and acceptance of hypotheses/theories create a shift from the personal discovery to a socially organized stage in the justification of the hypotheses. The role of assessment/acceptance is performed by scientific communities: a body of diverse network of interacting scientists (Grinnell 2009). The scientific communities, according to Longino (1990), have laid down standards by which the justification is done. One underlying assumption is that if we treat the justification of Science as a social practice (as involving a network of scientists), then we should regard the scientific method as something practiced not primarily by individuals but the scientific community.

The scientific communities work in an intersubjective fashion. Longino (1990) cites transformative criticism as the intersubjective model for knowledge production. She argues that the conditions/processes for transformative criticism enable the community to communicate their ideas in an iterative manner (p. 78). Proposals are shared among them, and in the light of big projects, responsibilities are shared. The first condition, "recognized avenues for criticism," requires that criticism of evidence, methods, and assumptions are not marginalized. Equal weight is given to original researches from diverse social backgrounds (1990, p. 76). The second, "shared standards," demands that the scientist and her critics rely on standards for constructive interactions.

The shared standards do not emanate from the psychology of the scientist (1990, p. 77). The third, "uptake of criticism," addresses the claims made by the defender of a hypothesis and the responses offered by other scientists on the said claims (1990, p.78). She listed “equality of intellectual authority” as the final social process/condition for intersubjectivity. It defuses the power asymmetry that one scientist might have over and above the others in the scientific community. Lysenkoism and Lamarckism are typical examples of sciences that were politically motivated and intended to suppress existing theories of biological evolutions. Longino’s idea of complex interactions and collective commitment to certain standards is nothing more than intersubjective agreement among the body of scientists.

The account of scientific objectivity by Longino (1990) rests on two things: (i) the quality of the inquiry and the community of scientists determine objectivity, (ii) the outcome (i.e., the theory, scientific knowledge) conforms to the way the world is. I agree with the first claim but reject the second. In order to reveal background assumptions, a community of scientists relies on critical interaction and criticisms. To reveal background assumptions, there should be diversity in the community of scientists. The diverse community requires the inclusion of dissenting scientists. Longino’s idea is that the inclusion of diverse scientists enhances the expression of alternative perspectives (1990, p. 78). The presence of dissenting perspectives will reveal the background assumptions because such assumptions are mostly not recognized by those who have them. To meet the standard objective process, the community should be committed to revealing and discussing the assumptions that underpin the hypotheses/theory. Her second view is problematic in the sense that if we have diverse perspectives which perspective will qualify as representing the world? Her realist intuition fits the way the scientific community works rather than the way the world is.

Grinnell (2009) and Anderson (2011) insist that within the scientific communities, individual scientists depend on one another for the conditions under which the hypotheses/theories are justified. They share a certain level of education or training, and the sciences they do depend on the valuation from the society within which they exist. What I wish to emphasize particularly is that it is the social dimension of Science that offers a better justification and the second-best objectivity rather than a value-free individualistic model.

This section highlights the nature of both subjective and intersubjective approaches in Science and concludes that the intersubjective approach provides a picture of how we can achieve scientific objectivity. I emphasize the social practice and the interrelationships among scientists as core in defining objectivity. By focusing on science as a social practice, we rather defuse the traditional idea that Science is an individual affair.

Chapter 4
The Procedural Defense of the Social Character of Science

I defend the procedural conception of the social character of Science that applies to critical interaction and criticism. I argue that there are some cases within which the procedural account does not only serve to blot out wrong assumptions and values, but it provides a forum for complementing diverse values and assumptions. This process is typical when we consider cases of genuine peer disagreement. I adopt a moral and epistemic proceduralist approach. The moral proceduralist approach identifies critical interaction and criticism as legitimate if it satisfies certain conditions of equality and diversity of any scientific community. The epistemic proceduralist approach also identifies critical interaction and criticism as legitimate if it satisfies certain conditions of the learning process and mutual accountability (epistemic fairness) within any scientific group. I discuss critical interaction and criticism as a form of democratic decision-making processes. In section 4.1, I contrast the instrumentalist and proceduralist framework of the social organization of Science. I then discuss the moral argument for the proceduralism. I rely on Amartya Sen's democratic theory about individual agencies. I exemplify Sen's idea in relation to respecting the agency of individual scientists regardless of their social background. In section 4.2, I focus on the epistemic argument for proceduralism. Here, I borrow Sen's theory of the constructive function of democracy, that is, the learning processes that feature in the decision-making procedures in democratic institutions. I adopt this idea for two reasons: (i) Science involves a community of scientists with diverse values, and (ii) I consider the community of scientists to be a form of a democratic institution on the basis of its decision-making processes (i.e., critical interaction and criticism). Section 4.3 adopts Korsgaard's notion of intrinsic value to discuss the epistemic value that characterizes proceduralism's learning processes. I then focus on disagreement as a mechanism that fosters procedural objectivity.

4.1. The Notion of Instrumentalism and the Moral Argument for Proceduralism

According to the instrumentalist account of the social processes of science, there is an objective outcome that the social character of Science, i.e., critical interaction and criticism should realize, independent of the actual processes and methods (Estlund, 1997, 2007; Dewey, 1927). I refer to Estlund's and Dewey's view as instrumentalism. However, according to proceduralism, the objectivity of the social character of Science depends on the processes themselves, rather than the outcome (Peter, 2008, p. 5). I reject instrumentalism because it fails to recognize the intrinsic value of the processes that feature in the social character of Science. According to Peter (2008), since it places normative weight on the ideal outcome of critical interaction among scientists, it will create persisting disagreement between what counts as a good outcome and what should be considered as an instance of mistake. Hence, my defense of the proceduralist framework of social objectivity.

According to Estlund (1997), equality, diversity, and epistemic fairness only have instrumental value – the value of equality and epistemic fairness depends on the contribution to objective outcomes after critical interaction among scientists on assumptions, hypotheses, and theories. I take equality and diversity to be features of the well-organized social dimension of Science (or the scientific community). Freedman (2009) insists that diversity gives us a cluster of scientific perspectives and diverse cognitive skills within the scientific community. Equality guarantees mutual respect for all scientists regardless of social, cultural, or political background. Both diversity and equality highlight the actual working of the scientific community. According to Longino (1990), the community of inquiry must acknowledge and tolerate disagreement on assumptions, hypotheses, and experimental designs. Equality and diversity are preconditions for tolerance and acknowledgment.

If I compare Estlund's and Dewey's view of instrumentalism seriously, it seems to suggest some ideal objective-tracking as the standard which determines the objectivity in Science. If equality, diversity, and epistemic fairness do not contribute to the objective ideal outcomes, it is irrelevant for scientific objectivity. Proponents of instrumentalism take it as a premise that a good outcome can be identified independently of the social process existing among the network of scientists. The instrumentalist approach can be considered a monistic conception since only the quality of the outcomes is relevant for objectivity. By not focusing on the instrumental value of the procedures, proceduralism denies the idea of a monistic view since it adds some conditions that enhance equality and epistemic fairness in the social process of Science (Peter 2007).

Peter (2008) addresses proceduralism as offering a better view of epistemic fairness and diversity than instrumentalism. It offers a different approach to why it is relevant to have scientists from diverse social settings to participate in the justification stage of Science. The interests and perspectives of the individual scientists in the scientific community are diverse, and that they have different views about certain background assumptions, hypotheses, and theories. Rawls' idea of reasonable pluralism is akin to this approach (1993). Since on the instrumentalist approach, the focus is on the outcome, and it does not take into account the fact of reasonable pluralism to identify the ideal outcome. The proceduralist perspective emphasizes "the respect of reasonable value pluralism" (1993, p. 63f). The notion of respecting reasonable value pluralism implies that individual scientists from diverse social settings and values participate in the justification stage of Science. It prevents attempts to suppress diverse opinions within the community. It also helps in problem-solving and facilitates specialization

Amartya Sen makes a distinction between the well-being and agency of people, which can be incorporated in the work of scientific communities. His distinction seems helpful to the proceduralist project in elaborating on the essence of equality and diversity. Sen (1985) argues that we need not simply see people as patients who do or do not have well-being, but as people with an agency to pursue specific goals. "To respect the value of people is to respect their agency" (Peter 2008, p. 6). To respect the agency of people, there is the need to have inclusive procedures that will harbor scientists with diverse opinions and values to participate in the critical interaction and criticism (social organization of Science). Sen's argument can serve as a premise for establishing equality, which is paramount in the proceduralist project. The reason is that an individual scientist depends on the network existing in the scientific communities. The network, which relies on the reviews, interaction, and criticisms, depends on the agencies of the scientists. It is the agency that ensures the uniqueness of the contributions from the scientists. The notion of big Science, which involves the body of large numbers of scientists who have diverse expertise, is an example of the network of Science. The Manhattan Project, industrial researches, and institutionalized researches connected to private funding require different expertise of scientists. Scientific communities would require the agents' interactive framework to achieve the projects and the goals of the research. Science is a community but because it involves agents it can benefit from Sen's idea of agency. There is a need for inclusive procedures that will enhance participation in the social arrangement of such projects.

The respect of individual agencies applies to the proceduralist approach which confers objectivity on the procedures themselves. Since it secures the inclusion of diverse values, it is the procedure that guarantees the social interaction and criticism within the scientific community. The instrumental value (i.e., the ideal outcome) cannot be the sole requirement for Science. Christine Korsgaard had a similar view:

> It is the processes themselves that determine normativity on those results…And the normativity of the procedures themselves springs not from the quality of their outcomes, but rather from the fact that we must have such procedures if we are going to form a general will. In order to act together – to make laws and policies, apply them, enforce them, in a way that represents, not some of us imposing our private wills on others, but all of us acting together from a collective general will – we must have certain procedures that make a collective decision and action possible and normatively speaking, we must stand by their actual results (Korsgaard, 1997, p. 309).

Korsgaard refers to democratic decision-making processes. The idea of reaching an outcome (namely, finding a vaccine for COVID-19) fundamentally involves following certain processes. Suppose X is a vaccine. If X has been passed in form by a duly constituted body of scientists, and it has gone through the justificatory stage of testing, assessments, evaluation, it is accepted if the scientific community says that it is. The legitimacy of the scientific community is the duly constituted body of scientists who engaged in rigorous assessment and evaluation. The assessment and evaluation of the X center on the critical interactive model among scientists.

So far, I have made a case for a moral argument for the social character of Science by emphasizing the intrinsic value of equality and diversity. I now turn to the epistemic argument for proceduralism driving home the notion of epistemic fairness among scientists within scientific communities. I will appeal to Sen's argument for constructive function in his *Democracy and Social Justice*. He made a case for constructive function in democracy: "the practice of democracy gives the citizens an opportunity to learn from each other. Even the ideas of 'needs' require public discussion and exchange of information, views, and analyses" (Sen, 1999, p. 3).

4.2 The Intrinsic Epistemic Value of Proceduralism

The "constructive function" (Sen 1999) plays a crucial role in how to interpret the requirement of a proceduralist conception of the social dimension of Science. Although it is mostly applied in democratic theories, I deem it useful as a concept for a community of inquiries. It is akin to the “epistemic contribution of partisanship” (White & Ypi, 2016) or any group endeavor. It captures the epistemic value of the process for membership improvement. Most importantly, critical interaction and criticism serve as a forum for learning from each other. In a diverse scientific community, it is likely to have epistemic differences in terms of the scientists' social conditions (interests and ideologies). Consequently, there will be epistemic asymmetry in the scientists' ability to engage in critical interaction and criticisms. Regular forums and discussions about the community's research interests are well suited to serve as learning opportunities for all members.

Generally, scientists rely on each other for research projects. Anderson (2011) suggests that testimonies and trust are conditions by which any scientific community flourishes. One aim of critical interaction and criticism in scientific communities does not reduce to solely choosing a peculiar outcome. We can measure the relevance also by its constructive function; it provides the scientists the room to form preferences on research interests. For instance, we need not only assess or evaluate scientists working together to produce a vaccine for COVID-19 based on the potency of the vaccine. White & Ypi (2016) emphasizes that such forums support socialization for epistemic empowerment. Individual scientists who form a network learn from each other from repeated experiments and evaluate hypotheses and theories. The associative principle that guides such a network (interconnectedness) is mutually appreciated, but not necessarily because of any particular outcome.

Another compelling instrumentalist account for the discussion in this paper is John Dewey's conception of scientific knowledge (1927). Dewey’s idea lies in two streams: (i) his idea explains better the epistemic value of the learning process and (ii) the instrumental value of the process of scientific inquiry. On the proceduralist perspective, Dewey's account offers a complete explanation of the learning process of critical interaction and criticism in scientific communities. On the instrumentalist's account, he considers the process of Science as a means toward finding solutions to societal problems. In *The Public and its Problems*, Dewey accounts for his view on scientific method and the process of inquiry, which is akin to the scientific method and processes. He writes:

> The layman takes certain conclusions that get into circulation to be Science. Nevertheless, the scientific inquirer knows that they constitute Science only in connection with the methods by which they are reached. Even when accurate, they are not science by virtue of their correctness, but because of the apparatus which is employed in reaching them (Dewey, 1927, p. 163).

In contrast to the ability of Science to aid us in acquiring true beliefs and avoiding the acquisition of false ones, Dewey places value on the processes that guide scientists to achieve an outcome. However, "in his pragmatist tradition, it seems inconsistent to rely solely on the scientific method" (Peter, 2008, p. 17). The reliance on the process of inquiry has dire consequences if the goal of the scientific inquiry is not met. He introduces the instrumental value of the process. The instrumental value of the scientific method is the solution it brings to solving human problems. According to Dewey, "science is converted into knowledge in its honorable and emphatic sense only in application" (1927 p. 174). By application, he means that Science should create solutions that alleviate human misery and suffering. Longino (1995) shares a similar sentiment. In her *Gender, Politics and the Theoretical Virtues*, she regarded "application to human needs" as one of the contextual values and criteria for theory choice. "Scientific inquiry directed at reducing hunger, promoting health, assisting the infirm, protecting or reversing the destruction of the environment is valued over knowledge pursued either for knowledge's sake" (Longino, 1995, p. 389).

Dewey combined the proceduralist and the instrumentalist approach to Science. On the one hand, the scientific method enables exchanges and communication among scientists, and on the other hand, the engagement of scientists enables the formation of good solutions to meet human needs. Although both Dewey and Estlund share the idea of diversity and equality of perspectives and experiences in scientific communities insofar as critical interaction and criticism yield good results (namely, correct outcome in Estlund's view and solving human problems in Dewey's approach), the outcome has more value than the procedure.

The challenge I have with Dewey's approach is that it presupposes an "ideal collective good" (1927) that the scientific method/process of inquiry must attain. What would be the ideal good collective outcome? Even if we know what the good outcome is, the critical interaction and criticism (democratic decision-making processes) will be redundant. It will be unnecessary to engage with each other. It will be better to defer to an epistemic authority that knows the outcome. He recognizes the equality, epistemic diversity, and individual agency. But if he accepts equality, then he must accept the diverse values of individual scientists. If he holds on to the instrumentalist view, then the possibility of reaching a shared good is not likely to occur. In a similar vein, Estlund (1997) wants scientific communities to be diverse only if their diversity can track objectivity (an objectively correct outcome).

Both instrumentalist approaches have something to offer for a proceduralist account I want to defend. However, they fail to place a higher value on the procedure and the conditions of equality and epistemic fairness if the outcome is the sole determinant of scientific objectivity. It fails to accommodate the plural nature of values that equality and diversity propagates. I now turn to the proceduralist framework, which can accommodate diverse values and non-instrumental approach to epistemic fairness on the basis of the constructive function of the critical interaction and criticism.

4.3. The Proceduralist Defense of the Social Nature of Science

I argue that the social processes of critical interaction and criticism have intrinsic value in ensuring equality, diversity, and mutual accountability among scientists toward epistemic fairness. It deepens the idea that scientific objectivity is about the procedure, not the outcome. The proceduralist position embodies epistemic concerns without focusing on the correct outcome of an interaction. It dismisses the focus on an objective outcome as normatively equivocal. The processes themselves are the source of scientific objectivity. I give a weaker definition of critical interaction and criticism as a process of critical engagement and communication with individual scientists from diverse backgrounds and social identities.

In modeling the social character of Science on the democratic decision-making process, we can highlight the epistemic nature that features in the value of learning processes (constructive function). How does the procedural account reveal the moral and epistemic value of critical interaction and criticism? What I mean by a moral value and epistemic value is that the critical interaction and criticism ensures equality and learning processes for the scientific community. I consider both values as intrinsic. I would like to discuss how the procedural account reveals the intrinsic values through disagreement. One advantage of discussing disagreement is that it allows us to represent divergent opinions as morally and epistemically productive and functionally useful for the scientific community. It also discards the notion of mistake or error in the general nature of the disagreement. On the weaker view, disagreement can prompt further research. I do not consider the outcome or response of the disagreeing scientists since that will be inconsistent with the procedural account I want to defend.

The notion of disagreement is the representation of dissent views by many scientists on hypotheses and (or background assumptions). When scientists engage themselves in critical interaction and criticisms, specific backgrounds assumptions are revealed and questioned; hypotheses are scrutinized. I propose that for scientific communities to reveal equality, diversity, and epistemic fairness through interactions in the face of disagreement, the individual scientists should see themselves as peers. There have been quite a several pieces of literature defining who epistemic peers are. I outline some of them briefly. Feldman believes that peers are "intelligent, serious, and thoughtful people with access to the same information" (2006, p. 219). Christensen characterizes peers as "equally well informed and equally likely to react to the evidence in the right way; equally intelligent and rational" (2007 p. 188). Kelly describes peers as "(i) they are equals concerning their familiarity with the evidence and argument which bear on that question, and (ii) they are equals with respect to general epistemic virtues such as intelligence, thoughtfulness, and freedom from bias" (2005 p. 175). Elgin also believes that peerhood involves "the same evidence, reasoning abilities, training, and background assumptions" (2010, p. 53).

Siegal highlights some weaker characterizations and requirements for peerhood: (i) evidence (approximately the same evidence); (ii) epistemic virtues (approximately equally virtuous, and fair-minded); (iii) epistemic ability (good at evaluating and assessing argument); (iv) scope (whether peerhood should be general or limited to particular issues); (v) education/training (2013, p. 14). I agree with Siegal to adopt a weaker approach to peerhood since a strict version will make instances of “reasonable genuine disagreement hard to come by” (2013, p. 15). A generous description of peerhood will portray epistemic peers as “having access to approximately the same relevant evidence, reasoning abilities, training, and background beliefs” (2013, p. 15).

The weaker characterization of peerhood will make sense of value diversity and the diverse social identities of scientists.

I follow a suggestion by Freedman that a plurality or diversity of values characterizes objective scientific communities. However, Freedman sees diversity to have an “instrumental value based on the outcome, i.e., the scientific knowledge” (2009, 54). On the proceduralist account, diversity in our scientific communities is valued, not because it leads to a specific ideal outcome but for offering equality and the platform for learning to take place. It is uncontroversial to claim that scientists who form a network learn from each other. The outcome need not measure the epistemic contribution of a diverse network, but it should be based on the intrinsic relationship of the network itself. According to Freedman (2009), we can identify the diversity of race and gender in our communities of scientific experts. Such diversity is well-suited to act as learning platforms for the scientists offering them diverse intellectual resources to deepen their knowledge on complex social conditions of individual experiences. I agree with the political value Freedman gives to diversity.

Viewing diversity solely from the instrumentalist's point of view seems to limit the potency in other social dimensions. Freedman writes about the value of diversity from the consequentialist stance:

> A diversity of interests and background assumptions in our research communities means that the production stage of scientific knowledge will be exposed to a broad array of human needs. Moreover, this should help to ensure that the outcome of this production (i.e., scientific knowledge) will be accountable to that diversity of human needs (Freedman, 2009, p. 54).

Diversity of perspectives should not be valued because it increases our chances of attaining objective outcomes. Epistemic practices should be best interpreted as procedural – there is nothing objective beyond critically interacting and criticizing each other constructively in "transparency and non-authoritarian ways" (Peter, 2008, p. 25).

For disagreement, the notion of epistemic authority of one value or scientist over another should be removed. Here, I follow a suggestion by Peter (2008) that when there is disagreement on facts, evidence, or interpretation of facts due to diverse values and perspectives, it undermines the epistemic authority of the individual scientists. In this case, the social processes of critical interaction and criticism are prima facie justified.

The procedural epistemic value of critical interaction depends on the relationship of mutual accountability. The notion of epistemic authority is crucial to establishing another epistemic value: mutual accountability. "Epistemic authority is a concept that captures the right to make claims about what ought to be believed, just like practical authority captures the right to make claims about what ought to be done" (Peter, 2012, p. 13). To suppose epistemic authority in a scientific community in the case of genuine disagreement is to suppose that one party to the disagreement should defer to the authority. It makes interaction and criticism redundant, especially when both parties have genuine cases to put across. In cases of the testimony of an expert on a scientific issue, and a situation where there is an epistemic asymmetry between the expert and others who have not trained adequately in the field, deferring to the expert's claim seems justified.

Epistemic authority in circumstances of peer disagreement among scientists who consider each other to be peers is usually defused. Peter (2018) insists that to acknowledge other peers with respect, even when they disagree with you, is to accept them as a source of valid epistemic claims beyond focusing on the outcome. There should be a case in which individual scientists are mutually accountable and responsive to each other. In other words, neither has an epistemic authority over and above the others. In cases of disagreement, Peter (2019) suggests that each scientist has reasons to move in the direction of the other by decreasing the confidence in their previous beliefs (p. 1191). The reason to move in each other's direction is rooted in the notion of mutual accountability or respect among scientists. Peers share epistemic authority, and it is dependent on the relationship of mutual responsiveness among them.

Anderson (1995, 2004) did not discuss proceduralism, but I follow her point about discarding the notion of dogmatism in value-laden Science. The procedural account defuses Haack’s worries about dogmatism, authoritarian, and totalitarian Science that characterized Nazi Science and Lysenkoism (1993, p. 38). It allows for political values to be scrutinized; scientists from different social backgrounds assess background assumptions. Tolerance of diversity was missing in Nazi science. One race was thought to have superiority and epistemic authority over the other races. The normativity of the social processes of critical interaction and criticism forecloses intolerance of equality, fairness, and diversity in Science.

The procedural account renders the difference between intrinsic value and extrinsic value very useful. Christine Korsgaard (1983) gives two distinctions of goodness. One of the distinctions identifies means and ends. The other distinction is between intrinsic and extrinsic value. The intrinsic/extrinsic dimension emphasizes the source of value. According to Korsgaard (1983), intrinsic value refers to that which is valued in itself or for its own sake. A thing is extrinsically valued if the source of value is not in the thing itself but outside of itself (p. 170). If diversity and the learning processes are intrinsically valued, they should always be valued as ends, not just as means. Estlund and Dewey's conception of the social process of Science gives a consequentialist and instrumentalist approach, and such approaches fail to capture the intrinsic value of equality and diversity and the constructive function of scientific communities. The proceduralist account avoids the problem of identifying whether or not an outcome is objective. Nevertheless, it offers a possible alternative of second-best scientific objectivity in the social organization of Science.

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