APPROPRIATING WITTGENSTEIN:
PATTERNS OF INFLUENCE AND CITATION
IN REALIST AND SOCIAL CONSTRUCTIVIST ACCOUNTS OF SCIENCE.

Mark C. Russell

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Joseph C. Pitt, (Chair)
Ellsworth Fuhrman
Marianne de Laet

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(ABSTRACT)

In this thesis, I draw attention to patterns at the intersection of (a) interpretations of science in two journals (Philosophy of Science, and Social Studies of Science) and (b) references to Wittgenstein’s writings. Interpretations of science can be classed according to the degree to which they support a realist or social constructivist understanding of the entities described by current scientific theories. By tracing the intellectual traditions from which these interpretations emerged, I develop an abstracted classification of these positions. Since this classification does not meaningfully map onto the positions articulated by the writers sampled here (which is telling about intellectual histories generally), I develop a new, more promising scheme of classification. I find that Wittgenstein is appropriated more often in support of social constructivist views of science, but that reasons for this support are generally weak. Using a novel measure of content which I call ‘appeal-to-authority,’ I show that there is a significant difference between these journals in their use of Wittgenstein’s writings. But there is a subtle methodological argument at work here as well. I show that methods of analysis which rely exclusively on intellectual histories, bibliometrics, and globablizing statements about the products of science suffer serious limitations. In short, this thesis reflexively shows that the methods upon which it is based allow room for considerable bias and manipulation, and thereby implicates many bodies of work built upon these methods.
Acknowledgments

This thesis was conceived through a somewhat disconnected sequence of experiences involving many fine people. In a number of STS courses on sociology and philosophy of science, I was introduced to the tension between realist and constructivist understandings of science. At the time, such readings seemed central to any approach to the study of science. Some time afterward, Jim Klagge’s seminar on Wittgenstein encouraged a rich, contextual approach to a certain portion of the history of philosophy. The resultant picture – produced by close attention to primary texts and bibliographic sources – seemed remarkably different from many philosophical stereotypes of his work. This realization, coupled with the many mentions Wittgenstein enjoys in the STS literature, led me to long for a systematic overview of the relationship between a timely issue and the philosophical views constantly invoked in support of one or another side of that issue.

Special thanks are due to my committee, Joe Pitt (chair), Skip Fuhrman, and Marianne de Laet. Aside from introducing me to philosophy in the first place, Joe Pitt also proved to be an unrelenting source of patience, historical insight, and clarity of thought throughout this research. Skip Fuhrman is guilty of introducing me to citation analysis, thereby underwriting much the empirical side of this thesis. Marianne de Laet lent a much needed critical ear to the ideas that eventually led to this thesis, challenging me to focus many considerations into a single undertaking. I hope the diversity of this committee can be seen in the pages that follow. I also owe thanks to Bradley Hertel, for instilling a subtle appreciation for the value of careful social research.

I also thank family and friends. To my family, who allowed me to explore my interests without resistance, I am grateful. I also thank the many friends and various roommates for continued patience. Finally, I owe special thanks to Lori Watson, for
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Chapter One – Realism and Social Constructivism

1.1 Introduction: Wittgenstein, Realism and Social Constructivism

Science and Technology Studies is often described and defined as the research undertaken at the intersection of historical, sociological, and philosophical approaches to the study of science. My aim here is to foreground one aspect of this intersection so as to make the connections and tensions among these approaches plainly visible. In this way, we can gain a more complete picture of the field as a whole, viewed, as it were, from within.

In order to produce the right effect, this thesis takes a necessarily windy path. I spotlight the intersection where scholars appropriate the writings of Ludwig Wittgenstein, a philosopher, for the purpose of providing foundations for their views. For the most part, these are theoretical reflections on the ontological and epistemological status of science and its relation to social phenomena. Specifically, I focus on the purported tension between realism and social constructivism. Very briefly, realist accounts of science are characterized by a belief in the mind-independent status of entities mentioned in scientific theories; social constructivist accounts of science are united by an emphasis on social preconditions for the development of these theories, terms, entities – often at the expense of their mind-independent status. As sites of emergence for this tension, I have chosen two prominent journals (Philosophy of Science and Social Studies of Science) in which to search out patterns at the intersection of mentions of Wittgenstein’s work and arguments relevant to realism or social constructivism.

Starting with a common approach to scholarly work in the first chapter, I construct a set of categories by which to classify the varied approaches that amount to realism and social constructivism. This involves a survey of the literature (an
intellectual history of sorts) from which these ideas purportedly emerge. The first chapter has three goals. First, I construct a historical account of the emergence of these ideas about science. Second, I explore a scheme for classifying these interpretations based on intuitively meaningful discrepancies. Since this portion of the thesis takes place entirely isolated from subsequent research, it stands for a certain “history of ideas” approach to abstract subject matter. Since I ultimately discard this scheme in favor of an upgraded one, the final goal is to convey the sense that views based solely on intellectual histories may be problematic for anyone conducting empirical research.

It is in the second chapter that I introduce the updated scheme to render realism and constructivism more intelligible (and more easily comparable). Also in the second chapter, I proceed with the research using methods of citation and citation context analysis. The goal here is to explore the differences between the two journals regarding references to the work of Wittgenstein. The data are employed to test the working hypothesis: opponents in this debate have done little more than appeal to those select portions of Wittgenstein’s corpus which lend support to their views. I propose that this and other features of their enrollment of Wittgenstein (both philosophically and rhetorically) amount to little more than selective appeal to authority. Toward this end, the final chapter offers a thorough analysis of those citations of Wittgenstein that suggest a connection between his writings and realist or constructivist understandings of science.

There are a number of themes expressed in these pages. We could begin with the idea that scholars appropriate ideas, language and procedures from other writers in order to lend support for their project. Texts do not stand on their own. Rather, texts are constructions of relationships between established and novel views. But this is not a complete account of them. Some manage to meet a higher standard of intelligibility than others, which is one reason why we continue reading and writing. However, in some other cases the relationship forged between the text and its sources could be described as appeal-to-authority. Much of the point of this project is to construct a measure from which such citation behavior can be assessed using citation and content analysis.
At this point, one might ask “so what is important about how authors enroll Wittgenstein?” Since, as Latour (1987) tells us, the meaning of a text is a function of its reception and transmission beyond the circumstances of its production, this project promises to provide a picture of Wittgenstein’s work that shows what the readers of his work see as relevant to current controversies. In this sense, we will discover which side of the debate Wittgenstein currently “endorses.”

Another theme is meant to address methodological issues. Since there is only one observer of content at work here, I elaborate on the content analysis in the third chapter by presenting the subset of citations in which Wittgenstein is connected to the issue of realism or constructivism. This leaves room in which others might compare their analyses with my own. The point here is to deconstruct certain of my own findings proposed in the second chapter. In this way, I hope to promote the impression that these methods of citation analysis operate at a level of generality very much ill-suited to the level of abstraction that characterizes so many scholarly texts. By using these methods I am also providing a critique of them from within.

Finally, I must say something about the organization and general tone of this thesis. As any extended research project tends to show, the working hypotheses change considerably over the course of the project. While this may be the welcome result of research findings, it is also often a product of certain realizations about tensions internal to the field of study itself. After some deliberation, I decided to leave the emergent structure of this document intact. The result is that this thesis embodies a certain chronological story. Of course, this could be condensed down into a more easily digestible document. I am, however, convinced that the various dead ends and novel discoveries shown in the course of this thesis speak to the experience of scholarly research itself. In this regard, I offer this thesis as perhaps an example of what happens when we undertake large projects – both for myself and others who are currently grappling with the process of exploration.
1.2 Origins of Social Constructivism

A working definition of social constructivism is essential to the historical account that follows. Social constructivism is an account of science which underscores the constitutive features of social circumstances surrounding its conception and practice. The thesis is that social situations are to some degree influential in the outcome of scientific practices. When pictured this way, there are levels of constructivism which are intuitively distinguishable. These levels vary by the extent of their alleged social influence. We can distinguish between, on the one hand, a constructivist account of science that links specific scientific facts to their social origins in a laboratory and, on the other hand, an account which links the 20th century scientific worldview to certain social and political circumstances which shaped its development. There are many different conceptions of science and society which come into play in these perspectives, but the basic relation between the two is the same: the social is invoked to account for some aspect of science.¹

Accounting for the origin and evolution of social constructivism, some have thought it wise to begin with prominent social theorists -- Marx, Mannheim, Durkheim, and more recently, Berger and Luckman.² Reasons for situating the foundation of this line of thought in the hands of these theorists derive largely from their use of the phrase “social construction.” However, it is not clear that there is a linear connection between the use of this phrase in the context of sociological theory and the context of sociology of science. Subsequently, a number of questions arise: Where did social construction

¹This definition of constructivism is, admittedly, quite broad. As such, it includes some ways of looking at science whose adherents doubtless wish not to be included. For the sake of methodological simplicity I am assuming that most accounts of science can be distinguished by their allegiance to either realism or social constructivism. Of course, in reality nothing is this simple.

²For detailed discussions which address the influence of these figures in the current form of sociology of science, see Collins (1983) and Bloor (1976). For a more general view of the philosophical traditions out of which the sociology of knowledge, and (it is implied) sociology of science emerged, see Remmling (1967).
really come from? What are its central commitments? What criteria can we use to
distinguish between constructivists and non-constructivists? These questions direct this
brief survey of social constructivism. First, I address the question of social
constructivism’s origin in the literature. Second, I articulate what I take to be the central
commitment underlying this account of science.

Lacking a detailed scholarly account of its origins, one place to begin is with the
use and etymology of the actual phrase “social construction.” While the phrase gained
popular currency through Berger and Luckman’s book The Social Construction of Reality
(1966), they do not apply the phrase to scientific reality. Their use of the phrase is
limited to the “reality” that most would call “social” to begin with. This social reality is
comprised of entities such as institutions, hierarchical political structures, bureaucratic
organizations, specialized language communities, and other social groups aligned with
habitualized practices. The current configuration of these social structures is clearly
contingent upon the structures which proceed them. Berger and Luckman theorize that
the organization and structure of our social reality depends largely upon historically
and socially contingent circumstances. On this point their arguments have considerable
force. Yet, when we consider, for example, the picture of the world described by
scientific theories it is not clear that we ought to situate their origins entirely within this
social domain. So, while the phrase “social construction” may owe part of its origin to
Berger and Luckman, it is doubtful their account is the sole progenitor of today’s
constructivism which applies beyond social reality, to the scientifically parsed reality –
the entities proscribed by scientific theories.

Regardless of their use of the phrase, Berger and Luckman are not the first
sociologists to utilize the concept of “social construction.” The concept of social
construction, specifically in reference to scientific knowledge claims, is introduced to
academic discourse in 1935 by Ludwig Fleck. In The Genesis and Development of a
Scientific Fact (1935) he argues that scientific facts are constructed within socially defined
“thought collectives.” The phrase “social construction” does not occur in the book, yet
Fleck uses “construction” as a way to describe the elaborate process responsible for the
products of science -- facts about the world. In his view, the agents responsible for this process of construction are clearly social agents.

However, a Soviet professor named Hessen\(^5\) presented a paper in London, 1931 in which he attempts to establish the social and economic “roots” of Newton’s *Principia* (International Congress of the History of Science and Technology, 1931). This decidedly Marxist perspective on Newton’s scientific views inaugurates the contemporary social constructivist approach to the study of science. By generating attention to the unrealized potential in studying science from the perspective of social theory, this work can be seen as the foundation upon which current constructivist accounts build. Prior to 1931, the origins of these ideas can be loosely attributed to the sociological “fathers” – Marx, Weber, and Durkheim.\(^4\)

If we turn our attention to a narrower account of constructivism, where *knowledge* is the center of analysis, we can trace the foundations back much further. Initially vague and undeveloped notions regarding the social underpinnings of all forms of knowledge can be found in the works of a few 19th century philosophers and social theorists. Ward (1995: 118-119) credits Nietzsche with the distinction of being the first to attack the objective nature of truth, knowledge, and facts about the world.\(^5\) But

\(^5\) At the time Hessen was the Director of the Moscow Institute of Physics.

\(^4\) However, I will not provide a detailed account of their influence; for the current state of sociology as a discipline is indebted to them in ways I cannot spell out here. That some current research in Science and Technology Studies is related to these theorists should be of little surprise given the scope of their influence in sociology writ large.

\(^5\) In this regard Ward references “On Truth and Lie” but without a specific page or line number. I believe he may have had in mind the following, which is worth a look just for its obviously social bent:

> “What, then is truth? A mobile army of metaphors, metonymies, and anthropomorphisms – in short, a sum of human relations, which have been enhanced, transposed, and embellished poetically and rhetorically, and which after long use seem firm, canonical, and obligatory to a people...” (Nietzsche, 1976: 46-47).

This attempt at a deconstruction of truth has obvious similarities with some sociologist’s descriptions of truth as a product of social negotiation and consensus. Despite this similarity, it is not clear that sociologists of science (or constructivists, for that matter) have been directly
it remains to be shown that these writings were directly influential in the development of the current manifestation of social constructivism. More likely roots for this tradition of thought lie in the works of Marx and Mannheim. Simply put, Marx’s critique of capitalism develops the thesis that our ideas are contingent upon our social class and its material culture. In a certain sense social constructivism extends this thesis to its furthest point -- the ideas of scientists. Although there is clearly room for alternate interpretation here, the fact cannot be ignored that Marxism provides a framework within which constructivist sociology of science can be established.

In what is perhaps the most detailed and concise map of the developments in sociological analyses of science, Collins (1983) conveys social constructivism’s debt to Weber, Durkheim, and most importantly, Mannheim. While Weber and Durkheim articulate theoretical frameworks which serve as suitable foundations for the study of social determinants of science, Mannheim (1936: 48-49) directly explicates a thesis of the social determination of knowledge. Yet, the scope of this determination does not obviously include the knowledge gained through scientific inquiry. At times, it even seems as though Mannheim is carving a special niche for the “exact sciences” -- a niche which remains shielded from the thesis of social determination and is therefore foundational. Mannheim employs an implicit distinction between two classes of knowledge: (1) The class of knowledge susceptible to social determination; (2) The class whose veracity outstrips the influence of the social. In the first class reside knowledge of history, knowledge of one’s own intellect, and knowledge of the political. These are socially determined. The second class consists of systematized, mathematical and empirically derived knowledge which is somehow beyond the reach of social determination.

Given Mannheim’s implicit distinction, it is not surprising to find that Berger and Luckman (1966) promote a similarly weak form of the sociology of scientific

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influenced by Nietzsche’s work. Among the sources which describe or endorse social constructivism there are few references, if any, to his work.
knowledge. Arguments by some recent social constructivists are clearly directed against this tentative position for the sociology of knowledge. Perhaps they are reacting against characterizations of the sociology of knowledge such as the following:

The theoretical formulations of reality, whether they be scientific or philosophical or even mythological, do not exhaust what is “real” for the members of a society. Since this is so, the sociology of knowledge must first of all concern itself with what people “know” as “reality” in their everyday, non- or pre-theoretical lives. In other words, commonsense “knowledge” rather than “ideas” must be the central focus for the sociology of knowledge (Berger and Luckman, 1966: 15, emphasis added).

As this remark indicates, Berger and Luckman are concerned to show that “pre-theoretical” reality is socially constructed. However, the relation between “theoretical” (scientific) reality and social foundations is left as an open question. It is difficult to ignore the limitation of scope that Berger and Luckman prescribe for applications of the sociology of knowledge – especially since recent manifestations of constructivism eschew this limit in favor of broader applications of the constructivist thesis.

The development of pre-constructivist sociology of science is far from complete without the mention of perhaps its most prominent 20th century figure, Robert Merton. It is widely agreed that Merton defined the paradigm under which sociology of science in the 1960’s and 1970’s operated (e.g., see Ben-David, 1978; Collins, 1983: 188; Garfeild, 1979; etc.). With a clearly defined set of assumptions in hand, empirically attentive sociologists took on science as an institution, utilizing an array of empirical and quantitative techniques to measure variables such as scientific productivity, the

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6 Packaging this dubious distinction under the rubric of socially constructed “reality” writ large clearly sets up an account vulnerable to criticism by many reflexively minded sociologists who follow.

7 Since ubiquitous application of the constructivist thesis has been in fashion recently, a complete list of these accounts would be quite large. For starters, see Knorr-Cetina, 1993; Woolgar, 1988; Collins, 1996; Bloor, 1987.

8 For a concise history of the sociology of knowledge which specifically traces Merton’s influence, see Ben-David (1978).
structure of reward systems (e.g., Price, 1963; Cole and Cole, 1973), and correlations between various institutional configurations and publication patterns (e.g., Garfeild, 1979: 240-253). This approach was, admittedly, largely supportive of the system it studied. Sociologists who follow Merton’s lead continue to favor the epistemic hegemony of the sciences. As another position to rally against, Mertonian sociology of science may have contributed to the equity with which the Sociology of Scientific Knowledge (SSK, for short) school seeks to analyze all forms of knowledge, scientific or otherwise.

Turning our attention once again to the etymology of the phrase “social construction,” we can complete this historical account by focusing on the use of this phrase specifically in reference to science. The first evident occurrence of the specific phrases “social construction of scientific knowledge” and “social construction of science” in western sociology can be found in two articles which appear in an edited volume published in 1977 (Mendelsohn et al.). The articles by Mendelsohn and Van Den Daele therein coin the use of “social construction” specific to the products of science and scientific knowledge. So, if we need to place a date on the school of thought that describes itself by this phrase, we now have one: 1977.

My thesis is a simple one. Science is an activity of human beings acting and interacting, thus a social activity. Its knowledge, its statements, its techniques have been created by human beings and developed, nurtured and shared among groups of human beings. Scientific knowledge is therefore fundamentally social knowledge (Mendelsohn, 1977: 3-4).

[S]cience as a way of knowing and acting can best be understood as a socially constructed reality.... (Mendelsohn, 1977: 6, emphasis added).

In these passages, Mendelsohn clearly makes the explicit step from the social construction of reality in general, to hypothesizing the social construction of scientific reality. Van den Daele describes his thesis similarly.
The thesis which will be developed here suggests that there is a connection between the rise of science as a cognitive program and the rise of science as a social structure (Van den Daële, 1977: 28-29).

Hence, what may have begun as a thesis on the social origins of common sense, ends with a more focused thesis implicating the social construction of science.

1.3 Contemporary Constructivism

A survey of recent conceptualizations of the theses and commitments central to social constructivism shows there to be a wide variety of approaches and strategies. Some of these overlap significantly, while there is just enough variance among others to make for glaring inconsistencies when viewed as a whole. The classificatory scheme which follows has been compiled from many sources which have also attempted to provide definitions, descriptions and rough characterizations of social constructivism.\(^9\) The research programs in science studies which have been thus identified as constructivist can be arranged in a simple list, along with brief descriptions.

1) **The Strong Programme in the Sociology of Scientific Knowledge (SSK)**
   (Barry Barnes and David Bloor are its most noteworthy proponents) -- The central claim: *all* aspects of science are open to explanation through sociological analysis.\(^10\)

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\(^9\) For instance, explicit definitions of commitments which constructivists are often said to hold can be found in Boyd, 1983; Bunge, 1993; Collins, 1983; Knorr-Cetina, 1993; Mulkay, 1980; Niiniluoto, 1991; Sismondo, 1993, 1996; and Taylor, 1995.

\(^10\) The Strong Programme endorsed by these authors is best explicated in terms of its four prescriptive tenets for sociological investigations of science. These are:

1) **Causality** - social factors will be seriously considered among the causes of scientific knowledge.
2) **Impartiality** - in accounting for truth/falsity, success/failure, and rationality/irrationality of particular events in science.
3) **Symmetry** - entails a rejection of distinguishing between different types of explanations for true or false beliefs.
4) **Reflexivity** - sociological explanations should be amenable to accounting for the sociology of science itself.
2) **The Empirical Relativist Programme in the SSK** -- This perspective “embraces an explicit relativism in which the natural world has a small or non-existent role in the construction of scientific knowledge.” (Collins, 1981: 3).

3) **Weak Program in the SSK** -- It is not clear that this breed of constructivism needs to be addressed in this classification, other than to note that it *treats* all knowledge claims equally. The aims which characterize this program are prescriptive with respect to the formation of policies governing how different social groups adhering to different epistemologies and ontologies (e.g. scientists and lay public) can co-exist. This program makes a point of staying quite clear of assessing the plausibility of foundations for ontological entailments, while remaining agnostic about most epistemic claims as well (Chubin and Restivo, 1983: ch.3).

4) **Constructive Empiricism** -- As defined by van Fraassen: “Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate” (1980: 12). And empirical adequacy requires merely that the theory “save the phenomena”, leaving as an open question the ontological entailments of theoretical un-observables. (This is often seen in conjunction with some form of instrumentalism).

5) **Hermeneutics / Actor-Network Theory** -- Here, the world is viewed as a text shaped by the cultural and social setting in which a representation of it is formed (Bunge, 1993). According to the actor-network approach, facts are the outcomes of complex negotiations between “actants,” which include human, fictional, and “natural” physical entities as well as the networks in which they are situated. This perspective is most often attributed to writers such as Latour, Law, Callon, and occasionally Woolgar.

6) **Neo-Kantian Constructivism** -- The view that “scientific consensus has some direct material import, that representations create their own objects” (Sismondo, 1996: 8, emphasis added).

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For more detailed discussion of these tenets, see Bloor (1991: chapter 1).

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11 Harry Collins named this research program. It is not clear that it claims any members currently, however.
As we can see, this list brings together under one heading writers who, I venture, would rather not be lumped together. There is quite a lack of consensus on the proper definitions of, and relations among, these research programs. As new theorists enter the dialogue, these positions necessarily shift, closing or widening the gaps which separate them. My account does not address these longitudinal shifts; rather, I articulate a cross-section of the current landscape of thought in this intellectual community. However, for the purpose of articulating a set of definitions which can capture the central commitments of any constructivist position, this cross-section will do nicely.

1.4 Constructivist Claims and Commitments

Social constructivist accounts of science can be arranged along a spectrum spanning from weakest to strongest commitments. For instance, at the extreme point of the spectrum corresponding to the constructivist stance the so-called neo-Kantian constructivism holds a place. Boyd (1992) and Sismondo (1993) employ the phrase “neo-Kantian constructivism” to describe any account that entails a commitment to the strongest version of the thesis concerning the social construction of science. The idea is that “in some deep sense the structures studied by scientists are imposed on the world, in the sense of being reflections of the conceptual schemes they employ” (Boyd, 1992: 132). Sismondo attributes this commitment to Latour and Woolgar. As he puts it, neo-Kantian constructivism is “the strong claim that representations constitute material reality, or that no distinction can be made between material and social reality (and thus

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12 Associations between this account of science and Kant are an unfortunate outcome of this descriptive term. Although I use the label here, I do not intend to further the association which is probably a source of discomfort for most Kant scholars.
that the material should be incorporated into the social, which is more immediate)” (1993: 535).

From such descriptions we can discern two claims which writers attribute to neo-Kantian constructivism: 1) The view that representations of reality are *constitutive of* reality. That is, insofar as there is a mind-independent reality it is a product of the representations articulated by historically contingent social groups (obviously deflating the very idea of a “mind-independent reality”). This perspective packages a firm ontological commitment -- namely, that the representations we construct to envision reality *constitute* reality. Any significant sense of a mind-independent reality is precluded at the outset by neo-Kantian constructivism. This account also entails an epistemic commitment: 2) We are in a position to *know* that our awareness is confined to these representations of reality. One instantiation of this commitment is captured by holding that scientists do not have epistemic access to the un-observable laws and entities free from certain theoretical presuppositions. Norwood Hanson (1961) introduced the language currently used to describe such a commitment -- the theory-ladenness of observation.

We can summarize the commitments of neo-Kantian constructivism in a list of epistemological and ontological commitments:
A) Epistemological Construction
Characterized by the claim that our epistemic access is limited to socially constructed accounts of an underlying reality — a corollary of which is the “theory-ladeness of observation.”

B) Ontological Construction
The claim that there is no mind-independent reality. Reality simply consists in the representations we devise to negotiate successful interaction with our surroundings.

There is a third view which ought to be included with these positions: reflexivity with respect to claims of constructivism.

C) Reflexive Construction
The claim that the analysis given by the constructivist is itself available for analysis as a social construction.

Although Neo-Kantian construction involves no clear commitment with respect to reflexive construction, it figures prominently in other versions of the constructivist account. Nevertheless, each of these three constructivist claims (epistemic, ontological and reflexive) can be related to the research programs listed above such that the similarities and differences among them are highlighted. For the combinations of philosophical commitments associated with each of the positions classified in the above list refer to Table 1
Table 1 – Constructivist Commitments

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Epistemologic Construction</th>
<th>Ontological Construction</th>
<th>Reflexive Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Neo-Kantian Constructivism</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2. Strong Programme of Constructivism (SSK)</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>3. Empirical Program of Relativism (SSK)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4. Constructive Empiricism</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>5. Hermeneutics / Actor-Network Theory</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>6. Weak Constructivism</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on this classification we can say that, for instance, neo-Kantian constructivism is committed to the ontological claim -- i.e., that social construction precludes the possibility of a mind independent reality -- and clearly committed to the epistemological claim -- i.e., that we can not have epistemic access to things beyond than the representations of reality which we negotiate and construct ourselves. Similarly, we can see that Constructive Empiricism entails a commitment to epistemic construction only. But, in this case, the constructive empiricist can go one of two ways on the issue of ontological construction. The constructive empiricist is only bound by the claim that epistemic access to unobservables is not free from socially contingent influences. In this table, where a research program is not marked for a commitment this can reflect a number of situations. It may be that, for instance, Actor-Network accounts do not directly entail commitments to ontological constructivism, yet advance a
framework in which such commitments are viable. For the sake of clarity this table represents the minimum requirements of each account.\textsuperscript{13}

It is worth noting that epistemic constructivism does not entail ontological constructivism. For example, one may be committed to the claim that access to the world independent of our experience is necessarily shaped by theories regarding adequate methods of observation, and still maintain a commitment to the existence of a truly mind-independent reality. The same reasoning lies behind some variations of scientific realism under which the entities described by scientific theories are thought to be progressing toward or converging on a theory which captures the full nature of mind-independent reality. Also noteworthy is that epistemological constructivism by itself is not sufficient to distinguish one as a constructivist. The commitment to epistemological constructivism alone falls into a middle ground which is not easily situated with respect to either side of this dispute. (As I show in section 1.7, the same is true of scientific realists who only endorse a commitment to epistemological realism). On both sides of the issue, epistemic accounts are particularly troublesome. Although many accounts share the claim that some aspect of our knowledge is socially contingent, the range of conclusions based on this are so widely dispersed that they defy simple categorizations.

\textsuperscript{13} It is worth noting that an alternative exists for classifying different instantiations of the constructivist thesis: One can differentiate by virtue of the \textit{types of entities which are held to be constructed}. That is, one may apply constructivism only to unobservables postulated by a scientific theory, or to social institutions, or to grounds for closure of a scientific debate, and so on. In this way, constructivist claims of increasing scope can be ordered and used to classify the research programs in the sociology of science outlined in section 1.3. While such a scheme holds a place in discussions of constructivism elsewhere, it is not clear that we cannot do without it here. Hence, I shall proceed under the assumption that the scheme shown in Table 1 can accommodate enough variance to construct a set of criteria adequate for the task of identifying constructivist approaches in the Science and Technology literature.
1.5 Origins of Scientific Realism

Realist accounts generally assert that concepts, objects, categories, or unobservables exist independent of our knowledge of them. Realism, unlike social constructivism, is a term that has been used to describe an account of such things dating back to philosophy’s inception.\(^{14}\) Hence, the strategy of tracing its development with an etymology of the term “realism” provides little in the way of a digestible overview. A conceptual analysis of the development of this position suffers the same deficiency. In fact, a full account of the development of this philosophical tendency would have to start with the beginning of philosophical inquiry itself. Such a full account is not undertaken here.\(^{15}\) Since this thesis is concerned with the tension between current accounts of science, “contemporary” or “scientific” realism is the focus of the discussion which follows. For a simple working definition, scientific realism is any attitude toward science in which the terms of a theory are taken to refer to genuine entities in the mind-independent world. But even this sub-category of realism also has such a long past that etymological and conceptual overviews of its development offer little for clarification. Subsequently, I propose that an understanding of this position is best achieved by sketching the arguments currently given for it.

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\(^{14}\) De Regt (1994) and Stockman (1983), among others, have analyzed these applications of the realist line of thought into a series of historical stages, each characterized by a general tendency to apply the realist interpretation to a discernible set of things. De Regt’s (1994: 1-2) scheme of classification consists of three distinct stages. First, in the “medieval stage,” realism is largely defined in contrast against nominalism with respect to the ontological status of Platonic universals. The second, “modern” stage, sees realism counterposed to idealism with respect to the issue of the existence of material objects independent of the mind. In this stage realism is characterized as a positive stance concerning the possibility of the existence of the external world and other minds. In the third “contemporary” stage, realism is opposed to anti-realism as an attitude philosophers hold regarding the status of scientific theories and the unobservable entities which they describe. Hence the version of realism in currency today goes by the name “scientific realism.” Stockman (1983: 72-78) also casts the historical application of realist theses in three stages. His stages are virtually indistinguishable from de Regt’s. His characterization of the third stage -- scientific realism -- is worth noting for how it importantly distinguishes
1.6 Contemporary Scientific Realism

The expanse of contemporary scientific realism can be surveyed by focusing first on the arguments against it, and subsequently, the responses made on its behalf. Here I discuss the relevant insights of Pierre Duhem and Charles Peirce as a way of introducing some of the complexities associated with this perspective. Perhaps the first crucial objection to a realist ontological interpretation of scientific theories is Pierre Duhem’s argument detailing the underdetermination of theories by experiment.

In the late nineteenth century Duhem advanced the thesis that physics and metaphysics are inherently distinct modes of inquiry. One of the crucial devices in this argument shows that any experimental fact can be employed to support many logically inconsistent hypotheses. Since the results of an experiment can be interpreted such that they lend support for two logically incompatible hypotheses (depending on which auxiliary hypotheses are used), the verification of hypotheses is underdetermined by experimental evidence. Hence, experiments in science cannot provide the empirical foundation for theories as had once been assumed.

The experimental method is not able to transform a physical hypothesis into an indisputable truth, for we are never certain that we have exhausted all the imaginable hypotheses concerning a group of phenomena. Crucial experiments are impossible (Duhem, 1996: 87)

In other words, since hypotheses are underdetermined by experiments, no single experiment can be used to champion one theory over another. In a strong sense, theories are incommensurable with respect to single experiments.  

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between ontological and epistemic concerns. As he puts it, the contemporary use of ‘realism’ is “located in debates over the cognitive status of scientific theories and the empirical status of theoretical terms in such theories” (Stockman, 1983: 78).

For an attempt to trace the issue of scientific realism through ancient, medieval, and modern philosophy, see MacKinnon, 1972.
At a more general level, Duhem endorses a rather unique view of the relationship between scientific theories – especially those of theoretical physics, and metaphysics. He argues that science and metaphysics each possess unique methodologies and disparate subject matters. Duhem maintains that explanatory metaphysics is outside the realm of scientific inquiry. Instead, metaphysics falls within the domain of theological and religious discourse. His reasoning for this division goes as follows. Religion, on the one hand, is causal and explanatory, yet lacks instrumental value. Physical science, on the other hand, is classificatory, has instrumental value, but does not vindicate ontologies or causal explanations. In virtue of this division, he holds that both realms of discourse can reach acceptable conclusions which stand at odds with each other. To reject this division between metaphysics and science is to hold a position consistent with scientific realism. That is, by discarding religion as the domain of inquiry for working out metaphysical claims, the burden of ontological inquiry shifts to scientific theory.

Regardless of how he argues for the primacy of religious discourse in determining explanatory ontology, the important point is that he rejects scientific theory as an enterprise from which ontological conclusions can be produced. I maintain that scientific realism can be seen as a response to this attempt (among others) to dissociate physics and metaphysics.

There is another respect in which Duhem’s philosophy of science may be uniquely instrumental in the development of contemporary scientific realism. Duhem thinks that eventually science and theologically based metaphysics will come to have a common set of referents -- instrumental science and theological metaphysics will converge. He maintains that science will be constituted such that the objects it describes will correspond to those described by theologically grounded cosmology. In other words, science will eventually achieve a classification of nature which is consistent with, and supportive of, the religiously articulated metaphysical system.
Thus, the history of physics lets us guess at a few features of the ideal
type to which scientific progress tends, that is, the natural classification
that will be, as it were, an image of cosmology (Duhem, 1996: xv).

This picture of science incrementally converging on a “natural classification” is
described by subsequent scientific realists as “convergent realism”.

Duhem is not alone in this hopeful realist outlook. Charles S. Peirce also
advances a thesis of convergent scientific realism.\textsuperscript{16} Peirce’s reasons for characterizing
the relation between science and reality as “convergent” derive from his ideas about the
nature of “truth”. In contrast to a correspondence theory of truth, Peirce’s idea of truth
is better described as a “convergent-correspondence” account of truth. On this account,
truth is properly understood in terms of a point in the future at which all parties agree
on the truthfulness of some group of propositions which, at that time, will fully
correspond with “reality” (Buchler, 1955: 38). From this account of truth in the future,
his account of the truthfulness of scientific theories follows suit. Peirce’s position is not
clear. It could be either: (a) all forms of science will eventually converge on a singular
account of reality or (b) that all the minute hypotheses of each science will converge on
this unitary account. Despite these differing interpretations, it is clear that Peirce saw
science as something which could in principle provide the true and complete ontology.

The idea of science converging toward a true depiction of reality is supported by
certain patterns in the history of science. The best examples of such conceptual shifts
reside in physics, but analogous instances can be found in nearly every area of human
inquiry. A theory explaining some phenomena that postulates the existence of an un-
observable entity may be modified in the face of new evidence to account for the same
phenomena with a different set of un-observable entities. For instance, notions from
alchemy that the four Aristotelian elements were the basic constituents of matter have
been dispensed in favor of a theory of matter that takes certain atomic configurations to

\textsuperscript{16} Two sources to which the interested reader can turn for the full account of Peirce’s
philosophy of science and its relation to contemporary issues dealing with scientific realism are:
Ilkka Niiniluoto’s \textit{Is Science Progressive?} (1984) and N. Rescher’s \textit{Peirce’s Philosophy of Science}
(1978). Also related is the general outline of Peirce’s philosophy of science in Delaney (1993).
be primary to the constitution of matter. Any unobservable entity can, in principle, be removed from the system in favor of another. As a result, the realist finds it philosophically problematic to confer ontological status to any un-observable entities. The problem, simply put, stems from the tension between two commitments: (a) a commitment to the truth-value of entity existence claims in scientific theories and (b) the lesson from the history of science that current theories will eventually be discarded. Peirce’s way around the problem, convergent scientific realism, is an eloquent one -- but it unleashes additional problems. The convergent scientific realist accepts the impermanence of current scientific theories while postulating a final stage of scientific inquiry in which un-observables have one-to-one truth value correspondence with things-in-themselves. On this account, current scientific theories are rough approximations progressing closer and closer to this end-science.

The progressive account of scientific realism is not without problems of its own. Its weaknesses are two-fold. First, the history of physical science provides evidence that, at times, large portions of previously accepted descriptions of unobservables are often rejected. The result is that one has a regressive account rather than progressive account with respect to explanatory scope. Second, by virtue of what can the philosopher claim actual progress? Claiming progress requires at least a hint of the final state of scientific theory against which progress could be measured or assessed. If the convergentist has access to some vision of the final state of scientific theories, why isn’t she a realist about only that final vision instead of each successive step along the way?

The convergentist is not in as precarious a position as it may seem. In answer to the objection posed above, convergentists will point out that their view of progress in science does not require that each and every replacement theory be closer to the final state than the theory it replaces. On the contrary, it only needs to be the case that on the whole newer theories more closely approximate the final state for there to be progress. In response to the second worry, convergentists might do well to argue that reasons for postulating a final convergence between scientific theory and reality outweigh reasons
for denying such a state. For instance, without such a final state to believe they are working towards, scientists might become depressed, edgy, and violent, turning their attention to the development of new sophisticated torture devices. More seriously, this postulated end-state can serve as a regulative ideal for pioneering scientists (Pitt, conversation). So long as scientists know that we have not reached the end-state yet they will continue refine current theoretical beliefs.

Based on the above characterization of some of the reasoning associated with scientific realism, there is a standard set of problems against which scientific realism is often proposed as a response. This problem set can be conveniently arranged in a simple list.

a) The Under-determination of theory by experiment.

b) Conceptual revolution – Fallibilism of scientific theories in the History of Science.

c) The Theory-ladenness of observation.

The theory-ladenness of observation, as a problem for the literal interpretation of scientifically theorized unobservables, is perhaps the most problematic thorn in the side of scientific realism. Thomas Kuhn, in his *Structure of Scientific Revolutions* (1970), used all of the components of this problem set (especially favoring (c)) to construct a new perspective on scientific change which has since been characterized as “conventionalist,” i.e., counterposed to “realist.” In fact, Kuhn’s entire thesis of the historical contingency of scientific theory change could be adequately summarized by reference to the problems posed on the above list. Most importantly, his theoretical “paradigms” which guide activity in specific scientific disciplines can be seen as little more than a description of science that takes the theory-ladenness of observation as a primitive component of organized human inquiry.

In short, the thesis of theory-ladenness of observation states that scientists empirical observations are significantly shaped by the theoretical paradigm within which they are working.
Nevertheless, paradigm changes do cause scientists to see the world of their research-engagement differently. In so far as their only recourse to that world is through what they see and do, we may want to say that after a revolution scientists are responding to a different world (Kuhn, 1970, emphasis added).

When this idea about observation is taken seriously and coupled with a few examples of radical theory change in science, it becomes clear that theoretical entities (and the ontological systems which they might entail) may be historically contingent. From this account it seems that a realist interpretation of such entities is naive.

1.7 Claims and Commitments of Scientific Realism

In this section I propose a scheme of classification for realist accounts of science based on accounts by prominent philosophers. Richard Boyd, a widely recognized scientific realist, characterizes the position as follows:

[Scientific realism] ordinarily mean[s] the doctrine that non-observational terms in scientific theories should typically be interpreted as putative referring expressions, and that when the semantics of theories is understood that way (‘realistically’), scientific theories embody the sorts of propositions whose (approximate) truth can be confirmed by the ordinary experimental methods which scientists employ (Boyd, 1980: 613, emphasis added).

As this passage indicates, scientific realism is a particular attitude toward the relation between terms in scientific theories and their referents. The issue, then, requires addressing: (i) the attitude we ought to take toward the referring terms of a theory and (ii) a realist attitude towards existence of a mechanism of connecting terms

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17 An interesting problem arises, however, when the philosopher asks “should we also construe the history of science as a form of organized human inquiry?” “And if so, how might Kuhn’s own historical observations be informed by a particular theoretical ‘paradigm’?” Questions of this sort underscore a lack of reflexivity in Kuhn’s historical analysis – this lack weakens his account considerably. This sort of question will not be taken up here, as I am only
and referents in virtue of which claims about the terms can be held “true.” What’s important for the scientific realist, then, is an attitude of semantic realism with respect to the referring terms of scientific theories, and subsequently an attitude of causal realism concerning the connection between referring terms and unobservable entities. Much of what lies behind determining the nature of this connection can be described as epistemological posturing. That is, one may hold a positive position with respect to (ii) by virtue of maintaining that scientists and philosophers alike are in a position from which truth-bearing connections (causal, correspondent, or otherwise) can be viewed. The way I am staging it, the core of claims made by scientific realists can be characterized by certain commitments, which include, among other things, semantic and causal “realisms.”

We should also note that in the last clause of Boyd’s definition he states that the scientific realist must take a realist attitude with respect to the methodology of science. That is, true descriptions of reality should depend on the “ordinary experimental methods which scientists employ.” If one thinks that the methods currently used by scientists are not capable of testing and confirming theoretical propositions the case for a realist stance toward unobservables described by science is exceedingly difficult to articulate. Conversely, methodological realists must address arguments for the theory-dependent nature of scientific methods. Ian Hacking is perhaps the best example of such a methodological realist. Hacking endorses the thesis that experimentation in science is independent of potentially relativizing (and weakening) theoretical input. He directly denies the theory-dependence of methods, and constructs a case for realism based on the autonomy and evaluative success of experimental procedures in science (Hacking, 1984).

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summarizing the development of scientific realism. For more on these one might start with an article by Larry Laudan, “Kuhn’s Critique of Methodology” in Pitt (1985).

18 One obvious way out of such a predicament is to go the route of convergent realist. But as I have demonstrated above, the problems with such a perspective make it a somewhat unattractive alternative.
To sum up, Boyd’s general definition of scientific realism contains two implicit, yet more specific, commitments of a realist orientation: (1) what we can call *semantic realism* -- (a conflation of concerns expressed above as (i) and (ii)) characterized by a realist interpretation of the terms of a given scientific theory and (2) *methodological realism* -- the attitude that some aspect of the methods employed by a given scientific discipline in the testing of theoretically conceived propositions are capable of bearing results which are, at bottom, truth bearing.  

These are not, by any means, the only categories of realist theses directed at science. As an example of an alternative configuration of commitments to claims like those above, Bas van Fraassen deserves mention. Borrowing from Wilfred Sellars, van Fraassen advances a subtle interpretation of science that addresses context-dependence in explanation and truth, yet endorses the instrumental realist claim that “to have good reason for holding a theory is *ipso facto* to have good reason for holding that the entities postulated by the theory exist” (Wilfred Sellars quoted in van Fraassen, 1980: 7). To put it differently, an instrumental realist thinks that instrumental value trumps concerns of ontological status. Van Fraasen’s position, known as *constructive empiricism*, reduces to the following claim:

“Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate” (van Fraassen, 1980: 12).

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10 Notice also that the “terms” here need not be exclusively those which refer to un-observables. One could make a case that even a realistic stance on the interpretation of terms used to describe *observables* can be problematic in virtue of certain lessons from the history of science. Such an argument would seek to undermine the realists possession of literal interpretations of observables, in case the realist would want to construct a system whereby unobservable terms can be cashed out solely in terms of observation terms. Issues of this sort have surfaced in conversations between empirical constructivists, such as van Fraassen, and hard-line realists. For a broad survey of such issues, see Leplin (1984).

20 A potentially important feature of the claim of methodological realism is that this commitment can be sustained in the absence of all other realist claims. For, this type of claim can be qualified such that one ONLY addressed the truth bearing potential of the methods of testing and inquiry, but leaves the truth potential of various starting points and units of analysis open to question.
The essence of his position hinges on the definition of “empirical adequacy.” But what he means by empirical adequacy is not entirely clear. What is clear, however, is that on his account our epistemic access is, in principle, limited such that we have no grounds for making ontological claims merely in virtue of instrumental or explanatory value. His account highlights the importance of another important realist claim which should not go unmentioned – namely, epistemic realism.

One can get the sense of epistemic realism by noticing one aspect of the differences between Boyd’s and van Fraassen’s formulations of realism. Boyd finds it important to characterize his realism such that reference of theoretical terms comes to the fore.21 In addition, his version of realism entails a commitment to the legitimacy of methods used to formulate and test these terms. Meanwhile, van Fraassen focuses on grounds for acceptance of a theory, and what we are warranted in believing by virtue of this acceptance. In a sense, Boyd and van Fraassen agree that the semantics of theories is important.

However, they hold markedly different views on the proper interpretation of what it means to accept a given semantics. Van Fraassen’s takes an agnostic approach toward ontological commitments from theory acceptance. For him, acceptance of a theory only requires considering its instrumental value. Moreover, acceptance of a theory on these grounds in no way commits one to acceptance of a given ontology. He also admits the converse -- that a realistic commitment to a particular ontological framework may steer one’s acceptance of a theory (although he thinks a choice based on ontological requirements is hopelessly misguided).

Boyd will similarly admit that prior ontological commitments can shape one’s acceptance of theories, but he is more interested in reasoning which goes the opposite direction. For Boyd, acceptance of a theory entails a realist interpretation of the entities described by the theory. The difference between their views on acceptance can thus be characterized as a purely epistemological matter. Put differently, van Fraassen thinks that
the grounds we have for accepting a theory are not sufficient to warrant claims of epistemic access to mind-independent entities. Boyd maintains that reasons for accepting a theory do warrant claims of epistemic access to these entities.

To sum up, we can state the issue in terms of a single claim, over which various scientific realists disagree quite often: (3) epistemic realism – with modern scientific practices and theories, we are in a position to acquire knowledge of genuinely mind-independent entities.

As it is formulated above, epistemological realism is interwoven with some of the consequences stemming from semantic realism. For instance, when speaking of phlogiston prior to Lavoisier’s crucial work, epistemic realists would claim that the reasons for accepting the phlogiston theory warranted a commitment to the mind-independent existence of phlogiston. This would necessarily involve a commitment to some form of semantic realism -- namely, that the phrase “phlogiston exists” could be true in a non-trivial way by virtue of some referential connection between that phrase and objects independent of our psychological representations of them.

There is yet another broad category of theses which are held by scientific realists: (4) Metaphysical realism. This position is somewhat more difficult to explicate than the previous theses. The reason underlying this difficulty is its broad scope. Metaphysical realism is a blanket concept which covers a diverse range of perspectives on science. But, as Horwich (1982) points out, the extreme forms of the metaphysical realist’s commitment can be articulated in terms of two positions: a strong or a weak interpretation. The weak interpretation is comprised of a commitment to the existence of the external world. Protons, electrons, quarks and muons are interpreted as “real” in the sense of merely being things which we can and do talk about. So, insofar as these concepts hold a place in our conversations and thoughts, they are “cognitively real.” This version of metaphysical realism does little to distinguish the realists from the non-realists, for both sides willingly agree to such a claim. The strong formulation, on the

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21 Hilary Putnam’s realism leads down the same path toward attention to theories of truth reference as a way of answering the anti-realists objections. For instance, see Putnam (1982),
other hand, takes “real” to mean not only “potential subject matter,” but adds that the entities are autonomous with respect to (a) our ideas about them, and (b) any methods of inquiry by which we come to assess the nature or qualities of their existence. All interpretations of metaphysical realism which fall between the strong and weak theses are exceedingly difficult to categorize.

Another point worth noting about the character of metaphysical realist claims is the fact that it is virtually impossible to claim a form of metaphysical realism without also affirming some commitment to semantic, methodological, or epistemological realism. Although the degree of entailment is not entirely air-tight it seems that a distinguishable feature of metaphysical realism is that it entails a commitment to at least one other form of realism distinguished here.

We are thus left with four claims concerning the conceptual and ontological status of the unobservable entities described by scientific theories:

1) Semantic Realism
2) Methodological Realism
3) Epistemological Realism
4) Metaphysical Realism

If one wished to categorize the patterns of commitments to these claims by some recent scientific realists, the picture might look something like Table 2.

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and his article “What is Realism?” which appears in Leplin (1984).
Table 2 – Realist Commitments

<table>
<thead>
<tr>
<th></th>
<th>Boyd</th>
<th>Van Fraasen</th>
<th>Hacking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Semantic Realism</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Methodological Realism</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>3. Epistemic Realism</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4. Metaphysical Realism</td>
<td></td>
<td></td>
<td>X</td>
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</tbody>
</table>

1.8 Conclusion

The pragmatic consideration which drove the proceeding survey was the need for a set of definitions which are employed in the citation and content analysis in Chapter 2. Now that the range of positions have been sufficiently sketched and arranged according to intuitively appealing categories, we can proceed with the next natural step – analysis of the manner in which Wittgenstein’s work is referenced by a sample of those who tend to write on this issue.
Chapter Two -- Research

2.1 Introduction

In this chapter I am concerned with three things: First, I describe my methods of gathering and analyzing data. Second, I introduce an improved classificatory scheme for realist and constructivist commitments that will replace the scheme from the last chapter. (The need for this updated classification is discussed shortly.) Third, I provide a broad overview of the findings with an eye toward eliminating certain tempting conclusions.

As a research technique often used in the sociology of science, citation analysis has proved to be a somewhat clumsy tool when used alone. It does not measure scholarly influence as precisely as once hoped. However, when conjoined with content analysis, it is a tool capable of making deep and precise exploratory cuts into the nature and meaning of referencing behavior. For instance, what were first thought to be patterns exhibiting the influence of one author on another may prove to be patterns more consistent with corrosive criticism after considering the content of the remarks which surround the references. A conclusion garnered through citation analyses can be significantly reinforced, or, alternatively, vanquished by analysis of the content of the text in which each reference occurs. In this chapter, I demonstrate the alleged virtues of this dual approach by analyzing references to the work of Ludwig Wittgenstein in two journals prominent in the Science and Technology Studies literature. In this same sample of articles, I also trace remarks relevant to the tension between social constructivism and scientific realism.
2.2 The Journals – Sample

While a complete study might have surveyed books and articles published in edited volumes, as well as journal articles, it was determined that the process of deciding which books to include would be significantly biased, or wholly arbitrary. For this reason edited volumes and monographs are not included in this study. In a sense, decisions as to content have been left to the editorial boards and referees of each of the journals chosen. As a result, we have a sample of texts whose content reflects directly on the general attitudes of the editorial boards regarding certain issues, as well as perhaps their disciplinary leaning.

The journals Philosophy of Science and Social Studies of Science were chosen deliberately. Exploring the subtleties of context surrounding references to past work would be a daunting task without some familiarity with the field study.21 For this reason, both journals hail from academic disciplines with which the author is familiar. Another consideration leading to the choice of these journals was the extent of their prestige in science and technology studies generally. Finally, an initial review of their contents suggested a certain degree of receptiveness to explorations of the tension between scientific realism and social constructivism. Since these journals represent quite

21 I might have attempted to round out the trinity of enterprises focused on the study of science by including a journal representative of the history of science. But since there is a significant lack of references to the work of Wittgenstein by those who study the history of science, this would have added little of value to the present study. (A brief search on the Social Sciences Citation Index returned zero articles citing Wittgenstein in the journal ISIS between 1975 and 1996).
different contexts for publication, they are considered independent samples. While they are unrelated in this respect, they are open to comparison because we are concerned with the subset of articles in each sample that cite the work of Wittgenstein.\(^{21}\)

### 2.3 Methods

Rather than employing a set of hypotheses from the outset, this study moves forward in a more exploratory manner – guided by a number of central questions. Here are the questions which underlie the research design and the formulation of hypotheses.

1) **What are the disciplinary backgrounds of those who cite Wittgenstein in each journal?** Is this factor related significantly to the content of the articles citing his work?

2) **What concepts are most often taken from his work?** Is there a significant difference across these two groups of authors? In other words, to what purpose are Wittgenstein’s writings put in these notably different scholarly settings?

3) **On which side of the realism / constructivism issue has Wittgenstein been more often enrolled?** Furthermore, is there evidence to suggest a trend of increasing or decreasing enrollment over the course of the study?

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\(^{21}\) This is not to say that these journals clearly represent one side or another in this dispute. It is only assumed that, on the whole, these journals provide venues in which arguments concerning the epistemic and ontological status of science can be aired.
4) Is there a single factor around which citation behavior with respect to the work of Wittgenstein is best predicted? Initial possibilities for such a factor include (a) the journal in which the citations appear, (b) the authors orientation towards the issue of realism and social constructivism, (c) the “period” of the work being referenced (i.e., early vs. late Wittgensteinian thought), or perhaps some other as yet undiscovered factor?

In the final section of this chapter we will return to these questions and develop answers informed by my findings.

A) Citation Analysis.

The tedious process of thumbing through huge volumes of citation indexes which once characterized citation analysis has been replaced by a much simpler procedure. Using an electronic version of the Social Science Citation Index, accessible through the Dialog CIP information service, a file was created containing the bibliographic information for all articles which incorporated a bibliographic citation of some work by Wittgenstein. Gathering this data could not, however, be entirely automated -- the database only covers articles published later than 1975, while the goal remained to gather data through 1971 (the year in which Social Studies of Science began publication under the title Science Studies.) The resulting sample contained 46 articles altogether -- 17 in Social Studies of Science and 29 in Philosophy of Science.

B) Citation Context Analysis.

The articles were coded for content according to two narrowly related sets of variables. First, I read each article for bibliographic references and footnote numbers which could be linked to passages in the articles. These passages serve as the “context”
in which references to Wittgenstein’s work are situated.\textsuperscript{24} The set of such “citation contexts” numbers 115 within the 46 articles citing Wittgenstein (86 in Philosophy of Science and 29 in Social Studies of Science).\textsuperscript{25} The length of the passage relevant to each citation is flexibly defined – the entire paragraph containing the citation usually sufficed to provide a picture of the role intended for the citation with respect to the subject matter of the article. When one paragraph seemed insufficient for this purpose, the full section surrounding the citation (i.e., introduction, conclusion, etc.) was considered the context to be coded. The second portion of collecting data required coding each article in terms of a second, more detailed set of variables.

A set of variables with which to measure the content of citation contexts has been advanced by Moravcsik and Murugesan (1975). Although originally designed to measure differences in content between empirical and theoretical articles in physics journals, these measures are general enough to be of use here. Focusing on the content of the text within and surrounding the footnote marker for each reference to Wittgenstein’s work, the citing documents were classified according to four dichotomous variables. There are actually three possible values for each of these variables – the third value is “neither”, used in cases where no classification was deemed appropriate.

1) Is the reference \textbf{Conceptual} or \textbf{Operational}? In other words, is the citation made for the purpose of a theoretical or conceptual contribution, or does the citing document rely on a method or procedure developed in the referenced document?\textsuperscript{26}

\textsuperscript{24} Similar strategies described as “citation context analysis” can be found in Small (1978), Moravcsik and Murugesan (1975), Spiegel-Rosing (1977) and Cozzens (1985), to name just a few.

\textsuperscript{25} Resulting in a mean of citations per article of 2.5

\textsuperscript{26} This classificatory scheme saw first application in a study of the citation behavior of physicists. This first dichotomous variable is a relic from this initial application. Since the
2) Is the reference **Organic** or **Perfunctory**? That is, is the reference required for an adequate understanding of the point being made, or is it rather an acknowledgment of work which falls under a general category?

3) Is the reference **Evolutionary** or **Juxtapositional**? In other words, does the referring paper stand on the shoulders of the cited work, or does it stand as an alternative to it?

4) Is the reference **Confirmative** or **Negational**? In other words, how does the referring paper judge the correctness of the cited paper? Does the referring paper make the reference simply in order to point to error, or does it purport to confirm the content of the cited paper?

In addition to these, two further variables were coded:

5) Is the reference **Persuasive** or **Non-Persuasive”? In other words, does the referring article use the reference to substantiate a contestable claim? More specifically, is the reference essential to an argument being made, or is it referred to in an uncritical review of previous work?

6) Is the cited document employed as a “**Concept Symbol**”? In other words, does the author of the referring document connect an idea with a specific

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philosophy and sociology of science are, by and large, of a conceptual orientation, this variable draws a distinction worth very little to this study.

27 The persuasive function of citations appears in Gilbert (1977) in a study of the rhetorical function of citation behavior in science journals.

28 Utilizing a theory of symbol formation and use culled from Edmund Leach, Small (1978) proposes a conception of citation behavior as symbol generation and symbol maintenance. Prominent works reportedly become so by way of references which repeatedly associate authors names with ideas, arguments, and conclusions. Although this variable is open to a bit of subjective variation, I have attempted to improve upon his conception and code in favor of
author? (For example, when a citing document contains the remark: “Despite a proclivity for rejection of causal reductions along *Humean* lines, no primitive assumptions burden the argument outlined here.” The reference to Hume is coded as using the cited document as a concept symbol.)

In order to link the values of these variables with information about the content of the articles, two more pieces of information were noted in each reference. First, it was determined which of Wittgenstein’s ideas were employed or alluded to. Some of these concepts overlapped significantly, and they were subsequently refined into a smaller set of meaningful categories. Categories include, for example, “form of life,” “family resemblance,” “meaning as use” and so on. Fifty distinct categories of referenced concepts are the result of this process (Appendix A contains, among other things, a list of these concepts). Secondly, the specific texts that each reference cites have been recorded, including the page and paragraph numbers made use of, where available. Only six of Wittgenstein’s texts are cited in the sample of 115 references. The texts are slightly different in each journal. A difference we will return to shortly.

Lastly, the contexts surrounding each reference were coded for their content in regards to the claims of constructivism and realism. Those which were relevant in some way were coded for the presence or absence of each commitment. Out of 115 citation contexts, only 14 engage the issue of realism and constructivism. This subset of articles clearly constitutes the core of those that make the most direct connection between the writings of Wittgenstein and the issue of realism and constructivism. Some characteristics of this subset of citation contexts provide insights which will be crucial in our attempt to answer the questions outlined above. Therefore, we will undertake a

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*This variable only in cases where the authors name appears in the text (rather than the footnote) along with a summarized idea. In this way only those references which most explicitly participate in symbol maintenance are coded as such. Further refinement of this variable is achieved by associating the Wittgensteinian concept in each reference with its use as a symbol. Appendix A contains the results of this breakdown of concepts.*
closer look at this subset in the next section -- but first, let us look at the structure of the data sets.

In order to avoid confusion we must bear in mind that there are three distinct sets of data described above.

A) Article Data -- The author’s disciplinary background, year of publication, journal of publication and type of article (feature, book review, etc.)

B) Issue Relevant Data -- In reference to the content of the article as a unit of analysis, this set of data contains information regarding claims relevant to the issue of realism and social constructivism.

C) Citation Context Data -- Includes information about the document cited, the four dichotomous variables discussed above, whether or not specific page numbers were cited, the general concept made use of, and so on.

Since (A), article data, and (B) issue relevant data, both contain information that applies to the entire citing article, they can be compared without difficulty. The unit of analysis here is the individual article. However, the same is not true for (C) citation context data. Since the unit of analysis for this set of data is the individual citation, it is difficult to relate patterns in this data set to patterns in the data for (A) and (B) (There are articles which contain as many as 24 individual citation contexts, and some which only contain 1). Due to this difference in units of analysis, it is not possible to make inferences from patterns of variables in the level of citation contexts to variables at the whole article level. This information is still useful, however, for articulating a descriptive picture of the two journal samples.
In Chapter 1 we developed a scheme of classification for (B), issue relevant claims. However, in the course of gathering data using this scheme, it became clear that there were a significant number of claims and positions regarding the debate that could not be fairly classified according to this scheme. As with any attempt to base research on an intellectual history only, practical applications are difficult. To compensate, I developed a new scheme based to a large extent on that offered in Chapter 1, with adjustments stemming from the positions described by the author’s own accounts in each article. The resultant scheme has the advantage of *symmetry between certain commitments on both sides of the issue*. Moreover, the claims are arranged in a way which reflects a similarity between the increasing scope of each level, on each side of the issue.

**Table 3 - Clusters of Realist and Constructivist Views**

<table>
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<tr>
<th>Constructivism</th>
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<tr>
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Under each of these headings are a number of varied approaches to realism and constructivism which, when seen as examples, make clear the reasons for constructing these symmetrical threshold scales.
2.4 Realism and Social Constructivism: Two scales based on threshold commitments.

Metaphysical Commitments

Scholarly perspectives on science are a diverse group of positions with a tendency to resist rigid categorizations. Nevertheless, certain of these perspectives can be identified which are radical in their claims. These positions occupy the outermost edge of both social constructivism and realism. They are identifiable in part by virtue of the scope of application given to their respective claims. For instance, in the case of realism, we can identify a position under the heading 'metaphysical realism.' According to this perspective the theoretical unobservables of science have ontological status. The claim of the metaphysical realist is that, in general, science elaborates metaphysical and ontological claims. The similarly radical tendency in social constructivism is called 'metaphysical constructivism'. According to this perspective, the products of science consist of the social and political circumstances in which the practice of science takes place.

I propose that there is a noticeable absurdity in these extreme positions. Without a limit on the metaphysical scope of these commitments, they tend toward self-refutation. Let us consider each in turn. For the social constructivist, this absurdity derives from the claim that all accounts of phenomena, knowledge, and unobservables generated by science are the product of social and political circumstance. To substantiate this claim, the metaphysical constructivist invokes relationships that hold among social groups, institutions, assumed methodological practices, and subject—object distinctions (among other things). But in so far as these foci reflect just another process of scientific inquiry, they are not protected from the account of knowledge, phenomena, and unobservables which they are invoked to support. When metaphysical social construction is applied to the observational claims it rests upon, it
undermines its own viability. Even from merely an epistemic perspective, the result is a claim about the knowledge generated by science that is subject to its own analysis, constituting a vicious circle. To hold this position seems absurd.

Woolgar (1988) advances a constructivist account which claims there is no reality beyond the social situations in which our representations of reality are formed. This position is a curious one because it generates a knowledge claim that cannot overcome itself. If it is true, then its truth is diluted by the fact that it is a product of social construction. The claim ‘there is no reality removed from its social origins’ must be seen as a product of its social origins (or perhaps Woolgar’s social origins!). In a sense, this requires that we maintain a full fledged realism about 'the social.' But any evidence we invoke to bolster this claim will again be seen as a product of the social situations in which such evidence is sought and tested. Hence, we are faced with a vicious circle of evidence. Such a position is uncomfortable, if not absurd.”

Realism fares no better when given the same global application. In Chapter 1 we observed that the history of science is rife with accounts of things such as 'N-rays' and 'phlogiston' – unobservables which were once thought to command ontological status but are now explained in terms of interactions among other unobservable entities. If we advance the thesis that the unobservable theoretical entities employed in science are real in the sense that each term (e.g., 'atom') refers to a genuine mind-independent entity, we must avoid the implication that all the entities ever proposed by science genuinely exist. Otherwise, our realist attitude seems absurdly ubiquitous, and the world looks like quite a cluttered place.

A more subtle outlook might endorse a variation of Sicilian realism (so called ‘realism with a vengeance’ according to which all of the best scientific theories, at all levels, genuinely refer.) (Joseph Pitt, conversations). In this case, the absurdity of a strong metaphysical claim is avoided because genuine reference with ontological import is taken to be inseparable from reference with semantic and epistemic import.
But instead of dreaming up an *ad hoc* limitation on the temporal scope of our metaphysical realism, perhaps a better approach involves avoiding metaphysical claims altogether.

**Semantic Commitments**

Of course, there are many other positions besides extreme metaphysical realism and metaphysical constructivism. The way I parse things here, we can distinguish an additional three levels of constructivist and realist claims—*semantic, methodological, and epistemic*. For each side of the debate, these positions can be arranged in the form of an ordinal scale representing increasing thresholds of scope of application.

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The task which remains is to produce good reasons for distinguishing these levels within each perspective, describing the opposing sides in a way which underscores their comparability. Toward this aim I employ some claims taken from the articles in each journal sample.

Since the extreme sides of both realism and social constructivism tangle with absurdity, perhaps there are other positions whose tenability stems from other sources.

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29 This particular account has been called “Neo-Kantian” by some writers (Knorr-Cetina 1993, for instance). Given the discomfort this must produce for Kant scholars, I will refrain from furthering the association here.
Here, I propose the most relaxed versions of each position: 'semantic' realism and 'semantic' constructivism. Motivating a realist or social constructivist conclusion from reflections on our use of language strikes me as immediately more viable than from an indefensible metaphysical commitment. Why is this so? Because we are putting considerably less on the line by focusing on the semantics of the terms used in science, than we are when we focus on all scientific claims.

On the constructivist side of this pair, one argues that the meaning we attach to terms is largely contingent on shared experiences and purposes for which the terms are used. Meaning, even of scientific terminology, is inherently socially situated.

In support of this position, the semantic constructivist invokes arguments for the indeterminacy of meaning – namely, that the same term can denote different objects and incite different actions in a variety of social situations. For instance, take the term ‘entropy.’ What 'entropy' means is largely a matter of the community in which the term is uttered. In the linguistic community of thermodynamics, this refers to a certain pattern in the scope of probability distributions of states in physical systems. Here, entropy denotes certain patterns of microstate - macrostate relations. Meanwhile, in the linguistic community of information theorists, the same term is taken to refer to the range of possible arrangements of symbols, a subset of which constitute “information.” A larger set of symbols has a higher degree of entropy than a set of fewer symbols. Here, the requirement of microstate - macrostate relations is mysteriously suspended. (An attempt to disentangle these uses of the term is advanced in Wicken, 1987). Thus, depending on whether we are thermodynamically or informationally inclined, so to speak, the meaning of the term “entropy” is markedly different. The situated meaning of scientific terms lends considerable force to the semantic constructivist’s perspective. In this sense, the meaning of 'entropy' is construed as a product of social circumstances. But the social contingency inherent in language is not limited to mere semantics. At the level of grammar, what it means to follow a linguistic rule properly is largely socially
contingent if not arbitrary. Observations such as these motivate constructivist claims that take aim at the language of science and its objectivity.

Constructivist claims of this sort were observed repeatedly while coding the sample of citation contexts. Since all of these claims were initially classified as ‘semantic,’ so there has been no attempt to consolidate different individual approaches under one general heading, as is the case with many of the other categories of claims and commitments. In order to make this category of commitments more clear, we will turn to a pair of examples. Making a case for the constructivist assumptions of Einstein’s theory of relativity, Schumacher (1988) eloquently exemplifies the semantic social constructivist:

To believe that we can determine the relationships between terms and the world is to believe that our terms are not so much related to each other as they are to the world. What will hold for one user of terms will hold for all others. We will have a classical theory of absolute meaning rather than a special theory of the relativity of meaning, what in general Wittgenstein calls ‘language games’, games whose significance is derived from the relationship between the players. Hence we see once again, in a wider context just how Einstein’s work is explicitly social. (530)

As this passage indicates, semantic constructivism involves suspending a realist attitude toward the relationship between language terms and The World. In place of this, we adopt an outlook that underscores the way in which these terms are produced through social ‘language games.’

Similarly, in a summary of his argument, Brown (1976) attacks the realist presuppositions underlying the definition of ‘semantic components’ in ethnosemantics. Semantic components are “the general conditions which must pertain to objects in order to be denoted by particular words” (378). Brown uses Wittgenstein’s notion of meaning-as-use to criticize what he considers to be a unitary theory of meaning. In his own words:

Semantic components – and by implication the words with which they are associated in componential analysis – may be meaningful not because they
pertain to objects, or are images, feelings or mental experiences, but rather because they are used in a certain way, that is to discriminate among a set of words such as kin terms (394).

In reference to constructivism, the implications of this focus on "meaning as use" are clear. Brown holds a commitment to meaning as a phenomenologically and socially constituted concept. In place of an assumption of congruence between the intention of a term and a mind-independent reality, meaning is seen as a general congruence between uses of a term.

I file commitments like these under the heading 'semantic constructivism.' It is not immediately clear what follows from these claims for a general approach to the study of science. The epistemic, methodological and ontological implications of these observations are the subject of many texts that confront the issue of social constructivism and realism. The point to remember is that, when aimed at the assumed referential invariance of scientific language, the thesis of social construction is not without supportive observations.

Reflections on semantics quite similar to those above also motivate a distinguishable cluster of realist claims. In place of highlighting the indeterminacy of meaning, the realist draws attention to the instrumental value in treating the language of science as if it had referential import. Barnes (1985) calls this the 'realist mode of speech' while Radder (1992) calls this 'referential realism.' On these accounts, using terms to denote observables is instrumentally valuable in or outside of scientific contexts. When we speak of lions, tigers, and bears, it is instrumentally valuable to assume that there are such beasts and assume that our words have the capacity to 'latch on' to them. We purportedly assume this limited form of realism whenever we attempt to communicate basic information to another person. And insofar as clear communication is valuable for achieving certain ends, a realist construal of referencing terms is instrumentally valuable. For the same reason, a realist construal of terms that denote un-observables is also instrumentally valuable.
On a somewhat different angle, Radder describes this variant of realism as 'realism about concepts' that purportedly avoids epistemic and ontological commitments. He motivates this attitude toward the language of science by considering the normative consequences of non-realist (including constructivist) approaches. For instance, when environmentalists argue for political action to place limits on emissions of Clourofluorocarbons (CFC’s), their position is only weakened by an account of science which construes ‘the hole in the ozone layer’ as a phrase whose meaning is socially contingent. If the unobservables of science are contingent upon socially constituted semantics, it follows that instead of taking political action environmentalists ought to attempt to shift all discussions away from such unobservables. For cases like this,

constructivist relativism has unacceptable normative consequences. In order to avoid these consequences we need, I think, a modest form of realism concerning science and technology, instead of ontological and/or epistemological relativism (158).

The resultant referential realism “takes into account the independent existence and the causal agency of reality and explains when terms from the description of experiments and technologies may refer to elements of this reality” (158). This realism merely assumes that terms can actually 'stand for' concepts and that such a relationship is primitive to scientific linguistic practice.

Barnes mirrors this view in what he calls “residual realism”: “It is to acknowledge that our words, as they are used on specific occasions in specific contexts, may point to entities beyond themselves” (Barnes, 1985: 759). I define the category of “semantic realism” specifically in reference to these claims about realist presuppositions underlying our use of language.

Semantic realism and semantic social constructivism are comparable positions in so far as they are both motivated by reflections on our use of language and the status of meaning in our picture of the world. For the empirical project of this thesis, semantic
realism and social constructivism are regarded as commitments juxtaposed at the same level of thought.

**Methodological Commitments**

In the next paired level of the updated scales, scientific methodologies are the source of motivation for both realist and constructivist construals of science. At issue are the epistemic and ontological implications of methods of inquiry, experimental practice, and theory-experiment interaction, to name only a few. Naturally, we will call these accounts *methodological construction* and *methodological realism.* One general feature of this category of commitments is a shared focus on the practices endemic to scientific inquiry. In a certain sense, these sorts of claims are the most hotly contested.\(^3\)

The realist with respect to the methodology of science holds a position which can be summarized as follows. Centuries worth of development in certain of the sciences have produced guidelines for experimental practices, unobtrusive observations, and accepted standards for their results. The tight logical structure and precision of these methods is exhibited by their predictive power in certain situations. As a more or less cumulative result, we enjoy a state of scientific practice today which is capable of generating Truths about the mind-independent world. We have every reason to hold that the methods currently employed in the sciences are capable of producing lasting knowledge of the mind-independent world. That is to say, we are warranted a ‘realist faith’ in the methods, regardless of the current theoretical state of science.\(^3\) Any shortcomings of our understanding of the world today can be accounted for by alternate influences, such as inadequacy at the level of theories or improper operationalization of a given theory.

This realist position is concerned with the truth bearing capacities of our methods of inquiry. Since there are a number of identifiable components of ‘scientific

\(^3\) For a set of articles that develop this theme, see Pickering (1992).
methods,’ there are also a wide range of realist attitudes that fall under the general heading ‘methodological realism.’ Here are some typical individual claims that were observed in the course of coding the articles.

*Realism toward the “objectivity of theory evaluation”:* Greenwood (1990) argues that the theory-ladenness of observation and the Quine-Duhem thesis pose no threat to the objectivity of theory evaluation.

*Realism toward theories and quantities of measurement:* Byerly and Lazara (1973) reject the instrumentalist and operationist views of scientific theories in favor of “a realist interpretation of theories and a modest realism concerning the existence of quantities” which makes the measurement scales used by scientists the most intelligible.

*Cognitive Self-Transcendence:* Meynell (1977) proposes and attempts to define a putative capacity of human beings, and societies of them, to “know what is so at quite different times and places”. Essentially, this amounts to a general defense of objectivity – namely, that humans have various methods of achieving perspectives from which knowledge of the mind-independent world is possible.

Accounts such as these have been grouped under the heading ‘methodological realism.’ It should be noted that some of these accounts draw out the epistemic and ontological implications of methodological realism, resulting in a more advanced variation of the realist thesis. The same is true for the category of claims called ‘methodological constructivism.’

Many constructivists advance a view of the methodology of science that highlights the role of social circumstances in the production of scientific ‘facts.’ For

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31 Herein lie arguments for realism which invoke the ‘reproducibility’ of experiments.
instance, in one of the first in a trend of 'lab studies,' Woolgar and Latour (1979) trace the 'construction of order' in the case of a substance called TRF(H). In their own words:

Our claim is not just that TRF is surrounded, influenced by, in part depends on, or is also caused by circumstances; rather, we argue that science is entirely fabricated out of circumstance; moreover, it is precisely through specific localized practices that science appears to escape all circumstances (239, emphasis added).

Woolgar and Latour view the scientific methods involved in the production of facts in a way which underscores how ideas are reified through certain techniques and day-to-day practices in the social setting of the laboratory. In particular, localized practices of persuasion and routinized inscription are seen as the methods by which scientists create facts rather than discover them. Of course, there is a dose of latent self-refuting absurdity in this account. This absurdity derives from the fact that the account they offer of the 'construction of order from disorder' in the laboratory is itself a 'construction of order' from the disorder of their initial observations, using the same methods of filtering, counting and inscription as the scientists (254). In this sense, we can see how their account of 'methodological constructivism' assumes a realist attitude towards its own methods of inquiry. Thus, a commitment to methodological realism blankets their account and subsequently dilutes its plausibility. But aside from this point of criticism, these authors nevertheless describe their own project in terms consistent with my characterization of 'methodological constructivism.'

There are many other examples of the same commitment in the sample of Wittgenstein referencing articles. For instance, Resnik (1992) maintains a constructivist construal of science based on a consequentialist view of methodological rules in science. On his account, rules are only justified in so far as they assist in our reaching this or that aim. Since our scientific aims can be seen to be oriented around a number of social and political aims, it follows that rules which govern scientific methodology are at least
partly socially constituted, and socially followed. The notion of “interpretive flexibility” also characterizes methodological constructivism. In this respect, Collins (1981: 7) introduces a special collection of articles which “show that the consensual interpretation of day-to-day laboratory work is only possible within constraints coming from outside that work.” Thus, interpretations of scientific experiments and their outcomes are shaped by socially contingencies. In this case, flexibility of interpretation provides motivation for his constructivist construal of the products of science.

Another example of a perspective on science that I take to be part and parcel of “methodological constructivism” is the critique of the objectivity / subjectivity distinction in Mulaik (1995). Here, it is argued that the very conditions necessary for consciousness require a metaphoric “me” as distinguished from the “I.” The “me” is a picture of the self as an object among other objects in the world, and the “I,” is merely an heuristically loaded grammatical device, not an object. This subject – object schema “is the foundation for a basic intuition of most scientists, that hypotheses must be tested with data not used in their formulation” (301). By linking an historically and socially contingent metaphor for the self with the practices of scientists, Mulaik’s account constitutes a thoroughly constructivist interpretation of scientific methodology. It is clear then that methodological constructivism can be motivated by a wide range of reflections on the practices that make up scientific inquiry.

**Epistemic Commitments**

Now we can flesh out a conception of the category of commitments which bear on the epistemology of science -- *epistemic constructivism* and *epistemic realism*. The same equivalence holds between these two positions as between those positions described above; namely, this level of realist and constructivist commitments share a common motivation from reflections on the *epistemic* import of science. Due to the large number

32 That is, the same rule can be applied differently across different social situations.
of articles whose claims were coded at this level of constructivist or realist commitment, I will not attempt a summary of them all here. (The curious reader should consult Appendix B for a complete set of summaries of these constructivist and realist claims.)

For working definitions, the following general descriptions will do. Epistemic constructivists often share concerns with semantic and methodological constructivists. In fact, these positions provide insights which are often used as building blocks in an account of science that emphasizes its epistemic social contingency. Thus, epistemic constructivism usually, but not necessarily, presupposes one or both of semantic or methodological constructivism.

In order to operationalize and measure these commitments, they had to be thought of as thresholds of scope. To put it a different way, if an article is coded as “epistemic,” this reflects that the scope of the claims peaked at the level of epistemic commitment, even though the article may have also contained semantic and methodological commitments.

On the other side of this pair of commitments, epistemic realism is an attitude toward science which regards it as capable, in principle, of producing knowable truths about The World. My description of this class of claims did not require revision from the account given in the first chapter. Accordingly, we need not repeat the descriptions.

We are now in a position to review the findings, beginning with the broadest scope, then narrowing focus to the individual citation contexts that prove to be the most interesting for this thesis.
2.5 Findings

The sampling methods described in section 2.3 produced a smaller than expected sample of articles, book reviews, discussion and review papers (N=46).\footnote{These sample sizes are small enough to preclude many attractive strategies of statistical analysis. Wherever possible, I have supplied Pearson Chi-square measures of significance. However, in most cases my discussion is necessarily limited to descriptive statistics.} The sample is not evenly divided between the journals, with 17 items from Social Studies of Science and 29 from Philosophy of Science. Reasons for this difference may be trivially related to the subject matter that each editorial board deems appropriate. It is not surprising to find that Philosophy of Science contains twice as many references to Wittgenstein considering that the focus of this publication is almost entirely of a theoretical orientation. Let me clarify this. Wittgenstein’s work is arguably more of a theoretical than empirical nature. The majority of his writings can be described in terms of two foci: (1) Specialized topics in logic and mathematics; and (2) Theoretical exploration regarding the relation between language, thought, and behavior (including but not limited to: an ordinary language approach to the philosophical study of language, standards of objectivity, epistemic study of color, and so on). Since both of these foci are germane to a number of topics in the philosophy of science (but not clearly so in the sociology of science), it is not surprising to find that Philosophy of Science contains twice the number of articles referencing Wittgenstein than does Social Studies of Science. Moreover, a casual review of the indexed titles for Social Studies of Science exhibits an apparently even ratio of articles that report empirical findings (such as studies in science policy) to articles with a theoretical or conceptual focus. Thus, by virtue of Social Studies of Science’s inclusion of articles which report empirical findings the disparity between these journals in the number of articles referencing Wittgenstein is explained: A publication which admits both theoretical and empirical projects will contain proportionally fewer theoretical papers and, hence, there will be fewer references to the work of Wittgenstein than a publication admitting articles attuned to more theoretical issues.
However, when the number of Wittgenstein referencing publications is expressed in terms of the percentage of the total number of articles published in each journal, the disparity vanishes. Between 1971 and 1996, 1.84% of publications in *Social Studies of Science* make reference to Wittgenstein; 1.82% of publications in *Philosophy of Science* do so also (see Figure 1). With nearly equivalent rates of reference to Wittgenstein, it is unclear whether the substance of his work is the only factor motivating these references. Perhaps there are other factors which can account for the likelihood of an author to cite Wittgenstein’s work. Among such factors may be the disciplinary background of the author, or the position an author takes with respect to the issue of realism and social constructivist claims.

![Percent of Articles Citing Wittgenstein](image)

**Figure 1 – Percent Articles Citing Wittgenstein by Year by Journal**

As Figure 1 shows, the variance in proportions of articles citing Wittgenstein each year does not conform to any obvious pattern. This is true for both journal samples. However, even with unpatterned variance, both journals exhibit nearly equivalent overall proportions of citing articles over the course of the entire study.

One of the most interesting findings has to do with the difference in *texts cited* in each journal over the course of the study. Table 5 summarizes these findings.

**Table 5 – Citations by Source by Journal**
This table shows that for both journals, the *Philosophical Investigations* is the most frequently cited text, accounting for 61% of the references in *Social Studies of Science* and 55% in *Philosophy of Science*. This is the only similarity between the two journal’s use of the texts. Interestingly enough, the second most frequently cited text in *Social Studies of Science* is *Remarks on the Foundations of Mathematics*, while for *Philosophy of Science* it is the *Tractatus*. The significance of this pattern cannot be overstated. This indicates that authors in *Social Studies of Science* acknowledge Wittgenstein’s realist tendencies a mere 4% of the time. Allow me to elaborate this point.

In the *Tractatus*, Wittgenstein develops a complex, systematic, and intricately structured narrative on the relation between language and The World. His thesis regarding the representative capacity of language is commonly called the ‘picture theory of language.’ According to this account the logical structure of an ideal formal language precisely mirrors the structure of reality. In the ideal language, the logical relations among individual terms, relation terms, general class terms and properties replicate the structure of the world so that these linguistic items can be taken to ‘rigidly refer’ to objects in the mind-independent world. Of course, logic is the ideal language, whose structure is obscured by the inadequacy of ordinary language. By refining our understanding of the logical structure of the ideal language – the predicate calculus –

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34 While there are 29 citations in the sample, there is one in 1982 that curiously does not cite a specific title. Hence, for Table 2 this reference is not counted.
we can come to a position from which we can achieve knowledge of the structure of the physical world. The picture theory of language thus reinforces a realist construal of language in its most primitive form. On this foundation, which he later came to reject, Wittgenstein thought it was possible to construct an adequate picture of the world using the tools of reason and logic. Obviously, such a theory leaves little room for constructivism.

This brings us to what is important about the citation patterns mentioned above. In *Social Studies of Science*, references to the *Tractatus* account for only 4% (which represents only *one* reference!) of all references to Wittgenstein’s corpus. This clearly suggests that *Social Studies of Science* authors are reluctant to engage this realist account of logic and language. The picture in *Philosophy of Science* is quite the opposite. Here, references to the *Tractatus* account for over a quarter of all references to his work. From this we can gather that authors in *Philosophy of Science*, if not inclined toward realism, are at least willing to approach the text as a philosophically or historically significant work.

Since none of his writings speak directly about science, why would authors in *Social Studies of Science* avoid one important text with such regularity? I propose that constructivist accounts, which I show are situated more often in *Social Studies of Science* than *Philosophy of Science*, *privilege certain of Wittgenstein’s texts* for their value in furthering the constructivist agenda, rather than conducting an open reading of the texts which so crucially defined his unique perspective on language. This reluctance is merely one example of the larger pattern of selective citation – a pattern which is more prominent in *Social Studies of Science* than in *Philosophy of Science*.

That this is the case can be seen in Table 5. Notice that in *Social Studies of Science* there is a larger majority of citations for *Philosophical Investigations* than in *Philosophy of Science* (61% and 55%, respectively). While this is clearly the reference of choice for both journals, *Social Studies of Science* exhibits more of a focus on this single text. The pattern of selectivity is also manifest by the fact that authors in *Social Studies of Science* only cite a total of five texts whereas authors in *Philosophy of Science* cite seven. We cannot put
very much stock in this pattern, however, since the number of cases in each sample is small enough to make general claims about patterns problematic in the least.

The reason for offering an account of realism and constructivism in Chapter 2 as a symmetrical scale of threshold claims is that it allows us to develop a picture of the interaction between the two scales of commitment. That is, we can arrange the scale of constructivist claims along one axis and situate the scale of realist claims along the other, generating a matrix. When set up this way, there are two areas of the matrix which reflect consistent commitments and potentially conflicting commitments, respectively. In the chart shown below, the area containing potentially conflicting commitments is surrounded by a bold border.

\[
\begin{array}{|c|c|c|c|c|}
\hline
& None & Semantic & Methodol. & Epistemic & Metaphys. \\
\hline
None & & & & & \\
Semantic & & & & & \\
Methodol & & & & & \\
Epistemic & & & & & \\
Metaphys & & & & & \\
\hline
\end{array}
\]

**Figure 2 – Matrix of Realist and Constructivist Commitments**

If for instance, an article contains a commitment to semantic realism in addition to a commitment to metaphysical constructivism, the article would fall in the area of potential conflict. The assumption at work here is that realism and constructivism are incompatible positions. Hence, any positive commitment to both sides of the issue will fall in the zone of potential conflicts. One might ask at this point what can be gained if this zone only represents potential rather than actual conflict? What we gain by employing this scheme is a measure of the ratio of consistent to potentially conflicting positions for any sample. Insofar as this ratio plays only a minor role in my argument, we need not dwell on its shortcomings.
Applying this measure to each journal sample, we find that articles in *Social Studies of Science* endorse proportionally more potentially conflicting positions than articles in *Philosophy of Science*. For details, see the charts below.

**Sociology of Science**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Semantic</th>
<th>Methodological</th>
<th>Epistemic</th>
<th>Metaphysical</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Semantic</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Methodological</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Epistemic</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Metaphysical</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Conflict= 4</td>
</tr>
</tbody>
</table>

**Figure 3 - Matrix for Social Studies of Science**

**Philosophy of Science**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Semantic</th>
<th>Methodological</th>
<th>Epistemic</th>
<th>Metaphysical</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Semantic</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Methodological</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Epistemic</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metaphysical</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Conflict= 2</td>
</tr>
</tbody>
</table>

**Figure 4 - Matrix for Philosophy of Science**
As these charts indicate, nearly one quarter of all Wittgenstein citing articles in *Social Studies of Science* endorse perspectives consistent with some combination of realist and social constructivist commitments – placing them in the area of potential conflict. Meanwhile, for *Philosophy of Science*, this figure is a mere 7%. But what follows from this disparity? All we can say is that authors in *Philosophy of Science* advance positions with respect to the issue of realism and constructivism which are more firmly positioned in one or the other side of the issue.\(^{38}\) That is, in terms of this scale of measurement, authors in *Philosophy of Science* are more consistent.

\(^{38}\) Of course, my interpretation here could be challenged for its reflexivity. That is, since the definitions of each side of the issue have been culled partially from each of these two journals, the very way in which I have defined each position may bias this picture toward the conclusion. While I recognize the seriousness of this criticism, I think that when this finding is combined with others that follow from the citation context analysis, my interpretations are sufficiently supported.
Figure 5 - Philosophical commitments of all Wittgenstein citing articles by journal.

This representation of the commitments can also supply a general picture of the intellectual landscape with respect to realism – social constructivism. Toward this end, Figure 5 overleaf displays the same information in a more graphically intelligible way. For both journal samples, the most prominent category of commitment to the issue is a lack of commitment (i.e., “None” on each chart). The largest number of articles in each sample fall in the ‘neutral’ category for both sides of the issue. However, there are differences which outweigh this similarity. For Social Studies of Science, the second most frequently held commitment is to epistemic constructivism, while for Philosophy of Science, this position is split between methodological constructivism and epistemic realism.  

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36 Plotting these commitments over time for each journal shows no noticeable pattern.
These graphics also indicate that *Social Studies of Science* authors are ambivalent to the issue more often than *Philosophy of Science* authors. This partially suggests that *Social Studies of Science* authors are more actively and explicitly engaged in resolving the realism – constructivism issue. They may be more concerned with the issue because they have a considerable stake in its outcome. Meanwhile, for *Philosophy of Science* authors, the significance of this issue is negligible.\(^{37}\)

Results from the *citation context analysis* also exhibit noticeable differences between the journal samples. Here, since the variables are representative of the citation context unit of analysis, factors such as the author’s disciplinary background\(^ {38}\) and other variables representative of the article unit of analysis could not be compared across journal samples.

Table 6 displays differences in proportions of findings from citation context variables between both journals. The percentage value represents the proportion of all citations to Wittgenstein that were coded positively for the measures shown.

<table>
<thead>
<tr>
<th>Variable</th>
<th><em>Philosophy of Science</em></th>
<th><em>Social Studies of Science</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Persuasion</td>
<td>10.5%</td>
<td>31.0%</td>
</tr>
<tr>
<td>Concept-Symbol</td>
<td>26.7%</td>
<td>51.7%</td>
</tr>
<tr>
<td>Details Cited in Ref.</td>
<td>81.4%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Debate Relevant Cites</td>
<td>5.8%</td>
<td>31.0%</td>
</tr>
</tbody>
</table>

Let us address each finding in turn.

\(^{37}\) Of course, these patterns obtain only in the sample of articles in each journal that reference Wittgenstein. A future project may undertake to determine what proportion of *all* articles engaging the realism / constructivism issue also employ references to Wittgenstein. Only when this is done can we say with any certainty that the difference in my samples is representative of a true difference between the journals.

\(^{38}\) Author’s disciplinary background (determined by noting the department in which each author was working at the time of article publication) did not prove to be significantly related to constructivist and realist commitments. The lack of significance, however, is due to the small N’s in each category of background.
Persuasion

This variable measures whether the cited source functions as a persuasive element in the argumentative structure of the citation context. As you can see, nearly a third of citations to Wittgenstein in Social Studies of Science (31%) were observed to have such a function, while only a tenth of those in Philosophy of Science serve this purpose (this difference is statistically significant at the .01 level"). There are at least two ways we might interpret such a pattern. First, we might think that using persuasive reference indicates the author is genuinely engaging the cited text. In order to argue with any persuasive force, an author must at least avoid looking foolish by attributing views to texts which do not contain them. As long as this is done, weaving reference to a text into a persuasive narrative only bolsters the argument. On this account, Social Studies of Science would appear to engage Wittgenstein’s work more frequently than Philosophy of Science.

An alternate interpretation would cast this persuasive use of philosophical texts as a crass and perhaps naïve mis-appropriation. A more philosophically attentive approach avoids direct persuasion, referencing texts in order to “map the field of thought” he or she seeks to address. While I appreciate both of these interpretations, I want to advance a markedly different interpretation of this measure.

Philosophical thought has often been described as a conversation among thinkers dispersed throughout time. Authors writing today can engage the writings of, say, David Hume, as though they represented one side of a conversation whose end is far from near. For such a dialogic approach, one clearly needs to be both as charitable as possible to the text, while simultaneously assessing the merits and faults of these charitably reconstructed arguments.

The only way in which persuasive citation can be consistent with such an approach is if it occurs in an article whose principle function is engaging the cited text.

8 The details using Pearson’s Chi-square are as follows: Pearson $X^2 = 6.950$; Significance to 0.0084.
We can test the extent to which this is taking place by noting the number of citations to the text in the article. It strikes me as quite unlikely that an author could offer a charitable reconstruction of an argument, critically appraise it, and make reference to it as a persuasive element in his or her own argument with only one or two references to the text. On this account, persuasive citation in publications with only one mention of the text is taken to show the author has failed to critically appraise the text. In this situation, persuasive citation amounts to little more than appeal-to-authority.

The overall mean number of citations per article in Philosophy of Science is 2.97. For Social Studies of Science, the mean is 1.71. From this crude measure alone, the difference between the amount of attention given to the texts is noticeable, but not necessarily significant. Philosophy of Science exhibits a higher rate of citations per article than Social Studies of Science. To pass judgment based on this number alone would be hasty. We can test for difference between the two samples only by focusing on the ratio of citations per article within the subset of persuasively citing articles. For Social Studies of Science, the mean number of citations for persuasive-citing articles is 2.4, while for Philosophy of Science, the mean is slightly higher at 2.8. Hence, the difference is too small to justify any solid conclusions.

Concept-Symbol

References to Wittgenstein are used as placeholders for concepts more often in Social Studies of Science than in Philosophy of Science. A little over half of all the references in Social Studies of Science are structured this way, while only a quarter of those in Philosophy of Science exhibit this structure.41 What does this mean for the appropriation of Wittgenstein? I maintain that there are three principle functions of concept-symbol citations. (a) They pay respect to writers who originally conceived some unique and

41 This difference is significant at beyond the 0.05 level. Pearson X² = 4.607; Significance to 0.0318.
lasting idea. (b) These citations can be used to direct the reader to source material in lieu of a first-hand account of the concept (perhaps to save space by passing over what is taken to be ‘common knowledge’). (c) Alternatively, I suspect that they exhibit a desire to foster association between the referencing author and the cited author. These references cue the reader to recognize that the author is in some sense influenced by the cited text. Bibliographies often serve the same purpose – exhibiting a set of influences that the reader can use to discern specific intra-disciplinary identity.

The last of these purposes is clearly consistent with, and perhaps suggestive of, references functioning as appeal-to-authority. That citations to Wittgenstein in Social Studies of Science exhibit a higher frequency of this type of references than in Philosophy of Science indicates that as a group these authors may be citing his work more often as appeal-to-authority.

Details Cited

This variable simply divides the samples into two categories: (1) those who cite specific page numbers or paragraph numbers and (2) those who merely cite the title of the text, with no specific remarks in mind. As you can see in Table 6, the difference this measure produces between the journal samples is quite large. Slightly more than 80% of the references in Philosophy of Science include details, while roughly 45% of those in Social Studies of Science do the same. This clearly indicates two things. (a) Authors in Philosophy of Science use direct quotes and references to specific points more frequently than those in Social Studies of Science. (b) When we combine this pattern with the pattern that holds for concept-symbol references in Social Studies of Science, it suggests that authors in Social Studies of Science use blanket characterizations without specifically

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41 This difference is significant at the 0.0001 level. Pearson $X^2 = 14.440$. 
engaging the texts more often than authors in *Philosophy of Science*. Crosstabulating concept-symbol usage with cited details for each journal, the difference is indeed striking: 3.49% of citations in *Philosophy of Science* and 24.44% in *Social Studies of Science* cite without details while invoking Wittgenstein as a concept-symbol.

**Issue-Relevant Citations**

Finally, we come to the variable which divides the samples according to whether or not the citation addresses the issue of realism and constructivism. The findings here are quite telling. Roughly one out of every twenty citations in *Philosophy of Science* address this issue in some way; while in *Social Studies of Science*, this figure is nearly one in three. Obviously, the authors in *Social Studies of Science* view Wittgenstein as more relevant to the tension between realism – constructivism than authors in *Philosophy of Science*. Now the question is “For which side of the debate do these authors see Wittgenstein’s relevance?”

To answer this question as thoroughly as possible, I have selected those articles from each journal which use these references to engage the realism - constructivism issue in some way. This subset of the sample is the focus of the next chapter. We are now in a position to review the findings for the second set of measures.

Table 7 displays each of Moravcsik and Murugesan’s four content measures along with the breakdown of findings for each journal sample of Wittgenstein citing authors. A number of interesting differences are immediately apparent.
Table 7 – Means of Content Analysis Variables by Journal

<table>
<thead>
<tr>
<th>Variables</th>
<th>Values</th>
<th>Philosophy of Science</th>
<th>Social Studies of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor-1</td>
<td>(a) Conceptual</td>
<td>88.4</td>
<td>79.3</td>
</tr>
<tr>
<td></td>
<td>(b) Operational</td>
<td>8.1</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>(c) Neither</td>
<td>3.5</td>
<td>13.8</td>
</tr>
<tr>
<td>Factor-2</td>
<td>(a) Organic</td>
<td>53.5</td>
<td>58.6</td>
</tr>
<tr>
<td></td>
<td>(b) Perfunctory</td>
<td>37.2</td>
<td>34.5</td>
</tr>
<tr>
<td></td>
<td>(c) Neither</td>
<td>9.3</td>
<td>6.9</td>
</tr>
<tr>
<td>Factor-3</td>
<td>(a) Evolutionary</td>
<td>53.5</td>
<td>51.7</td>
</tr>
<tr>
<td></td>
<td>(b) Juxtapositional</td>
<td>25.6</td>
<td>10.4</td>
</tr>
<tr>
<td></td>
<td>(c) Neither</td>
<td>20.9</td>
<td>37.9</td>
</tr>
<tr>
<td>Factor-4</td>
<td>(a) Confirmatory</td>
<td>45.4</td>
<td>58.6</td>
</tr>
<tr>
<td></td>
<td>(b) Negational</td>
<td>12.8</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>(c) Neither</td>
<td>41.8</td>
<td>41.4</td>
</tr>
</tbody>
</table>

Factor-1

This variable is designed to distinguish citations that utilize or extend concepts from those that use methods, procedures, or operations. Philosophy of Science exhibits a slightly greater proportion of ‘operational’ citations than Social Studies of Science, which can be explained by certain citing articles which reference Wittgenstein primarily for his work on logical operations.

Also, slightly more citation contexts in Social Studies of Science were coded “neither” on this measure. That the citation context was not clearly recognizable as conceptual or operational might be taken to indicate a certain vagueness surrounding the authors’ motives for making the reference. Of course, it just as well might indicate that ‘conceptual’ and ‘operational’ are vacuous measures. Without a reasonable theory
to guide the way here, and with little difference to be explained, little comment is warranted.

**Factor-2**

An ‘organic’ as opposed to ‘perfunctory’ citation employs a reference because it advances an idea that is an integral part of the main argument in the citing article. ‘Perfunctory’ citations merely drop a name in connection with an idea or point whose necessity for the central argument of the paper is an open question. It is important to note here that the difference between the journals for this value is negligible. 37 percent of references to Wittgenstein in *Philosophy of Science* are perfunctory, while roughly 35 percent of those in *Social Studies of Science* are also. The difference is not statistically significant (Pearson $X^2 = 0.293$; significance at 0.8638). If we were to use only this measure to judge the extent to which authors invoke the work of Wittgenstein as an appeal-to-authority, the most obvious suggestion would be that both journals exhibit equivalent rates of such citation practices. Despite this lack of difference, we cannot overlook the fact that *slightly more than one third of all the citations are perfunctory*. Further research needs to be done to determine the extent to which such a proportion of perfunctory references is the norm in this field of research and others.

By itself, a perfunctory citation clearly does not constitute an appeal-to-authority. An author may use a perfunctory citation simply to pay a genuine intellectual debt to another writer. What *does* constitute an appeal-to-authority? In the next section, I propose that positive response to a number of measures, as well as impressions gathered through content analysis of the citation, can be used to distinguish genuine intellectual debt from mere appeal-to-authority.

**Factor-3**
This variable is similar to Factor-2 in that it also measures whether a citation is truly necessary for the central thesis of an article. An ‘evolutionary’ citation builds upon the conceptual foundation of the cited article, while a ‘juxtapositional’ citation is critical of some aspect of the cited article.

The patterns that hold for this measure are interesting indeed. The difference in terms of ‘juxtapositional’ citations is particularly striking. As Figures 6 and 7 below indicate, juxtapositional citations account for just over a quarter (26%) of citations in Philosophy of Science. However, in Social Studies of Science only 10% of the references are juxtapositional. What might account for this difference? How is it significant? I suggest that the proportion of juxtapositional citations in a group of articles can be used to gauge two things.

(a) We can assess the extent to which authors view some work as consistent with their positive project. For the case of realism and constructivism, this cashes out as follows. The set of articles whose principle aim is to advance realist or constructivist theses that also exhibit low rates of juxtapositional reference can be assessed as employing Wittgenstein’s work to support their project. However, this relationship was not anticipated early enough to collect all the data necessary for selecting this overlap. Specifically, we lack information about the ‘principle aim’ of any given article. For this reason, we are not in a position to comment on the extent of this overlap across journals.

(b) It is not clear that one can both engage in an appeal-to-authority and juxtapose their position to the cited position. In other words, juxtaposition can be used as a rough gauge of critical appraisal. And insofar as critical appraisal and appeal-to-authority are mutually exclusive practices, the extent to which a group of authors employ juxtapositional citations can be used to assess their propensity for appeals-to-

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41 While this may seem to be a big difference, its statistical significance is only moderate. Pearson $X^2 = 4.814$, significant to 0.0901.
authority. To put it a slightly different way, appeals-to-authority do not fall within the shadow cast by the set of juxtapositional citations.

**Figure 6 – Social Studies of Science, distribution of variable ‘Factor-3’**

![Social Studies of Science - Factor-3](image1)

**Figure 7 – Philosophy of Science, distribution of variable ‘Factor-3’**

![Philosophy of Science - Factor-3](image2)
Given that the proportion of juxtapositional references to Wittgenstein in *Social Studies of Science* is significantly smaller than in *Philosophy of Science*, it is clearly suggested that *Social Studies of Science* authors engage in appeal-to-authority more than their counterparts in *Philosophy of Science*.

**Factor-4**

This variable is a measure of the citing author’s evaluation of the referenced work. Accordingly, a citation may *confirm or negate* some aspect of the cited work. In a certain respect, we can see that this measure is not entirely independent from Factor-3. For it is difficult to see how an article could reference a work juxtapositionally without negating some feature of the cited work. But unlike Factor-3, this measure does not discount citations that reference a given work only in passing. In any case, the differences between the journal samples is noteworthy.⁴³

Among citation-contexts in *Philosophy of Science*, roughly 13% are ‘negational’ with respect to some aspect of Wittgenstein’s work. However, in *Social Studies of Science* there are *no such citations*. In so far as appealing-to-authority and negating the views of that authority are incompatible, the absence of negational citations clearly suggests a greater proclivity for appeal-to-authority on the part of *Social Studies of Science* authors.

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⁴³ Pearson $X^2 = 4.495$; significant to 0.1057.
2.6 Summary remarks

To summarize the points made above, I propose that certain responses to a number of measures, as well as impressions gathered through content analysis of the citation, can be used to distinguish what may be genuine intellectual debt from mere appeal-to-authority. One combination of findings which suggests appeal-to-authority is a high or low representation of each following variable values:

- Factor-2 (b) Perfunctory ↑
- Factor-3 (b) Juxtapositional ↓
- Factor-4 (a) Confirmatory ↑
- Concept-Symbol ↑
- Details Cited ↓
- Persuasive ↑

(The arrow indicates high or low presence of the variable value.)

It should be obvious from the previous discussion that none of these measures, taken individually, can entirely support the claim that Wittgenstein citing authors in these journals merely appeal-to-authority rather than genuinely engage his writing. And since we do not have a baseline of what constitutes “normal” citation practice to compare with appeal-to-authority for any one of these variables, no claims can be made about these samples in relation to “normal” citation behavior. However, I propose that when these variable values are viewed in combination and compared between the journal samples, we come to a position from which we can assess which sample of writers is most likely to be citing Wittgenstein in mere appeal-to-authority.

We can look at the key variable values again – this time noting which journal sample exhibits the highest score for each measure.
Table 8 – Combined Measure for Appeal-to-Authority

<table>
<thead>
<tr>
<th>Measure</th>
<th>Journal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor-2 (b) Perfunctor ↑</td>
<td>Philosophy of Science</td>
</tr>
<tr>
<td>Factor-3 (b) Juxtapositional ↓</td>
<td>Social Studies of Science</td>
</tr>
<tr>
<td>Factor-4 (a) Confirmatory ↑</td>
<td>Social Studies of Science</td>
</tr>
<tr>
<td>Concept-Symbol ↑</td>
<td>Social Studies of Science</td>
</tr>
<tr>
<td>Details Cited ↓</td>
<td>Social Studies of Science</td>
</tr>
<tr>
<td>Persuasive ↑</td>
<td>Social Studies of Science</td>
</tr>
</tbody>
</table>

For all but one measure, Social Studies of Science is better represented than Philosophy of Science. At this time, however, there is no method of assessing the association among all these measures. Of course, we can use each measure here ‘in series’ so to speak, successively narrowing down the number of citation contexts that fall within each variable value. But given the small size of each sample it is not surprising to find that in both samples such a technique produces an empty set. For larger data sets, this technique may lend meaningful results. But for the data gathered for here, our conclusions can only be based on the difference between journals for each individual variable. The pattern produced is not insignificant. For five out of six rough indicators of appeal-to-authority Social Studies of Science is better represented than Philosophy of Science.

No strong conclusions are warranted at this point, however. The potential for error in the preceding interpretations cannot be overstated. In this chapter I have attempted to emulate the methods and interpretative strategies often employed in citation studies. But each of the proceeding interpretations can, in the end, be reduced to a foundation of mere opinion and perhaps even bias. This situation is only exacerbated by the manner in which the data were collected. Since the sample of data gatherers, hypothesis makers and analysts is considerably small (N=1), we must not jump to conclusions. Precisely in response to these shortcomings the focus of the next
chapter is considerably more narrow – moving from citation context analysis to a thorough content analysis of these references to Wittgenstein.
Chapter Three  -- Appeal To Authority and Selective Citation

3.1 Issue-relevant citation contexts

By selecting only articles whose references to Wittgenstein tie his work to some aspect of the realism – constructivism issue, we achieve a subset of 14 citation contexts in 11 articles. Reversing the pattern that holds for the larger sample of articles, more such citations occur in Social Studies of Science (N=9) than in Philosophy of Science (N=5). This pattern alone suggests that authors in Social Studies of Science are more concerned with his work as a source of support for their views on the issue than authors in Philosophy of Science. This notion is reinforced by a look at the proportion of articles in each journal sample that meet this criterion: Philosophy of Science = 5.6 %; Sociology of Science = 31.0 % Clearly, authors in Sociology of Science are more prone to appropriate Wittgenstein’s work in arguments for this issue than authors in Philosophy of Science.

It is not clear that there is any longitudinal pattern for this relationship over the course of the study. As Figure 8 indicates there is a noticeable difference between the occurrence of these citation contexts over time over the two journals. For Philosophy of Science, there is one citation context in 1973, and then a span of 22 years before the next one occurs in 1995. For this journal, it appears that authors view Wittgenstein as relevant to the issue of realism-constructivism only in the early 1970’s and again more recently. Social Studies of Science exhibits quite an opposite pattern. All of the issue-relevant citation contexts in this journal appear between 1977 and 1992, with a peak of three citations in 1982.
Figure 8 – Number of articles in which Wittgenstein is cited in relation to realism or social constructivism, by journal, by year

(SSS = Social Studies of Science; POS = Philosophy of Science).

Lacking a theoretical framework in which to make sense of these opposed patterns, I can only speculate on their significance. One plausible reason behind this pattern could be a shift in academic opinion concerning the relevancy of Wittgenstein’s work for philosophical or social reflections on science, respectively. Of course, the patterns could also reflect changes in the constitution of the editorial boards – whose evaluation of submitted manuscripts can include subjective judgments on the worth of figures in one’s bibliography (Edge, 1979). Since these articles are grouped around two slowly changing editorial boards, we can think of their contents as discussions localized to two specialized linguistic communities. In a certain sense, this study can be seen to resemble an ethnography.

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4 An extension of the current study might focus on the relationship between the constitution of each editorial board and concomitant changes in citation patterns. But this would only be fruitful in a larger study. With the small size of the current sample, any relationships here would not be statistically significant.
For now, we must leave these patterns and turn to a content analysis of these contexts. We can shift our focus to a closer reading of these citation contexts so that we can gain a picture of the fit between realism, social constructivism, and Wittgenstein’s work. By taking such an approach, we can transcend the interpretative difficulties involved with comparing patterns endemic to different units of analysis. Below, each citation context is quoted in full, along with a brief analysis.46

3.2 Social Studies of Science

Speaking on the paradoxes inherent in some constructivist approaches of the sociology of science, Meynell (1977) makes reference to Wittgenstein as follows:

However, these doctrines and methodological principles are now pretty widely agreed to be unsatisfactory. Recent philosophers and sociologists have tended to settle in effect for the impossibility of self-transcendence, with each society engaged in its own characteristic 'forms of life' and 'language games' to which 'reality' and 'the world' are internal. (*) As I have been arguing, this position, when made self-consistent and thoroughly applied, destroys itself.

The (*) represents the footnote number that directs the reader to another remark - in this case, an endnote:

18. The main source, though notoriously an ambiguous one, for this view, is L. Wittgenstein, Philosophical Investigations (Oxford: Blackwell, 1958); it has been applied in detail to social science by P. Winch in The Idea of a

46 It must be admitted that what counts as “the full context” has been determined without the guidance of any full-blown theory. For the citations that follow, context was determined by reference to two determinations: a) explicit mention of cited author was taken to indicate the beginning of context; b) alternatively, beginning of context was connected with mention of the specific idea for which a citation was subsequently made. But generally, since I was concerned here with a specific issue - realism versus constructivism - determinations of context were made with relevance to this issue in mind. Full citations of these sources can be found in Appendix C.

In this citation context, Wittgenstein is labeled the "main source" of a relativist construal of 'reality.' Active in this labeling procedure are (a) P. Winch's appropriation of Wittgenstein for his discussion of the foundations of the social sciences, and more broadly, (b) the author's understanding of 'form of life' and 'language game.' Both of these are the subject of rich controversy and discussion by Wittgenstein scholars and philosophers. Nevertheless, in a single sentence, these concepts are described as the foundation of a perspective on science that takes relativism to a self-defeating application. Aside from this rather rushed and unsupported conclusion, notice that this concise evaluation of Philosophical Investigations occurs side by side with the reference to P. Winch's influential monograph on the philosophical foundations of the social sciences. This reference contains one primary source and two secondary sources. It is clear, however, that the author is simply adopting the description and analysis offered by the secondary sources. Relying heavily on secondary source material is consistent with a larger pattern in citation practices (MacRoberts et al., 1986). In this context, the citation to Philosophical Investigations seems nothing more than a polite gesture of credit for coining the phrases 'form of life' and 'language game.' The interpretation of these phrases is taken directly from Winches secondary source. Notice also how the interpretation of ‘form of life’ and ‘language game’ might fit into the categories of realist and constructivist commitments. The following remark is quite telling: “…each society engaged in its own characteristic 'forms of life' and 'language games' to which 'reality' and 'the world' are internal.” Even with the scare quotes around ‘reality,’ this is consistent with a social constructivist thesis – or better yet, what we might call ‘social relativism.’ Whether this also is intended to reflect a belief about the status of entities mentioned in scientific theories is another matter. Since the remark does not explicitly refer to the conduct of science, any classification would be too hasty. All we can say is
that it is consistent with even the strongest commitments to social constructivism – certainly ‘epistemic’ and perhaps even ‘metaphysical’ constructivism.

While this citation context clearly adds to the image of Wittgenstein as a significant figure in the origins of constructivism, it is not alone. Collins (1981) in a widely known description of his “empirical programme of relativism” develops the connection between Wittgenstein's philosophy and relativist theories of science as follows. Discussing the variance of approaches to the study of science, he states:

One school, however, inspired in particular by Wittgenstein and more lately by the phenomenologists and ethnomethodologists, embraces an explicit relativism in which the natural world has a small or non-existent role in the construction of scientific knowledge.*

In the body of the endnote marked at the end of this sentence, there are references to two works by Wittgenstein:

2. In this regard, the best known books of Ludwig Wittgenstein are Philosophical Investigations...and Remarks on the Foundations of Mathematics.... Peter Winch's book, The Idea of a Social Science...has shown the importance of Wittgenstein to many non-philosophers and has given rise to the 'rationality debate'...(p.8).

I would like to point out two interesting features of these remarks. First, in the body of the text, Collins names only one figure – Wittgenstein – as inspiring an ‘explicit relativism’ which I take to be consistent with both ‘epistemic’ and ‘metaphysical constructivism.’ He does this by using the name in the text and then by citing two sources in the footnote.* Collins describes his influence as ‘inspirational.’ Since this occurs in an introduction to a paper attempting to describe and delineate a specific research program in the sociology of science, the precise nature of his inspiration is important. There are, however, no further remarks on this matter. This citation performs all of the work in establishing Wittgenstein's connection to constructivism. If
we adopted a neutral perspective on Wittgenstein’s association with constructivism, this endnote directs us by assertion (and certainly not argument) to the belief that his work is foundational to constructivism.

This brings us to the second remarkable feature of this citation context. Namely, there are significant figures mentioned alongside Wittgenstein's work. There are none in the text of the citation context, except for a vague reference to 'phenomenologists and ethnomethodologists.' In the text of the footnote, however, these vague referents are supplied with names. For the phenomenologists, Collins cites Berger and Luckman (1966) *The Social Construction of Reality*. As I have shown in the first chapter, this work is significant for constructivism mainly for its use of the social construction thesis in regard to institutions and structures that are inherently social to begin with. Its significance for this thesis lies in the fact that it is referenced as an 'inspiration' for the constructivist project secondary to Wittgenstein's *Philosophical Investigations* and *Remarks on the Foundations of Mathematics*. Collins clearly provides a firmly asserted, but poorly supported, claim that constructivist sociologists of science are indebted to Wittgenstein.

The point of this analysis is to articulate the degree to which each journal subset links Wittgenstein's work to constructivist or realist agendas. So far, three issue-relevant citation contexts in *Social Studies of Science* make reference to Wittgenstein's work in a way that strongly suggest it is foundational to the constructivist agenda. The remaining six citation contexts make this connection to less of an extent.

Responding to Woolgar’s review of a monograph by cultural anthropologist Garfinkel, Barnes (1981) situates his reference to Wittgenstein in the following context.

Garfinkel's work is an analysis of the realist mode of speaking practically universally employed by all of us. The methods of accounting he identifies are those we all use to maintain a sense of pattern and order through the flux of appearances. On the one hand Garfinkel is the direct descendent of that earlier pre-eminent analyst of the realist mode, Wittgenstein; on the other he draws attention to the same themes as are

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46 Because two sources are cited, this article is coded as containing two citation contexts.
stressed (with approval) by prominent realist philosophers and epistemologists like Harre' and Putnam.* (p.484).

The footnote attached to this last sentence contains a reference to Philosophical Investigations. Here, Wittgenstein is still displayed as a 'pre-eminent' critic of realism. In essence, Barnes is recognizing that Garfinkel owes a conceptual debt to Wittgenstein, but Wittgenstein's role is only that of an 'analyst of the realist mode of speaking.' Based on this feature of his remarks, Barnes' reference can be seen to directly connect Wittgenstein's name with semantic constructivism. There is little to here to suggest a connection to any other level of constructivist commitment.

In a project using a method ironically similar to my current project, Lynch (1982) weaves a citation into a content analysis of conversations between researchers in a laboratory. Speaking on the role of historiography in scholarly inquiry, he remarks on the conceptual shift between object-of-inquiry to object-as-tool.

What once was the object of inquiry and argument becomes the material through which one comes to grasp something else; it becomes transitive, and in being transitive provides for the 'body's' reflexive modes of certainty* (p.504-505).

Regarding these 'reflexive modes of certainty,' Lynch brings Wittgenstein into the discussion in a longish endnote, which I quote in full:

22. In a discourse on doubt and certainty, Wittgenstein states:

If a blind man were to ask me 'Have you got two hands?' I should not make sure by looking. If I were to have any doubt of it, then I don't know why I should trust my eyes. For why shouldn't I test my eyes by looking to find out whether I see my two hands? What is to be tested by what? (Who decides what stands fast)

And what does it mean to say that such and such stays fast?
(See On Certainty...). Wittgenstein does not answer the question he poses at the end of this passage by proposing definitions or criteria which distinguish what can be doubted from what is certain. However, he does provide numerous examples of imagined situations of ordinary conduct which in practice involve expressions of 'certainty' or 'doubt,' without need for the absolute grounds required by some philosophers' speculations. Wittgenstein does not offer anything so simple as a linear historical sequence to account for the occasions under which something at one time doubted can be the 'test' for the questioning or certification of something else. His treatment does, however, illuminate (a) the absence of absolute grounds of indubitability other than what is used and taken for granted in actual practice, and (b) the relativity of 'inquiry,' not only to what it 'tests,' but also to what it takes for granted in the testing (p.526-527).

To his credit, Lynch states his interpretation of the quoted passage quite clearly. What he takes to be its most interesting features are its implications for our assumptions of absolute grounds of indubitability, on the one hand, and the inherent relativity of any inquiry, on the other. In terms of the level of constructivism this remark suggests, both noted features point to the level of epistemic constructivism. Lynch applies Wittgenstein's comments on doubt to the lack of indubitable grounds in concept-testing generally. The pernicious doubt arises from the fact that we have no reason to trust one of our senses, sight, over any other. This position could be summarized as a 'relativism towards individual perceptions.' In so far as perceptive relativity falls under the rubric of epistemic constructivism, we can label this interpretation as such. However, the relativism at work in the quoted passage is not entirely co-extensive with the relativism suggested by the basic constructivist thesis. Remember, the constructivist thesis, as a working definition, locates the source of any relativity in social and political contexts that surround the knowledge production process. But the relativism shown here is not inherently social -- Wittgenstein's relativism operates at the level of human sensory devices. His claim is that our choices to rely on one sense rather than another have no concrete foundation. For this reason, this comment can be linked only with methodological constructivism, not epistemic constructivism.
Allow me to clarify this. The reason for linking this idea with methodological constructivism is that our reliance on certain perceptions at the expense of others is often employed to precise advantage by experimental instruments and procedures. For example, when I approach a microscope and peer down on a sample, one of the last things on my mind is how the sample tastes. Because the taste of the sample can tell us so little (it is assumed), we rely on our much keener sense of sight for discriminating amongst structures and substances. Our most basic approaches to inquiry are subject to this species-wide bias. In this sense, then, we can see that Wittgenstein's point concerning the individual relativity of sense perception provides motivation for a commitment to methodological constructivism.

One more feature of this citation context is worth mention. Of all the debate-relevant citation contexts in *Sociology of Science*, Lynch's is the most attentive to the details of the cited passage. He *quotes* and attempts to analyze a passage from one of Wittgenstein's works. On all accounts, this sort of citation context is more accessible than those which assert connections between a lengthy, confusing text and some currently fashionable theory. We can discover the extent to which all authors in the two journals use such close readings of the text by looking at the proportion of citation contexts that cite some form of textual details, such as page or paragraph numbers. Those who use textual details clearly offer a closer reading of the text than those who do not. Table 9 displays this breakdown.

<table>
<thead>
<tr>
<th>JOURNAL</th>
<th>DETAILS</th>
<th>NO-DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Philosophy of Science</em></td>
<td>81.4 %</td>
<td>18.6 %</td>
</tr>
<tr>
<td><em>Sociology of Science</em></td>
<td>44.8 %</td>
<td>55.2 %</td>
</tr>
</tbody>
</table>

As this figure indicates, citations to Wittgenstein in *Philosophy of Science* include details over 80 % of the time, while this is true for authors in *Sociology of Science* less
than 20% of the time. Given the above interpretation, this shows authors in *Philosophy of Science* generally bring a closer reading of Wittgenstein’s work to their articles than authors in *Sociology of Science*. Instead of pursuing this finding now, we will return to this interesting difference shortly, after looking at the rest of the issue-relevant citation contexts.

The next issue-relevant citation context is situated in a review of Livingston's *Ethnomethodological Foundations of Mathematics*. Here, Bloor (1987) criticizes the author for his attempt to conduct research without a general theory to guide him. Bloor argues that there actually is a theory at work behind Livingston's research, and goes on to show how certain theoretical frameworks fit this research better than others. This is where Wittgenstein comes in. Among the list of those who have previously studied the foundations of mathematics, Wittgenstein is mentioned alongside Lakatos as a theorist whose work might have provided grounding for Livingston’s approach.

The non-classical character of this work is indicated in Wittgenstein's attitude towards foundational studies, as when he says: 'The mathematical problems of what is called foundations are no more the foundations of mathematics for us than the painted rock is the support of the painted tower' (V-13). Wittgenstein, to a greater degree than any writer before or since, was fascinated by the character of the logical 'must,' and by the detailed nature of mathematical reasoning and proving. He, too, noted the natural tendency towards a Platonic or Realist self-understanding of our reasoning processes; and he, too, discussed Gödel's theorem. That a book written in this area which does not seek to build on, or take issue with the *Remarks* is both puzzling and regrettable (p.353).

Bloor goes on to suggest two reasons why Wittgenstein's work might not have fit with Livingston's agenda. Irrespective of these reasons, the passage above shows Bloor making a connection between *Remarks on Mathematics* and a critical stance towards realism. But it is not clear from this passage precisely how he thinks this connection holds. This citation context offers too little to go on for assessing a realist or constructivist commitment. It can only be nominally connected with the issue. As a
result this citation context is considered *neutral* with respect to the realism – constructivism issue.

The next issue-relevant citation context occurs in a brief response to an article by Latour. In this response, Schumacher (1988: 523) adjusts but also reinforces Latour's claims that "Einstein's work is *explicitly* social." Schumacher sets up a conventionalist account of inquiry to describe Einstein's work in a way congruent with a constructivist thesis. He cites Wittgenstein's work on three separate occasions – only two of which are explicitly connected with the realism – constructivism issue.47

We run in a logical circle at the origin of all our enquiries, even within our own society or culture. Hence to begin enquiry at all we must make a series of free choices, to define our terms, as we say. Hereby we *make* the invariance that grounds our communications and eliminates the possibility of mere relativism (p.529).

As this passage indicates, Schumacher is concerned with the assumptions of 'invariance' from which inquiry begins and develops further accounts of invariance. He connects these assumptions with two of Wittgenstein's texts in the following manner.

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47 The first of these notes a general similarity between Einstein's and Wittgenstein's rejection of 'classical' thought. This is the only instance in which the *Tractatus* is mentioned in *Social Studies of Science* – as such, it warrants a full quotation.

To put our result in its most general form we can draw the analogy between Wittgenstein's analysis of the meaning of terms and Einstein's analysis of the meaning of terms. Wittgenstein's rejection both of a private language and of what he calls in his early work 'the picture theory of language' – that language reaches out to touch the world – *bears* an interesting resemblance to Einstein's rejection of the classical significance of simultaneity in one inertial frame (p.529).

I should mention two things. First, the *Tractatus* is mentioned here only because it is the source in which the 'picture theory of language' is expounded. Second, and most importantly, he mentions this text because Wittgenstein rejects his original realist construal of language. Thus, on the only occasion where the *Tractatus* is mentioned in *Social Studies of Science*, it is mentioned in the context of a rejection of realist thought!
Wittgenstein likened the problem of meaning in a private language to the dilemma of a person who consults another copy of today's newspaper to check on the accuracy of the first copy's reports.*

To believe that we can determine the relationships between terms and the world is to believe that our terms are not so much related to each other as they are to the world. What will hold for one user of terms will hold for all others. We will have a classical theory of absolute meaning rather than a special theory of the relativity of meaning, what in general Wittgenstein calls 'language games', games whose significance is derived from the relationships between the players.* Hence we see once again, in a wider context, just how Einstein's work is explicitly social (p.530).

As these two passages indicate, this author is linking a social constructivist semantics to Wittgenstein, and then stretching it to apply to Einstein's conception of 'special relativity.' The footnotes both refer to the Philosophical Investigations.

By arguing that Wittgenstein's conception of 'language games' grounds a 'special theory of the relativity of meaning,' Schumacher instills in the mind of the reader a connection between Wittgenstein and the thesis of semantic constructivism.

In the last issue-relevant citation context in Social Studies of Science, Radder (1992) inserts a remark from On Certainty into his criticism of the normative relevancy of the constructivist position on science. The entire citation context is worth quoting here.

Of course, Since both judgmental relativism and radical sociological voluntarism are impossible in practice, it is not feasible to be a consistent constitutive reflexionist. For example, a basic premise of Woolgar's programme is the claim that 'the social network constitutes the object.' Questioning this claim would make life for the constitutive reflexionist very hard indeed. After all, as Wittgenstein remarked long ago:

“Doubting and non-doubting behavior: There is the first only if there is the second. My life consists in my being content to accept many things.”*

Nevertheless, fostering and acting upon the illusion of being a consistent constitutive reflexionist makes one blind to the normative or normatively
relevant presuppositions, assumptions and implications of one's own position, and prevents one from engaging in critical and constructive normative reflexion. (p.149).

As these remarks indicate, his critique of constructivism homes in on two symptoms, (a) that 'consistent constitutive reflexionism' is impossible in practice, for its self-defeating implications. That is to say, the basic premises – that objects are socially constituted – cannot adequately defend itself against its own reflexive application. Also, (b) the alleged virtues of 'reflexive constructivism' serve to hide the normative assumptions upon which the position crucially hinges. As he goes on to argue, the problem with constructivism is best seen from the perspective of its normative consequences. So many constructivists wish to use the thesis to alter the balance of epistemic and normative power of science in favor of a more open climate. What Radder criticizes is that the desire to do this is itself normatively loaded – but also loaded in a way which conflicts with the claim of reflexive constructivism. In short, he uses the normative assumptions of the position to disarm the epistemic and ontological assumptions.

Between these two criticisms is a reference to Wittgenstein's On Certainty. In this context, the quoted remark enforces the point that all knowledge claims stem from initially unfounded presuppositions. We can only come to believe something when we know what it is that we doubt. Here, Radder is using Wittgenstein's criticism of epistemic foundations against constructivism! Of all the citation contexts in this sub-sample, this is clearly the only one which employs Wittgenstein's name against constructivism.

Before we move on to the issue-relevant citation contexts in Philosophy of Science, lets review the findings of the those in Social Studies of Science. Arranged chronologically, implicit judgments toward Wittgenstein’s corpus proceed as follows.
1974 – Foundation for ‘extreme relativism’
1981 – Foundation for epistemic and perhaps metaphysical constructivism
1981 – Semantic constructivist; anti-realist
1982 – Basis for methodological constructivism
1987 – Neutral toward constructivism
1988 – Semantic constructivism
1992 – Critical of constructivism (Wittgenstein’s criticism of epistemic foundations as reason for criticism aimed at constructivism)

Only one of these articles contains a critical appraisal of constructivism. Five out of the seven endorse some level of constructivism.

3.3 Philosophy of Science

There are four issue-relevant citation contexts out of the 86 citations to Wittgenstein between 1971 and 1996 in this journal. We will look at each of these in turn.

The first citation occurs in Byerly et al. (1973) in an article defending a ‘realist interpretation of measurement systems.’ In connection with their criticism of a modified operationalist account of measurement – that concepts of measurement follow directly from experiences with quantities of objects – the authors cite Wittgenstein's notion of 'family resemblance' as one example of non-realist attempts to speak of the unreality of quantities. The context proceeds as follows:

Wittgenstein* used the metaphor of 'family resemblance' to break the hold of the temptation to believe that there must exist one simple referent for all general terms. The suggestion by some of those taking up Wittgenstein's notion is that the association of characteristics making up a cluster may rest simply on linguistic convention. However, even if there be no common characteristic running through the instances falling under every general term, this analysis only sharpens the realist-nominalist question [regarding quantities of measurement] (p.15).
Let's consider the role that 'family resemblance' plays in these few sentences. First, the authors point out what Wittgenstein used the metaphor to do - namely, to argue against the belief that there is a one-to-one relation between general terms and their referents. Then, they add that there are some who extend this to say that characteristics which define family resemblance are based on nothing more than linguistic convention. Here, the implication is that a realist construal of quantities is not tenable when the cluster of experiences which serve to define a quantity are contingent on local linguistic conventions. Since the authors are concerned to defend such a realist construal of quantities, Wittgenstein's concept is problematic. However, since another writer has elaborated an idea very similar to the 'family resemblance' concept -- the cluster theory of experiences underlying definitions of quantities -- the authors focus their attention on this new account in place of Wittgenstein's.

In this brief citation context the 'family resemblance' concept is connected with an attack on realist interpretations of quantities by way of a semantic conventionalism or constructivism. Hence, in this setting Wittgenstein is portrayed as a semantic constructivist.

The next issue relevant citation context appears in an article that espouses a rather unique view of scientific inquiry. This account of explanation in science privileges the role of 'reductivist' thinking. This type of thought is held to operate in the process of answering research questions (Ramsey, 1995). The reference to Wittgenstein comes near the end of the paper, in the discussion of an 'instrumental' or functional view of theories -- theories-as-tools (p.17).

Thinking of a theory as such a tool does not reduce theoretical activity to pure instrumentalism. Standardly, instrumentalism is interpreted as a way to avoid ontological commitments in our theories. The kinds of tools discussed here allow us to do things we were unable to do before. They are not inference tickets with no ontology attached. These kinds of reduction involve 'transforming something into a different form by performing an operation on it' (Nickel, 1973, 184). The theories are objects
of ontological analysis; one performs operations on them, not just with
them. No ontological question is involved as it is traditionally
formulated. This focus on function rather than structure is relevantly
similar to Wittgenstein's (1958) shift of focus [from] meanings as objects to
meanings in terms of use. The critique of theories as objects is replaced
with a critique of theories in terms of their use or function. This
replacement necessitates a shift from speaking of what a theory achieves
to what a scientist achieves with a theory (p.16-17).

I want to focus our attention here on the middle of the quoted remark. Here, the author
likens his functionalist shift in the interpretation of theories to Wittgenstein's
functionalist shift in the definition of meaning. His use of this shift is relevant to
realism by virtue of how it leaves the ontology of theories as an open question. In a
sense, then, the author is borrowing Wittgenstein's move away from the importance of
ontology in talk about meaning. He is using this move to motivate his own move away
from talk of the ontology of theories. This is clearly a move away from realism in favor
of what he describes as 'instrumentalism.' But the move stops here, and in doing so
avoids a positive commitment to either side of the realism – constructivism issue.44
Since the author is reluctant to engage the issue here, he enrolls Wittgenstein in a very
neutral manner. Consequently, this citation context is classified as 'neutral'.

We can now proceed to the next two citation contexts, both of which occur in
1996. Here, Wittgenstein is appropriated in an attempt to argue against non-
adaptationist explanations of color vision in human beings (Hall, 1996).

Philosophers who want to maintain a realist stance about colors have been
tempted to amass the multitude of kinds of causes of each of our color
perceptions into a big disjunction and to claim that that is what the color is
(Smart 1975, Armstrong 1987). But this is desperation. 'If someone
wished to say: 'There is something common to all these constructions --
namely the disjunction of all their properties' -- I should reply: Now you
are only playing with words (Wittgenstein 1953, paragraph 67).' [p.S127-
128].

44 This can be seen in Ramsey's concluding remarks on the implications of this move for talk
about explanation. "Perhaps a functional account of explanation could be applied; I leave this
as an open question" (p.18).
Based on these remarks, it is clear that the author wishes to use Wittgenstein's criticism of disjunctive definitions against the realist stance about colors. The realist cannot resort to a definition of colors comprised of a 'long, unnatural, open-ended' (128) disjunction without appearing to merely tamper with words. Again, we find that Wittgenstein's work is being used to fight off the tendency towards realist interpretations of linguistically denoted objects. Although this clearly connects the quote to an anti-realist view, it is not clear that his quotation of Wittgenstein motivates any positive agenda. The connection, if any, is left implicit. The quoted remark only does the explicit work of showing how to respond to disjunctive definitions. This citation context is thus categorized as 'neutral' with respect to the issue at hand.

In the next section of the same article, we find another issue-relevant citation context. This time, a quoted remark is used to launch the final section of the paper.

5. **A Non-Detectionist Suggestion.** -- "We predicate of the thing what lies in the method of representing it." (Wittgenstein 1953, paragraph 104).

Suppose we are looking in the wrong direction for the usefulness of color vision. Suppose instead of looking out to the external world and the detection of features or kinds in it, we look inward at the perceptions themselves. Maybe what color vision does is improve visual perception, not make it detect or represent something 'out there' (p.5131).

A noteworthy feature of both citation contexts in this article is that they cite a passage from *Philosophical Investigations* in a somewhat uninterpretive context. That is, with the attack on disjunctural definition of color, Hall simply quotes a passage and lets it do the work it seems to have been intended to do. Similarly, the above remarks suggest that the quote is meant to forshadow the nature of the authors intended conclusion. Uninterpretative use of quoted passages is a rare occurrence, as the analysis of previous citation contexts suggests. There are at least two ways we might view such a practice.

(a) We might think that such a reference can be used to summarize the citing author’s views. On this account, it would seem to reflect an understanding of the text, as well as
perhaps a bit of respect for the original intentions of its author. (b) Alternatively, there are reasons to view it less favorably. If philosophy is indeed best construed as a continual conversation across the ages, then uninterpretable quotation clearly derailed the conversation. How? I propose that by citing in this manner an author shifts the interpretative responsibility to the reader. Consequently, the use of the text adds nothing original to the continuance of the philosophical project. A more philosophically valuable approach would present quotes with a response, summary, or critical interpretation.

Of course, I tend to prefer the later of these two interpretations. Such an interpretation is particularly attractive for how it might inform a measure of appeal-to-authority. By shifting the responsibility of interpretation to the reader, these citations only build on the opinions that readers already have toward an author. Few would take the effort to assess the quoted remark on its own terms and propose competing interpretations. So using a quoted remark in this way constitutes appeal-to-authority in those cases where the reader already views the quoted author as an intellectual authority. In at least some cases, then, uninterpretable citation can function rhetorically as appeal-to-authority."

More important for this thesis is the point being made with the quoted remark. Hall seeks to reorganize the attempt to define color perception as follows. Instead of assuming that color perception has instrumental value by virtue of aiding in attempts to seek out or avoid some unitary class of things, the value of color is user-defined and user-specific. That is to say, the value of color perception lies in how it makes the world appear to those who possess it. The developmental value of this feature of perception lies in its ability to attract our interest and attention. And what is interesting and attention deserving is not the same for everyone. In a certain sense, the value is aesthetic, not necessarily instrumental (an interesting proposition, indeed). By shifting the source of value in such a way, Hall is, in effect, dispensing with a form of realism in
favor of weak, individually defined instrumentalism. In this respect his use of the quoted remark is again anti-realist, but in such a way as to be neutral towards any positive constructivist commitments. That is, since he does not propose social factors as potential influences on color perception, both the value of and variance in this sensory function operates at the level of individuals, not groups. Wittgenstein has served the purpose once again of dissuading the realist tendency. But in this case no positive claims of social construction are built up in its place.

The last issue-relevant citation context is found in one of the more recent issues of *Philosophy of Science* – June, 1996. Here, Beller argues to "undermine the adequacy of the notion of a general conceptual framework to describe the philosophical endeavors of working scientists" (p.183). To put it a different way, her goal is to show that there is no single conceptual framework around which the 'Copenhagen' physicists were oriented. No explicit reference to Wittgenstein occurs in the text, rather, the citation is confined to a footnote. The remark to which this note is attached is, however, very telling.

> This paper supports the stand that ideas can properly be understood only by an analysis of their local theoretical and sociopolitical emergence and use.* (p.184).

The footnote reads as follows.

1. This stand, from Collingwood, (1939) and Wittgenstein (1953), through Rorty (1979) and Fine (1986), now has an overwhelming following by scholars dealing with social studies of science and the rhetoric of science. Some of the prominent examples include Collins (1982), Shapin and Shaffer (1985), Knorr-Cetina (1981), Galison (1987), Latour (1987) and Pickering (1992). (p.184)

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*Had this point been clear at the outset of this study, I would have included a measure of such practices in the data to be gathered. But, alas, perhaps this can benefit those who undertake similar studies in the future.
One who reads this remark and follows the footnote is encouraged to conclude that a stand on the historiography of ideas originates, at least partly, with Wittgenstein's *Philosophical Investigations*. 'Local theoretical and sociopolitical emergence and use' of ideas comprise the guide to understanding these ideas. Nevermind that 'local' is perhaps the most poorly defined and severely abused term in arguments for constructivism; instead lets have a look at what this remark is committed to in terms of the realism – constructivism issue.

There are two interesting features of in this citation context: (a) the philosophical implications of the footnoted claim, and (b) the implicit associations fostered by the reference to multiple authors in the attached note. The first of these features is a matter that can be clearly stated: the author is committed to a contextualist reading of the history of ideas. Whether this also commits her to any version of constructivism is not immediately clear from this passage alone. On the whole this article is coded as endorsing semantic constructivism and none of the realist claims. Such a classification seems especially warranted by her use of the phrase ‘sociopolitical emergence’ in reference to scientific ‘ideas.’

The matter of implicit associations is a delicate one. I do not wish to say that every group of citations is intended to foster a certain picture of an author's intellectual associations. But in the mind of the reader unfamiliar with these names, this consequence is unavoidable. Placing Wittgenstein alongside Shapin, Pickering, Latour, Collins, Knorr-Cetina, and Rorty certainly suggests an association with constructivism.

The associations in *Philosophy of Science* between the issue of realism – constructivism and Wittgenstein’s texts can be summarized as follows:
1973 - Wittgenstein as semantic constructivist

1995 - Neutral

1996 - Neutral

1996 - Wittgenstein as foundation for semantic social constructivism

3.4 Appeal to Authority

Authors in Social Studies of Science make reference to Wittgenstein in connection to the issue of realist versus constructivist perspectives on science more frequently than do authors in Philosophy of Science. However, in both journals, their remarks overwhelmingly support the view that his work is more relevant to (and foundational for) social constructivism than realism.

I propose a Peircean reading of these findings. For Peirce, meaning consists in the conglomeration of practical consequences that result from the intersection of language with language and language with the world. Applying this construal of meaning to this study, we can say that one significant component of the meaning of Wittgenstein's philosophy consists in the constructivist approach to science for which it has been enrolled. The meaning of what he actually said and the meaning of what others have enrolled his works to say become one and the same. Hence, if these were the only two journals on the market we could conclude that Wittgenstein, especially in his later writings, is a social constructivist. Fortunately, there are many other publications in which tactics of appropriation are not viewed so favorably.

As for the selective citation of certain texts over others in these journals, we can say this much. By offering an outlet for publication in which authors regularly endorse constructivist readings of Wittgenstein’s corpus, Social Studies of Science adds to the image of ‘Wittgenstein the social constructivist’—simultaneously diminishing the image of ‘Wittgenstein the philosopher.’ But even for Philosophy of Science, when Wittgenstein is connected with the issue, only his later writings are deemed relevant.
Table 10 – Sources Cited among Issue-Engaging authors

<table>
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<tr>
<th>Source</th>
<th>Philosophy of Science</th>
<th>Social Studies of Science</th>
<th>Totals</th>
</tr>
</thead>
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<td>2</td>
<td>2</td>
</tr>
<tr>
<td>On Certainty</td>
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<td>2</td>
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<tr>
<td>Philosophical Investigations</td>
<td>5</td>
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<tr>
<td><strong>Totals</strong></td>
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<td><strong>9</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

As the table above indicates, only three Wittgensteinian texts are cited in direct connection with a commitment to the issue of realism versus constructivism. All of them decidedly fall within his “later” writings, after his rejection of his own initial realist construal of language. Thus, the meaning of his texts, especially the *Philosophical Investigations*, are colored by the arguments for constructivism into which they are so frequently enrolled. Whether such appropriation is consistent with a charitable reading is a subject for another project. I do not doubt that a large group of scientific realists could accomplish the same re-constitution of his image by similar practices of selective citation and appeal to authority. Tactics could include those used by social constructivists, but skewed to the realist agenda: frequent citation of the *Tractatus* in arguments for realism; footnotes displaying Wittgenstein’s name alongside strict realist authors, and so on. But since this group is currently absent from the intellectual community of science studies, we must rest content to think of Wittgenstein as a founder of social constructivist thought.

Unfortunately, the issue of appeal-to-authority has not been resolved to my satisfaction. Despite the introduction of a number of potentially telling measures in this regard, no single one of them offers decisive evidence. In the majority of cases, this unfortunate situation is due to the insufficient size of the sample here. A larger sample,
perhaps comprised of a greater number of journals, is needed to provide enough
evidence for appeal-to-authority with respect to any single author.

3.5 Concluding Reflections

Now we are left with a few questions. The sociologist might ask, “what has been
shown?”; an historian could query, “what account of the past has been given?”; and all
of us, including the philosophers, might assess the import of this thesis by asking “what
has been argued?” In order to answer these questions I suggest we briefly look at some
assumptions that have guided this research. I propose we can arrive at answers to these
questions by addressing my assumptions and their possible flaws one at a time. Often
the most generous source of self knowledge is self-critique. There are three general
areas where criticism might originate: historiographical oversights, issues of bias in the
content analysis, and presuppositions of quantitative measures.

First, the accounts of scientific realism and social constructivism given here
amount to little more than a ‘history of ideas.’ This approach relies on an assumption of
the existence of cognitive connections among thinkers and writers dispersed in time.
The very idea of groups aligned with one or another tradition of thought assumes that
these writers willingly participate in such alignments. But what evidence do we have of
cognitive connections? I propose that the only reliable source of evidence for such
connections lies with the published documents and the citations they contain. Of
course, these can be significantly augmented by unpublished documents, diaries and
letters. I have obviously chosen not to go this route. So it must be forthrightly admitted
that room exists for alternate accounts of the emergence of these schools of thought.

Also problematic for this ‘history of ideas’ is the very nature of the categorical
scheme it has been employed to support. One might wonder why I have chosen to
group authors according to the categories ‘metaphysical, semantic, epistemic,
methodological.’ “Why these categories and not others? Do you intend to reify these
categories like so many other thinkers?” While I recognize the tendency toward reification here, I have attempted to use it to my advantage. I am not denying that there may be better ways of capturing differences between philosophical commitments of these authors. Indeed, I hope that a more subtle understanding of these philosophical issues will soon lead to a more agreeable classificatory scheme. The issue can be made especially clear by looking at cases that seem to straddle two or more of the categories. ‘Metaphysical’ realism and social constructivism can be easily disentangled, but the same cannot be easily done for the other levels of the scales. Commitments to the epistemic status of certain scientific claims are often rooted in claims about privileging methodologies of enquiry; semantic commitments to the realist ‘mode of speech’ arguably underlie most forms of communicative action; that the organization of professional and scientific relationships has some impact on the nature and reception of scientific claims can only be denied by those ignorant of the history of science. Nevertheless, since these categories are currently held to be the among the most meaningful ways of speaking about philosophical issues, using them here makes this account accessible to a large and diverse audience.

This brings us to the second potential reason for criticism. One might object that with only one ‘observer,’ any classification of authors into these conceptual groupings is overwhelmingly suspect. I am obviously in a tight corner with this issue, and I doubt that much can be done about it at this point other than to own up to the problem.50 This clearly problematizes much of the analysis advanced in the third chapter. I do, however, have two brief responses in mind. First, the third chapter has been written such that my evaluations of author’s references are given with the evidence in full view. By displaying each citation context along with each evaluation, the reader is hopefully in a position to notice and discard any conclusions that seem unwarranted. The issue of ‘appeal-to-authority’ is thus presented with every bit of evidence open to our eyes – hopefully minimizing the net effect of any bias on my part. Second, perhaps this
implicitly shows how such problems can be avoided in the future. The best way may be to involve ‘observers’ from fields other than and perhaps unrelated to sociology of science. This way, any observer bias could be noticed and addressed at a much earlier stage of research.

The third set of problematic assumptions has to do with the relationship between quantitative and non-quantitative methods in this study. Here, the operative question is ‘what does citation analysis really measure?’ Much of the critical attention aimed at citation studies proceeds with this question in mind. Edge (1979) is critical of quantitative methods as a means of determining boundaries for subdisciplines or camps (so called ‘co-citation clusters’). He claims that such methods, especially citation analysis for patterns of influence in science, foster a rationalized view of how scientists communicate. The problem is that citation measures can only account for an explicitly formal segment of communication. Yet, the majority of intellectual influences may well have little to do with such formal documents. The true roots of scholarly influence could be informal interactions and communications – such as meetings at conferences, informal correspondence, personal conversations, and so on. I agree that this represents a problem for certain studies, but does not affect the analysis given here. My assessment of Wittgenstein’s influence on the issue of realism and social constructivism has relied entirely on measures of formal communication because there is little chance that Wittgenstein – living and writing in the first half of this century – had any informal communication or contact with authors citing his work between 1971 and 1996.

MacRoberts et al. (1986) describe a number of discrepancies between the published text and its associated bibliography. In a study of publications on genetics, they found that only about 30 percent of the conceptual content in the sample is accounted for by bibliographic references. This means that up to 70 percent of intellectual influence among articles can be overlooked by research that focuses exclusively on bibliographic citations. Collins (1974) Edge (1979, see pp.117-9), and

\footnote{After consulting with many fellow graduate students and some members of the faculty, it was determined that compensation for the extensive time required would not be available. Hence}
MacRoberts all agree that the most important influences are frequently overlooked in bibliographies. Especially in cases where an important work is basic to a subdiscipline, it will be taken as ‘common knowledge’ and if it is mentioned at all it will occur in the text of the document rather than a formal citation. To the extent that this pattern may also exist in the science studies literature, the present analysis of Wittgenstein’s influence and appropriation is far from complete. A complete account of his perceived influence can only result from a thorough content analysis of the entire field (a task which requires resources that I do not currently possess). Furthermore, even when authors cite a text, they do so for a myriad of reasons, many of which are at odds with one another.

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Nevertheless, there are at least six findings of considerable significance here. First, I have developed a scheme of categorization for rendering approaches to the study of science more intelligible. By evaluating the extent to which an author buys into realism or constructivism, groups of writers can be unarbitrarily compared. Second, I introduce a matrix for assessing the direction and severity of author’s use of these levels of realist and social constructivist thought. By plotting realist and social constructivist commitments against each other, we gain access to one more dimension of interaction between these camps. Third, by using this scheme, I show Philosophy of Science authors see these interpretations as mutually exclusive. Fourth, I show that in those cases where Wittgenstein’s writing is mentioned alongside the issue of realism versus constructivism, it is connected more frequently with constructivism than realism. This pattern is most prevalent in Social Studies of Science, but also appears in Philosophy of Science. Fifth, I construct a measure from previously extant measures of content for comparing the extent to which two groups of writers engage in appeal-to-authority. Sixth, applying this measure to the two journals in this study, it is shown that Social Studies of Science authors, when they reference Wittgenstein, engage in appeal-to-authority more frequently than authors in Philosophy of Science.

the decision to proceed with a single “observer.”
Finally, I hope to have constructed an argument which reflexively renders problematic the use of intellectual histories, bibliometric measures of influence, and globalizing claims concerning content. This is the trickiest part of the thesis: By adopting and employing a number of methods in good faith, I hope to connect any uneasiness we might have about the conclusions with the methods themselves. This move could be described as “deconstruction from within.” Whether and to what extent this approach is successful is a matter yet to be determined.
## Appendix A - All Concepts Cited

(Sorted by concept Code)

Legend:

- **Reference Number**: (number assigned to each citation datum -- the decimal numbers refer to individual citations within the same article number)
- **Source**: (Text of Wittgenstein’s cited. PI = Philosophical Investigations, Math = Reflections on the foundations of Mathematics, and so on)
- **Pages**: (pages or paragraph numbers cited)
- **Code**: (number assigned to individual concept categories)
- **Concept used**: (general idea employed in each citation in connection with Wittgensteinian source)

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<th>Pages</th>
<th>Code</th>
<th>Concept used</th>
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<td>PI</td>
<td>#104</td>
<td>x</td>
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Appendix B - Range of Epistemic Positions

Epistemic Constructivism

(#11) In a case study of laboratory practices in the field of neurology, Lynch (1982) describes a component of the research as ‘critical inquiry’. By this he means a continual awareness of the social agency responsible for each simple test or complex experiment. Scientists are portrayed as critical of some experiments simply by virtue of who performed them. On this basis he argues that the knowledge production capabilities of the lab are heavily influenced, if not constituted by, the social fabric within which the production of knowledge takes place.

(#13) Collins (1981) introduces a special edition of Social Studies of Science by describing three stages of the “empirical programme of relativism”. The stages are as follows: (1) Confirming the local interpretative flexibility of science which prevents science, by itself, from being decisive. (2) Describing the mechanisms which limit this flexibility and allow for interpretative closure. (3) Relating these situational factors in a systematic way to the wider social and political structure in which they take place.

(#14) In a review of Laudan’s Progress and its Problems, Barnes (1979) takes aim at his presuppositions with respect to scientific and human rationality. “A great range of academic work at the present time points us strongly and uniformly to the presumption that ‘rational’ acts and judgments cannot be understood solely in terms of a relationship between any individual mind and reality; one also needs to refer to features of received knowledge and culture, the particular contingent patterns of coherence and organization featured in that knowledge and culture, and so on.”

(#16) Beller (1996) offers and account of the historiography and philosophy of quantum mechanics that extends the work done by certain sociologists of science. This account is perhaps best described as “historical-social construction” because it is argued that the social-political conflicts at the time were influential for the realist / anti-realist stance of members of the Copenhagen than were the influences of its members on each other. In a sense, this form of epistemic constructivist privileges the broader political landscape over the small social group in the formation and articulation of theoretical scientists. “This paper supports the stand that ideas can properly be understood only by an analysis of their local theoretical and sociopolitical emergence and use” (184).
(#21) In a review of Bloor’s *Knowledge and Social Imagery*, Fuller (1993) advances an account of the relationship between science and sociology that brilliantly makes sense of the realist and constructivist assumptions working for each. Science, it is said, assumes that rationality is invariable, while the mind-independent world is variable. Based on this, we ought to use this rationality to study and make sense of the variations that exist in the world. As an alternative to this perspective, the sociology of science reverses this assumption. That is, we assume the mind-independent world is invariable while our interpretations of it are not. On this account, the focus for study are the range of interpretations of this singular reality across different social and political contexts. So, our knowledge of the world is variable -- socially constructed -- while the real world is invariant -- foundational.

(#28) Mulaik bases his account of the functional relation concept on what he calls “pragmatic realism” (1986). “We are not passive observers who only summarize the regularities in phenomenal experience. Knowledge is not a representation but a construct. We are active agents who construct a conceptual world in our interaction with a real world. And the independent reality of that world resides in its selection of those constructs to succumb and pass from existence in spite of our efforts to make them prevail” (327).

(#41) *Social construction of ‘reception’* – “Maybe there is scientific and sorceric reception, and either is repeatable under (different) shared conditions. ...Is not community membership -- whether the scientific or sorceric community -- determined precisely by agreement upon what constitutes good reception, good instruments of reception?” (Foss, 1974: 306). Here it is clear that Foss construes the perception necessary for scientific inquiry as contingent on a social context. In so far as these ‘instruments of reception’ are so integrally linked with the way we think of the production of knowledge in science, his account can be characterized as epistemic constructivism.

**Epistemic Realism**

(#7) In a conspicuously titled piece: “On the Sociology of Science and the Continuing Importance of Epistemologically Couched Accounts”, Henderson (1990) attempts to unseat Pickering’s shift of attention to science as practice. Instead, he offers an account of science that privileges epistemology. In short, he shows how sociological accounts of practice in science assume and rely on an epistemological picture of science. Given this, his aim is to shift the focus of science studies back toward epistemological accounts. Epistemic accounts of science are, by implication, assumed to be real and primary enough to dictate
further research in science and technology. By privileging the role of epistemic concerns in science, he advances a position consistent with epistemic realism.

(#19) Shrader-Frechette and McCoy (1994) explicate a new ‘logic’ for case studies in applied ecology in this article. By virtue of a ‘public’ recognition of the methods used in case studies, they achieve a certain objective status. This is consistent with a commitment to methodological constructivism. However, in terms of the normative conclusions warranted by the logic of case studies, one must be something of a realist in order to avoid inconsistency. In this respect, the authors conclude with a plea for more work on the ‘logic’ of case studies which will supply applied ecologists with more tight justifications for their knowledge claims. They believe that there is knowledge achieved through their methods -- the problem for them is constructing a logically valid picture of the methods by which this knowledge is produced.

(#20) Here, philosopher Norton Nelkin (1993) undertakes the grand task of defining consciousness. He argues that consciousness consists of three distinguishable, and even dissociable states: phenomenality, intentionality, and introspection. Irrespective of the structure of the argument, an assumption necessary for it to work is that scientific observation can give us insight into the structure of the mind. The author relies on psychological studies to support his case, and essentially concludes with a statement defining the constituents of mental dispositions. He claims that these states exist, and that they have the properties and interrelationships he describes. “So my philosophical theory begins to edge into a scientific one insofar as it has testable consequences. To the question, ‘But what about the unity of consciousness?’ I reply that there is no unity, only the appearance of it” (432). As this remark indicates, his argument draws upon some psychological research and then makes a claim -- an epistemic claim -- about the structure of the mind. For this reason it is consistent with epistemic realism, and remains a candidate for metaphysical realism.

(#26) Greenwood (1990) attempts to show that the Duhem thesis and the “theory-informity of observation” do not undermine the “objectivity of theory evaluation” (553). Although he points to ways in which these ideas may be internally problematic, he fails to offer a positive argument establishing the objectivity to be found in evaluating explanatory theories. He distinguishes between explanatory and exploratory theories and asserts that problems stemming from the Duhem thesis and the theory-ladeness of observation only apply to exploratory theories -- leaving explanatory theories nice and safe. He thus assumes, but fails to support, methodological and epistemic realism.

(#33) In what I call a weak epistemic realism, Levin (1979) attempts to show that across different theories, terms and their meanings are in fact commensurable.
The device which makes this possible is his assertion that radical theory change in science produces corresponding changes in the semantics of the theories involved. He is essentially trying to preserve epistemic realism by saving the cummulation of knowledge which results from theory change.

(#34) David Hull offers a new interpretation of biological ‘species’ as an historical entity, rather than a universal type defined by essential features. His new historical definition of this concept holds that “particular organisms belong in a particular species because they are part of that genealogical nexus” (358). The traits that define a species are contingent upon the current evolutionary state of that species, not upon a single archetype. So scientific disciplines that focus their study on single species, defined in terms of physiological traits, are chasing a red herring – by implication this verdict is rested upon anthropology and social science, both of which focus on ‘humans’ as though this were an essentially defined group. The author draws on certain examples from classical physics to illustrate his argument. In at least one sense, then, he thinks that the inquiry of certain of the sciences is capable of capturing the regularity of nature with its theories. For this reason, the article is construed as consistent with a commitment to epistemic constructivism.

(#42) The realist core of this article can be summed up in one remark “quantity concepts have referents” (Byerly et. al, 1973: 27). The article is an attempt to defend the realist interpretation of quantity concepts in measurement systems from conventionalist or non-realist arguments. The author does point out some weaknesses with these non-realist accounts, but offers a very unsatisfactory basis for grounding his realist perspective. In one case, the argument for realism is nothing more than that our theories are simple. “We suggest rather that the simplicity of temperature laws is one inductive criterion used to judge the perspicuity of our representations of actual connections among theoretical entities” (25). Such a view commits this author to epistemic realism, if not methodological realism as well.

(#45) Meynell (1977) argues against Bloor and Barnes’ conception of the role for epistemology in social studies of science. He defines and argues for a capacity called ‘cognitive self-transcendence’ which is a “putative capacity of human beings, and the societies of which they are members, who exist at particular times and places, to know what is so at quite different places and times, and would have been so even if they had not known it...” (489). The very consideration of this concept as a viable description of modern science commits him to epistemic realism – that we have reason to believe that science has in the past and is capable of producing in the future, True knowledge about the way the world is independent of us.
Appendix C - Bibliographic Information from Sample of Articles

Social Studies of Science


**Philosophy of Science**


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Vitae

Mark C. Russell

Mark Russell came to Virginia Tech in 1991, thinking that a degree in Geology awaited him. Fortunately, Joe Pitt introduced the curious conversation called philosophy in his “Knowledge and Reality” class that year and Mark took up a major better suited to answering the most important questions of all.

Mark Russell received a B.S. in Sociology with a second major in Philosophy, in 1995 from Virginia Tech. He is currently reading for a Ph.D. in Science and Technology Studies at the same university.