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Incommensurability, Relativism, and Scientific Knowledge

By


The thesis is submitted to University College Dublin in fulfilment of the requirements for the degree of Doctor of Philosophy in Philosophy

UCD School of Philosophy

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# Table of Contents

**Introduction** .................................................................................................................................................. 1

1 Chapter 1: Relativism: describing, defining, and motivating relativism .............................................. 17  
1.1 Introduction .................................................................................................................................................. 17  
1.2 Describing relativism and forms of relativism ....................................................................................... 17  
1.2.1 Relationships between forms of relativism .......................................................................................... 21  
1.3 Normative character of relativism .......................................................................................................... 21  
1.3.1 Adapting the co-variance definition ................................................................................................. 25  
1.3.2 Distinguishing relativism from pluralism ........................................................................................... 27  
1.3.3 Relativism and pluralism: the internal / external perspective .......................................................... 29  
1.4 Motivating Relativism: alternatives and disagreements ..................................................................... 32  
1.5 Describing relativism in terms of alternatives and disagreement ...................................................... 40  
1.6 Conclusion: Chapter 1 ............................................................................................................................ 42  

2 Chapter 2: Kuhn’s account of science ...................................................................................................... 44  
2.1 Introduction ................................................................................................................................................ 44  
2.2 The context of Kuhn’s account .............................................................................................................. 46  
2.3 Kuhn’s descriptions of normal science, paradigm, novelty, crisis, revolution ..................................... 49  
2.3.1 Normal science and paradigms ....................................................................................................... 49  
2.3.2 Normal science and puzzle solving ................................................................................................. 52  
2.3.3 Paradigms and rules: internal versus external perspectives .......................................................... 53  
2.3.4 Plurality of non-adherent perspectives ............................................................................................ 57  
2.3.5 Novel and anomalous facts: theory-ladenness and holism ............................................................. 63  
2.3.6 Crisis and scientific revolution: novel theories ............................................................................. 65  
2.3.7 Paradigm insulation .......................................................................................................................... 69  
2.3.8 Phase transitions ............................................................................................................................... 81  
2.4 From description to justification .......................................................................................................... 82  
2.4.1 Incommensurability: forms or manifestations, and degrees ....................................................... 83  
2.4.2 Paradigm shifts .................................................................................................................................. 86  
2.4.3 Normal science, extraordinary science and scientific progress ............................................... 89  
2.5 Conclusion: Chapter 2 ............................................................................................................................. 91  

3 Chapter 3: Charges of relativism against Kuhn ......................................................................................... 93  
3.1 Introduction ............................................................................................................................................... 93  
3.2 Scientific revolution and the scientific paradigm ................................................................................... 94  
3.3 The scientific paradigm and incommensurability ............................................................................... 100  
3.4 Incommensurability and alternatives-induced relativism .................................................................. 102  
3.4.1 Linguistic idealism ............................................................................................................................. 106  
3.5 Progress, truth and alternatives-induced relativism .............................................................................. 109  
3.6 Conclusion: Chapter 3 ............................................................................................................................ 112
## Chapter 4: Incommensurability: manifestations and scales ................................. 115

4.1 Introduction ............................................................................................................ 115

4.2 Background ........................................................................................................... 116

4.3 What might incommensurability mean? ................................................................. 118

4.3.1 Forms or manifestations of incommensurability .............................................. 119

4.4 Kuhn's descriptions of incommensurability in SSR ............................................... 121

4.4.1 General, paradigm incommensurability ......................................................... 124

4.4.2 Methodological incommensurability .............................................................. 125

4.4.3 Different worlds incommensurability ............................................................ 127

4.4.4 Manifestations rather than forms ................................................................. 131

4.5 The problem answered by a scale ......................................................................... 132

4.5.1 Exploring a scale of general, paradigm incommensurability ......................... 135

4.5.2 Suggesting a strong and a weak sense of incommensurability ....................... 136

4.6 Conclusion: Chapter 4 ......................................................................................... 137

## Chapter 5: Normal Science, relativism, and incommensurability .............................. 139

5.1 Introduction ............................................................................................................ 139

5.1.1 Paradigm and normal science: arguments for relativism about meaning, ontological and conceptual scheme relativism ......................................................... 139

5.1.2 Paradigms and puzzle solving ........................................................................... 150

5.1.3 Paradigm and rules ............................................................................................ 153

5.1.4 Novelty and anomalies, crisis and revolution .................................................. 156

5.2 Conclusion: Chapter 5 ......................................................................................... 161

## Chapter 6: Scientific revolution, incommensurability, and different worlds .......... 163

6.1 Introduction ............................................................................................................ 163

6.1.1 An argument from incommensurability to several types of relativism .......... 164

6.1.2 Scale and perspective ....................................................................................... 165

6.2 Paradigm shift ........................................................................................................ 166

6.2.1 An argument from paradigm shifts to epistemic relativism ............................ 167

6.2.2 An argument from different worlds to ontological relativism ..................... 171

6.2.3 Non-adherent arguments for relativism ......................................................... 175

6.3 Extraordinary science and scientific progress ...................................................... 176

6.3.1 An argument from progress through scientific cycles to epistemic or ontological relativism with reference to truth .............................................................. 176

6.3.2 Applying weak incommensurability to extraordinary science and scientific progress ........................................................................................................ 177

6.4 Normativity, realism and antirealism ..................................................................... 180

6.5 A problem coming into view ................................................................................ 182

6.6 Conclusion: Chapter 6 ......................................................................................... 182

## Chapter 7: Challenges to the very idea of incommensurability ................................. 185

7.1 Introduction ............................................................................................................ 185

7.2 Davidson's argument ............................................................................................ 186

7.2.1 Setting the context ............................................................................................ 187

7.2.2 Total failure of translation ................................................................................ 189

7.2.3 Adherent arguments for relativism .................................................................. 192

7.2.4 The problem answered by a scale ................................................................... 200

7.3 Conclusion: Chapter 7 .......................................................................................... 201
Abstract

Kuhn's *The Structure of Scientific Revolutions* (SSR) has been a source of inspiration for many relativistic theories in the social sciences and beyond (1962, 1970, 1996). Despite an ever-growing number of books and articles, however, the question of what sort of relativism, if any, and on what grounds it follows from SSR has not yet been adequately addressed. This thesis attempts to shed light on the connections between the Kuhnian view of science and relativism by investigating the precise mechanisms by which various kinds of relativism might be grounded in Kuhn's account of science. Traditionally, arguments for relativism, in SSR and beyond, have been framed on the presupposition of the possibility of incommensurability between scientific paradigm or conceptual schemes. However, Donald Davidson, Hilary Putnam and others have argued that relativism is impossible or incoherent, because if paradigms are incommensurable to the degree claimed then we cannot engage with other paradigms in order to consider them genuine alternatives and find no means of judging objectively between them, as an argument for relativism would require. Contrary to their views, this thesis argues that, within a Kuhnian framework, there could be levels of incommensurability that will be hospitable to some forms of relativism. However, we need a finer grade understanding of the very idea of incommensurability as well as of relativism in order to see how plausible arguments for relativism could be framed based on Kuhn's views of science in SSR. This thesis shows that a non-scientist observing from outside of a scientific paradigm, lacking objective criteria to assess the meaning of terms in scientific language; the methods and standards, including knowledge claims, of the paradigm; and the ontological commitments of the paradigm, can articulate arguments for relativism at any point in the Kuhnian cycle of scientific revolution. Scientists working within a scientific paradigm adhere to the semantic, methods and standards, and ontological criteria of the paradigm, accepting these standards as objectively correct, and so they do not frame arguments for relativism about science at any point in the Kuhnian cycle. The thesis does not defend relativism about science; rather, it is an attempt at clarifying some core issues in a contentious area of philosophy of science.
Statement of Original Authorship

I hereby certify that the submitted work is my own work, was completed while registered as a candidate for the degree stated on the Title Page, and I have not obtained a degree elsewhere on the basis of the research presented in this submitted work.
Introduction

Thomas Kuhn's *The Structure of Scientific Revolutions* (SSR) has been an immensely influential source of debates in favour of and critical to various forms of relativism (1962, 1970, 1996). This thesis investigates the ways in which arguments for relativism about scientific knowledge may find support in Thomas S. Kuhn's historically-informed account of science.

The thesis is not an attempt to articulate or defend arguments for relativism about scientific knowledge, nor to adjudicate between arguments for and against the claim that relativism follows from Kuhn's account. Rather, it investigates the detailed workings of plausible arguments for relativism that can be grounded in Kuhn's account of science.

I argue, contrary to claims by many influential philosophers, that the presence of incommensurability, the "lack of common measure," between scientific paradigms alone cannot lead to arguments for relativism, but that arguments for relativism can be framed through an exercise of judgement by someone external to a scientific paradigm. That is to say, the possibility of relativism does not depend on the occurrence of incommensurability between paradigms, but on the epistemic position one occupies, that of a scientist working internal to a scientific paradigm or that of a non-scientist observing science from a perspective external to a scientific paradigm.

According to my interpretation of Kuhn's account, scientists adhering to their current scientific paradigm during normal science or choosing a replacement paradigm during extraordinary science will judge what is the "objectively" correct account of the world based on their current or the new paradigm. The scientists' judgement relates to the meaning of terms in scientific language, the methods and standards of their discipline, the knowledge and truth claims of their discipline, the conceptual framework through which they view the world, and the ontological commitments of their paradigm. In contrast, non-scientists, observing science from a position external to a scientific paradigm, judge that scientists should be able to decide between disputes within a scientific paradigm and between competing paradigms according to some objective criterion that is independent of any scientific paradigm. As I interpret Kuhn's account of science, the non-scientists' judgement that there should be objective standards, independent of scientific paradigms, relates to the meaning of terms in
scientific language, the methods and standards of scientific disciplines, the knowledge and truth claims of these disciplines, the conceptual framework through which scientists view the world, and the ontological commitments of the paradigms that scientist adhere to.

The main result of this inquiry is therefore to foreground the role of judgement in arguments for relativism that can be based on Kuhn's account of science in SSR. One consequence of the role of judgement in arguments for relativism that I explore is that Kuhn's later refinement of incommensurability to mean semantic incommensurability does not significantly reduce the arguments for relativism that can be grounded in his account of science in SSR.

The problematic addressed by this thesis, describing the precise mechanism by which arguments for relativism can be grounded on Kuhn's account of science in SSR, is important for two main reasons: firstly, because traditional arguments for relativism have been based on the existence of incommensurable paradigms and have not considered disagreements within paradigms, and secondly, following Donald Davidson's argument against the very idea of a conceptual scheme, because the notion of incommensurability between paradigms seems to preclude relativism (1974). We need a more nuanced understanding of arguments for relativism and of the idea of incommensurability to discover how plausible arguments for relativism could be based on Kuhn's views of science in SSR.

Relativism is the idea that the judgements we form about the world are correct or incorrect, true or false, ethical or unethical, only with regard to their relevant context, and where competing, plausible combinations of judgements within their context occur, there is no objective means of deciding between them (Baghramian, 2004, p. 5). Our judgements can concern our knowledge of the world (epistemological and ontological judgements, both mediated by cognitive processes) and our moral and aesthetic judgements about the world (Baghramian, 2004, p. 6). This thesis is most concerned with cognitive relativism, which can be described as "the view that what is true or false, rational or irrational, valid or invalid can vary from one society, culture or historical epoch to another and that we have no trans-cultural or ahistorical method or standard for adjudicating between the conflicting cognitive norms and practices" (ibid). Within the category of cognitive relativism, we can differentiate between "relativism about truth (or alethic relativism); relativism about rationality, norms of reasoning and justification; relativism about knowledge-claims (or … 'epistemic relativism'); and relativism about ontology or theories of what there is (or conceptual relativism)" (ibid).
The traditional charges that relativism follows from Kuhn's account of science have focused on the incommensurability that Kuhn says can characterise the relationship between scientific paradigms. Martin Curd and J.A. Cover attribute to Kuhn's account of science six arguments for relativism: the theory-ladenness of observation, meaning variance, problem weighing, shifting standards, the ambiguity of shared standards, and the collective inconsistency of rules (1998, p. 219). According to the authors, the first two arguments are based on controversial theses about observation and meaning, whereas the other four are concerned with epistemic values, "the criteria used to choose between competing theories and paradigms" (Curd and Cover, 1998, p. 224). However, the four of the arguments for relativism based on epistemic values that Curd and Cover describe can be considered as arguments for conceptual or ontological relativism, and as such they depend on incommensurability between scientific paradigms. In addition, the first two arguments for relativism that the authors identify in Kuhn's account, those based on the theory-ladenness of observation and the theory-dependence of meaning, depend on semantic incommensurability between paradigms. Alexander Bird finds potential sources of relativism in the concepts of the scientific paradigm, in incommensurability between scientific paradigms, in Kuhn's claims about the "world change" that occurs with scientific revolutions, and in Kuhn's conception of truth (Bird, 2011, p. 475). But these are all different effects of incommensurability between scientific paradigms. Wes Sharrock and Rupert Read argue against charges that Kuhn's idea of a scientific paradigm leads to semantic (conceptual scheme) relativism, relativism about truth, what they call "linguistic idealism", and ontological relativism (2002, pp. 155, 157, 173). But the arguments that they are countering are all based on the property of incommensurability that Kuhn says obtains between scientific paradigms.

In contrast, I interpret Carol Rovane as raising the possibility that science is characterised not by incommensurability between scientific paradigms, but by tractable and intractable disagreements between paradigms which do not give rise to relativism (Rovane, 2013, p. 32). In *The Metaphysics and Ethics of Relativism*, Rovane analyses the distinction between alternatives and disagreements as part of her project to formulate relativism (2013). Rovane initially argues that there are different formulations of relativism: the contemporary Semantic Relativism based on disagreement, and the older 20th century formulation, as manifested in exchanges between Donald Davidson and Thomas Kuhn, which was based on alternatives (Rovane, 2013, p. 11). However, she then proposes that disagreements do not give rise to relativism (Rovane, 2013, p. 32). And she follows this with an argument that science is a realm of shared meanings, characterised by disagreements, but not by genuine alternatives.
(Rovane, 2013, p. 126). I refer to these motivations, following Rovane, as "disagreements-induced" and "alternatives-induced" arguments for relativism. Against Rovane's argument that science is a realm of shared meanings where genuine alternatives are not possible, I apply this distinction between alternatives-induced and disagreements-induced relativism, interpreted as concerning shared meaning or the lack of shared meaning respectively, to ideas in the philosophy of science and to Kuhn's account of science. By addressing the different motivations for relativism, Rovane has shown that to be comprehensive in our analysis of arguments claiming that Kuhn's account of science leads to relativism, we need to consider how disagreements, as well as incommensurability, can lead to such arguments.

But the very possibility of incommensurability between paradigms and of any ensuing relativism about science is challenged by Donald Davidson's argument in 'On the Very Idea of a Conceptual Scheme' (1974). Davidson argues that relativism is impossible or incoherent, because if paradigms are incommensurable to the degree claimed in Kuhn's account, then access between paradigms is impossible and the issue of whether they constitute alternatives that cannot be judged between cannot arise (1974). And Davidson's argument, that given the nature of translation "we could not be in a positon to judge that others had concepts or beliefs radically different from our own," was the catalyst for considering a scale of incommensurability (1974, p. 20). This is because his arguments against total and partial translation failure, analogues for incommensurability between conceptual schemes, suggest that were incommensurability to exist between scientific paradigms, then the paradigm shifts Kuhn describes could not occur: during periods of extraordinary research, scientists would not be in a position to engage with alternative paradigms in order to assess them as potential replacements for a paradigm in crisis. Neither, as it appears, could arguments for relativism be framed, because neither scientists nor non-scientists could engage with other paradigms in order to consider them reasonable alternatives and find no means of judging objectively between them, as an argument for alternatives-induced relativism would require. If, on the other hand, incommensurability varied on a scale, for example, from strong to weak, then the phase transitions between normal science and extraordinary science could occur. However, whether this transition would constitute a scientific revolution as Kuhn intended is open to debate, given that it occurs under conditions of weak rather than strong incommensurability.

Distinguishing between strong and weak incommensurability throws into contrast the difference in the conditions for the possibility of relativism for scientists and for non-scientists, for those adhering to a scientific paradigm and to non-adherents. For example,
under conditions of weak incommensurability between theories, a non-scientist external to a paradigm could make an argument for relativism, whereas a scientist, who is seeking a replacement paradigm, would not. It seems that any examination of arguments for relativism based on Kuhn's account can be made more specific by taking account of the interaction between incommensurability, whether weak or strong, and the perspective from which an argument for relativism is made, internal to or external to a scientific paradigm.

To pursue my line of argument in this thesis, I adapt distinctions from the literature on relativism and on incommensurability, and apply these to my reading of Kuhn's account of science in SSR and to arguments for relativism based on that account. Regarding relativism, I distinguish between relativism and pluralism in terms of the constraint to judge, although judging is impossible between intractable disagreement positions or alternative world views. I distinguish between alternatives-induced and disagreements-induced arguments for relativism. And I distinguish between the perspective from where such arguments can be framed: the adherent position that is internal to the disagreement position or world view and the non-adherent position that is external to the position or world view. Regarding incommensurability, I propose that rather than discussing forms of incommensurability, such as semantic, methods and standards, and world change incommensurability as suggested by Kuhn's account in SSR (1996, p. 150), we should consider these as manifestations of semantic incommensurability. I also propose that we can apply a scale of incommensurability in an analysis of Kuhn's account of science.

Describing a scale of incommensurability allows the other distinctions I have made to illuminate the workings of arguments for relativism based on Kuhn's account. For example, at different points during the Kuhnian cycle of scientific revolutions, under different conditions of strong or weak incommensurability, adherents and non-adherents make different types of choices about the dominant scientific paradigm. Under strong incommensurability, adherents are dogmatic and cannot frame arguments for relativism, whereas non-adherents do not share this dogmatic certainty and can frame arguments for alternatives-induced relativism. The description of a scale of incommensurability also helps to illustrate how both disagreements-induced and alternatives-induced arguments for relativism can be framed by non-adherents at different points in the Kuhnian cycle, whereas adherents do not frame such arguments. This difference, which is another distinction highlighted by the description of a scale of incommensurability, is due to the different type of judgement exercised by adherents, who judge what is "objectively" correct by choosing their current or a replacement paradigm, and
non-adherents, who do not have this kind of judgement available to them. For example, in any of the cases of incommensurability that Kuhn describes in SSR, such as Copernican and Ptolemaic astronomy, the phlogiston theory and Lavoisier's theory of combustion involving oxygen, or Newtonian and Einsteinian mechanics, by choosing the replacement over their current paradigm, scientists accept that the new paradigm describes the world by its own standards. However, the opportunity to choose a paradigm that guarantees its own objectivity is not available to those external to all scientific theories, both the old and the new paradigm. The non-scientist, who does not understand or embrace either Newtonian or Einsteinian mechanics, expects that scientists should be constrained to judge which is the objectively correct account by a standard independent of any paradigm. In the long term, critical experiments such as Arthur Eddington's expedition to observe the solar eclipse of 29 May 1919, may provide such standards. But in the meantime, those external to a scientific paradigm can frame arguments for relativism about science.

Given that the traditional arguments do not make use of the distinctions I am applying in my analysis, it would be uncharitable to criticize them in terms of these distinctions. Instead, to investigate both the traditional and other possible charges of relativism that might be based on Kuhn's description of science, I construct arguments for different types of relativism and examine them using the various distinctions I have drawn from the literature. In applying this methodology, I am not attempting to frame strong argument for relativism nor to argue for relativism about scientific knowledge. I am framing these arguments so as to examine the precise mechanisms by which various kinds of relativism might be grounded in Kuhn's account of science in terms of relativism and pluralism, disagreements and alternatives, strong and weak incommensurability, and the adherent and the non-adherent perspective. This approach reveals that it is the difference in the type of judgement exercised by non-adherents and adherents (or participants and non-participants in a paradigm) that allows the non-adherent to frame arguments for relativism about science whereas the adherent cannot. I try to interpret the role that judgement plays in framing arguments for relativism about scientific knowledge in a positive light: the non-adherent is not content to accept paradigm-bound "objectivity" and "truth" as is the adherent to the scientific paradigm, and their relativism shows a hankering for objectivity and truth independent of scientific paradigms, however inaccessible given Kuhn's account of science.

Although the distinctions I employ in the thesis are extant in the literature, they have not been applied as I describe, in combination, to Kuhn's account of science. The thesis also proposes a
novel conclusion: that the presence of incommensurability between scientific paradigms alone cannot lead to arguments for relativism, but that arguments for the two key variants of cognitive relativism, what I call “alternatives-induced” and “disagreements-induced” relativism, can be framed through an exercise of judgement by someone external to a scientific paradigm. This result should improve the specificity with which we draw relativistic conclusions from Kuhn's account of science.

Summaries of each of the chapters leading to this conclusion follow.

**Chapter 1: Relativism: describing, defining, and motivating relativism**

In Chapter 1, I consider how relativism can be described in general terms and the forms of relativism in different domains. I proceed from describing relativism as one type of response to the commonplace failure of our ability to know, under particular conditions, which proposition among apparently contradictory propositions is true, to descriptions of global and local relativism, and to definitions of forms of relativism within different domains of enquiry. I adapt a co-variance definition of relativism by including a constraint to judge between contextualised positions, although judging is impossible. According to this modified co-variance definition, relativism is the claim that a phenomenon x (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable y (e.g., paradigms, cultures, conceptual schemes, belief systems, language) and although it may be possible to compare different resultants of this (dependent-independent) co-variation, there is no means of judging between the relativisations. I show how the definition can be used to distinguish between pluralism and relativism, based on the constraint to judge between propositions in a dispute. I also consider how arguments for relativism have been motivated by the presence of, or the perception of, alternative world views or intractable disagreement positions. And I further adapt the modified definition of relativism so that it functions for both alternatives-induced and disagreements-induced relativism. According to this fuller definition, relativism is the claim that in cases of intractable disagreement positions (where meanings are shared between protagonists) or alternative world views (where meanings are not shared between protagonists), the disputed phenomenon x (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable y (e.g., paradigms, cultures, conceptual schemes, belief systems, language) and although it may be possible to compare different resultants of
this (dependent-independent) co-variation, there is no means of judging between the relativisations. I suggest that we should take account of the perspective from whence an argument for relativism can be framed, the adherent position that is internal to the disagreement position or world view and the non-adherent position that is external to the position or world view.

Chapter 2: Kuhn's account of science

In Chapter 2, I draw attention to several aspects of Kuhn's account of science in *The Structure of Scientific Revolutions* (SSR) that will be important in my investigation of arguments for relativism that might be developed from this work (1962, 1970, 1996). Based on his interpretation of the history of science, Kuhn describes a cyclical, two-phase account of science wherein periods of normal science (science conducted within or according to a scientific paradigm and mostly characterised by puzzle solving) are separated by periods of extraordinary science (science in crisis or revolutionary science), mostly characterised by the search for a replacement paradigm. The periods of extraordinary science are brought about by the perceived failure of the normal science paradigm, resulting in crisis, and resolved by the revolutionary adoption of a new paradigm and a return to normal science under the new scientific paradigm. I show that incrementally through the text, Kuhn refines his description of the relationship between scientific paradigms such that they are incommensurable and do not share a common measure. But I also show that Kuhn does not explain how this incommensurability can insulate the dominant paradigm from competing theories during normal science, while still allowing interaction between the paradigm and these competing theories during extraordinary science.

Chapter 3: Charges of relativism against Kuhn

In Chapter 3, using the descriptions and definition of relativism from Chapter 1, I examine some traditional charges that Kuhn's account of science has relativistic consequences. I show that the traditional analysis of the relativism that can be based on Kuhn's account focusses on alternatives-induced arguments grounded in the property of incommensurability, the lack of shared meaning, methods and standards, or ontology, between scientific paradigms. For example, Martin Curd and J.A. Cover identify in Kuhn's account of science six arguments for relativism: the theory-ladenness of observation, meaning variance, problem weighing, shifting standards, the ambiguity of shared standards, and the collective inconsistency of rules (1998,
p. 219). All of these, I argue, are grounded on incommensurability. Alexander Bird finds potential sources of relativism in the concepts of the scientific paradigm, in the property of incommensurability between scientific paradigms, in Kuhn's claims about the "world change" that occurs with scientific revolutions, and in Kuhn's conception of truth (Bird, 2011, p. 475). But I argue that these are all different effects of incommensurability between scientific paradigms. Wes Sharrock and Rupert Read identify and argue against charges that Kuhn's idea of a scientific paradigm leads to semantic (conceptual scheme) relativism, relativism about truth, what they call "linguistic idealism", and ontological relativism (2002, pp. 155, 157, 173). But I show that the arguments that Sharrock and Read oppose are all based on the property of incommensurability that Kuhn says characterises the relationship between scientific paradigms.

**Chapter 4: Incommensurability: manifestations and scales**

In Chapter 4, I introduce and explain some ideas and distinctions relating to incommensurability that will be useful in my analysis: principally, the distinction between forms and manifestations of incommensurability, and the idea of employing a scale of incommensurability in any analysis of Kuhn's account of science.

The concept of incommensurability and the relationship between relativism and incommensurability are more complicated than presented in the literature in the area. On review, it appears from some of the literature that there are different forms of incommensurability and that these can give rise to different forms of relativism. In addition, some of the literature on incommensurability suggests that we might describe scales of incommensurability: from global to local, or from partial to total, or from strong to weak.

I consider Kuhn's introduction of "incommensurability," and how the figurative language he uses to expand on his initial description could lead to the idea that there are different forms of incommensurability. I propose that rather than describing different forms of incommensurability (such as epistemological, conceptual or ontological) we should consider these to be different manifestations of semantic incommensurability, which is thus the source for different types of alternatives-induced arguments for relativism. Describing different manifestations of semantic incommensurability rather than different forms of incommensurability will ensure that my investigation is not adversely affected by Kuhn's later refinement of the concept of incommensurability to mean semantic incommensurability.
Also in this chapter, I propose that describing a scale of incommensurability is appropriate to Kuhn's account of science and useful in my analysis of the relativism that might be grounded in this account. Kuhn draws a strong distinction in the conduct of science during periods of established normal science and periods of crisis. I argue that in discussing the relativistic implications of SSR, and its connections with incommensurability, commentators have failed to attend to the varieties and sources of relativism arising from these distinctions. I argue that we can draw a useful distinction between weak and strong incommensurability. By weak incommensurability I mean that within a paradigm, adherents can be aware of another paradigm but not share it. This means that adherents share sufficient meanings to communicate with the alternative paradigm, but do not understand its meanings, methods and standards, or world view as adherents native to that paradigm do. In contrast, by strong incommensurability, I mean that from within a given paradigm, adherents cannot even acknowledge or be aware of a different paradigm. This means that adherents to one paradigm do not share sufficient meanings to communicate with an alternative paradigm, they do not understand its meanings, nor its methods or standards, nor its world view.

**Chapter 5: Normal Science, relativism, and incommensurability**

In Chapter 5, I show how Kuhn's initial descriptions in SSR of a scientific paradigm, puzzle solving, rules, novelty and anomaly handling, imply that what I term "strong incommensurability" characterises the relationship between the dominant paradigm and competing theories during normal science. Under conditions of strong incommensurability, adherents to one paradigm do not share sufficient meanings to communicate with an alternative paradigm; they do not understand its meanings, nor its methods or standards, nor its world view. I also examine the implications of this strong incommensurability on the framing of arguments for relativism based on Kuhn's account. I construct and analyze arguments for relativism based on Kuhn's initial description of the normal science paradigm and related aspects of his account of science: puzzle solving, rules, novelty and anomaly handling, crisis and revolution. In doing so, I am not attempting to construct from Kuhn's description unassailable arguments for relativism. I am merely using the construction of arguments for relativism as an analytical technique for determining what aspects of Kuhn's description of science might entail relativism. I also describe how arguments for disagreements-induced relativism might be framed for these components of Kuhn's account, in the absence of incommensurability or the presence of what I term strong
incommensurability. And I describe why the perspective of the person framing any argument for relativism should be a major consideration in the analysis. This is because there is a difference in formulating the possibility of relativism from external (extra-paradigmatic) and internal (intra-paradigmatic) perspectives. As we have seen, relativism follows from the possibility of incommensurable differences between alternative paradigms. However, the awareness of such differences is a precondition for countenancing the very possibility of relativism. But such a possibility does not exist for the practitioners of science within a Kuhnian paradigm. It is only when someone steps out of a paradigm and looks at the available alternatives that they can formulate the preconditions for relativism.

I argue that the paradigm, as initially described, without the specification of incommensurability, does not allow the development of arguments for alternatives-induced relativism. This shows that the possibility of incommensurability is a necessary condition for relativism. Under conditions of strong incommensurability between paradigms adherents do not allow alternatives-induced relativism, because they are locked in dogma. Under such conditions, non-adherents can frame arguments for alternatives-induced relativism. This difference indicates that it is not only the lack of shared meaning between paradigms, but the type of judgement exercised by adherents (internal to a paradigm) and non-adherents (external to a scientific paradigm) that leads to arguments for relativism.

But the possibility of incommensurability between paradigms, such that there is a lack of shared meaning between paradigms, by definition entails that there is shared meaning within paradigms. This provides the conditions for the possibility of disagreements-induced arguments for relativism. Under conditions of strong incommensurability between paradigms, adherents consider any disagreement within science to be part of science, an issue to be resolve, and any disagreement between the paradigm and some position outside of it as a simple case of the other position being wrong. They therefore do not allow arguments for disagreements-based relativism. However, under such conditions, non-adherents can ground arguments for disagreements-induced relativism on the disputes they perceive within a scientific paradigm.

This indicates that the possibility of alternatives-induced and disagreements-induced relativism is not dependent on the occurrence of strong incommensurability between paradigms, but on the epistemic position one occupies.
Chapter 6: Scientific revolution, incommensurability, and different worlds

In Chapter 6, I show that we can interpret Kuhn as intending that there can exist weak incommensurability between scientific paradigms, in addition to the strong incommensurability I considered in the previous chapter. By weak incommensurability I mean that within a paradigm, adherents can be aware of another paradigm but not share it, so that they share sufficient meanings to communicate with the alternative paradigm, but do not understand its meanings, methods and standards, or world view as those native to that paradigm do.

In Chapter 4, I suggested that a scale of incommensurability can do useful explanatory work when investigating Kuhn's account of science. Applying such a scale, in Chapter 5, I described how Kuhn's initial descriptions of a scientific paradigm, puzzle solving, rules, novelty and anomaly handling can be read as implying that what I term strong incommensurability characterises the relationship between paradigms during normal science. Continuing to apply a scale of incommensurability, in the current chapter, I argue that Kuhn's more detailed descriptions of science can be interpreted as implying that a weak rather than a strong sense incommensurability is required during extraordinary science and the revolutionary transition to a new scientific paradigm.

I also examine the impact that specifying weak incommensurability has for the framing of arguments for relativism that might be based on Kuhn's work. And in this, I employ the distinctions that I have previously used between adherent and non-adherent perspectives and alternatives-induced and disagreements-induced arguments for relativism.

I argue that under conditions of weak incommensurability, as I suggest pertains during extraordinary science and scientific revolution, adherents may be pluralist but will not frame alternatives-induced arguments for relativism. They can allow that several alternative paradigms might be correct, but they will not allow that it is impossible to judge between the alternatives. In contrast, non-adherents can frame alternatives-induced arguments, in addition to disagreements-induced arguments. The analysis using arguments for relativism shows that adherents and non-adherents exercise a different form of judgement to each other. Adherents choose a replacement paradigm and judge what is the "objectively" correct account of the world based on this new paradigm, whereas non-adherents judge that scientists should be able
to decide between competing paradigms according to some objective criterion that is independent of any scientific paradigm.

Taken together with my arguments from Chapter 5, this indicates that the possibility of alternatives-induced and disagreements-induced relativism is not dependent on the occurrence of weak or strong incommensurability between paradigms, but on the epistemic position one occupies. That is to say, the non-adherent to a scientific paradigm can make arguments for both disagreements-induced and alternatives-induced relativism under conditions of both strong and weak incommensurability. In contrast, the adherent to a scientific paradigm will not frame such arguments, regardless of the degree of incommensurability prevailing.

In conclusion, although relativism has often been formulated as a threat to the whole enterprise of science, I argue that relativism does not impinge on the practice of science and does not threaten it. However, relativism does remain at least a plausible epistemic position for those who are investigating or assessing the state of science from an external perspective. This in many way explains why relativism is a hot topic of debated among practitioners of science studies and not among scientists themselves.

Chapter 7: Challenges to the very idea of incommensurability

In this chapter, I describe how Kuhn's conceptions of a scientific paradigm and of incommensurability between paradigms can withstand the charges against it delivered by Donald Davidson in his 'On the Very Idea of a Conceptual Scheme', where Davidson argues that just as we cannot conceive of languages that are not intertranslatable, we cannot conceive of conceptual schemes that are incommensurable (1974). And I consider the challenge to the notion of incommensurability and to Kuhn's account of science presented by the Putnam-Kripke causal theory of reference.

Davidson denies the very conditions that Kuhn's account of science requires: the existence of a separable, conceptual scheme, which would allow the existence of scientific paradigms such as Kuhn describes, and the possibility of incommensurability between such paradigms. Davidson's position is that we share a common co-ordinate system, meaning that our experience consists holistically of the data of the world and the mechanisms by which we process these data (1974, p. 20). This means that there is neither one conceptual scheme, understood as a framework that organizes the data of our experience which can be
disconnected from that data, nor are there many such schemes. This is because it is not possible to distinguish between a conceptual scheme and empirical content: to claim that this is possible is to accept what Davidson calls the "third dogma" of empiricism (1974, p. 11). Davidson presents a series of inter-related arguments for this position based on his contention that there cannot exist a language that is not intertranslatable to our, or another, language. Davidson says that we can identify conceptual schemes with languages and investigate whether we can say "two people have different conceptual schemes if they speak languages that fail of intertranslatability?" (Davidson, 1974, p. 7). Such failure of translatability could in principle be total or partial, but neither of these is possible. Regarding total failure of translation, the metaphors of a language organising or fitting our experience of the world both, in different ways, involve the notion of translatability. Therefore, it does not make sense to talk of total failure to translate a language, given that to be translatable is part of what it is for something to be a language. Regarding partial failure, applying the principal of charity, Davidson says that translation occurs against a background of agreement about what sentences are true, and so partial translation failure cannot occur. Therefore, according to Davidson, as there cannot be languages that are not intertranslatable, (if something is a language, it is translatable), there cannot be cognitive schemes that are incommensurable.

I show that Davidson's argument does not rule out the existence of alternative conceptual schemes; that his argument may not apply to the case of scientific paradigms; and that, even if correct, his argument does not preclude Kuhn's idea of a scientific paradigm. The problem with Davidson's argument is that he strongly identifies conceptual schemes with languages, and by extension with paradigms. However, as we have seen in Chapter 2, Kuhnian paradigms have a very different role and function than whole languages.

In this chapter, I also consider the challenge to the notion of incommensurability and to Kuhn's account of science presented by the Putnam-Kripke causal theory of reference. As with Davidson's argument in terms of a theory of meaning, the key difference between the Putnam's causal theory of reference and Kuhn's conception of reference is our ability or inability to access mind-independent reality. I argue that Kuhn's conception of incommensurability, the idea that there could be terms that are non-translatable across paradigms, can survive the challenges presented by essentialism and Putnam's reliance on a causal theory of reference in his Twin Earth thought experiment. Kuhn argues that we cannot, as essentialism would require, use scientific terms to pick out properties of objects independently of the theory within which the terms are developed. Nor can we tell which
properties of objects are essential and which are accidental. In fact, what essentialism labels as "accidental" properties are just as necessary as what it labels "essential."

Kuhn's responses to the challenges presented by Davidson and by Putnam indicate how he was developing his conception of incommensurability and refining it to a semantic notion based on a theory of meaning and a theory of reference. In an addendum to this thesis, I indicate how Kuhn's refinement of his conception of incommensurability to mean local, narrow-sense non-translatability of terms might present difficulties for my analysis, given that this refinement seems to preclude a scale of incommensurability. And I indicate how this can be avoided by modifying my scale slightly.

Addendum

In keeping with the consensus, I argue that Kuhn refined his conception of incommensurability throughout his career to the point where he considers it to be a semantic phenomenon. And I argue that we can apply this conception of incommensurability as semantic incommensurability retrospectively to Kuhn's account of science in SSR. Although my investigation might seem to be threatened by this refinement, I suggest that the analysis can be modified to take account of it.

I begin by examining Kuhn's later refinement of the concept of incommensurability through Hoyningen-Huene's reconstruction of Kuhn's account of science. I then consider Kuhn's original articulations in SSR, where he seems to describe incommensurability as a complex of three forms of incommensurability: semantic, methods and standards, and different worlds (perceptual, or experiential, or ontological incommensurability depending on how we interpret him). I argue that we can read these articulations as describing a general paradigm incommensurability consisting of semantic, methods and standards, and different worlds incommensurability. And I show that Kuhn can be interpreted as describing these as manifestations of semantic incommensurability in SSR. Drawing again on Hoyningen-Huene's reconstruction, I describe how Kuhn explains how scientists learn to co-constitute their world through language during their education into paradigm adherence. And I consider what Kuhn would need to supply in order to subtend his ideas about incommensurability: a theory of knowledge, ontology, meaning and reference that makes sense of saying that a scientist's use of language in some way generates the world they encounter.
I argue that we can usefully apply a scale, from effectively strong to effectively weak semantic incommensurability when interpreting Kuhn's account of science in SSR. This scale is a modification of the scale from strong to weak incommensurability that I used in Chapters 5 and 6. In arguing for a scale of effectively strong to effectively weak incommensurability, I use Hoyningen-Huene's interpretation of Kuhn's refined conception of incommensurability: local, narrow sense non-translatability of, probably related, key terms in a paradigm. And I use Hoyningen-Huene's description of how for Kuhn translation has two essential components: word-for-word translation and interpretation.

Using these descriptions, I explore what happens when we apply the refined version of incommensurability and the distinction between the components of translation to Kuhn's account of science in SSR. I consider, given that these two distinctions allow that adherents can circumvent, but by definition not overcome, incommensurability, why would a community of scientists want to circumvent incommensurability? The answer, I suggest, is that during crisis and extraordinary science, scientists are motivated to engage beyond their native paradigm in the search for an alternative world view. I conclude that using a scale of effectively strong to effectively weak incommensurability shows that Kuhn's refinement of incommensurability doesn't affect the grounds for relativism that can be found in his account of science.
1 Chapter 1: Relativism: describing, defining, and motivating relativism

1.1 Introduction

In this chapter, I move from examining some descriptions of relativism to adapting a definition of relativism, and considering the motivation for relativism in terms of this definition. In doing so, I aim to establish three distinctions that will be useful in my analysis of the relativism that might be grounded in Kuhn's account of science in SSR. I distinguish between relativism and pluralism in terms of the constraint to judge (although judging is impossible) between intractable disagreement positions or alternative world views. I distinguish between alternatives-induced and disagreements-induced arguments for relativism. And I distinguish between the perspective from where such arguments can be framed, the adherent position that is internal to the disagreement position or world view and the non-adherent position that is external to the position or world view. For each of these three distinctions, I draw the details of the distinction from the extant literature and modify its application to suit the purposes of my analysis. In this thesis, I will use these and other distinctions to foreground the normative aspect of arguments for relativism. That is, to emphasises the role of the judgement of the person framing alternatives-induced or disagreements-induced arguments for relativism, internal to or external to a disagreement position, context, paradigm, or world view.

1.2 Describing relativism and forms of relativism

On a general construal, relativism is the idea that the propositions and judgements we form about the world or aspects of the world are correct or incorrect, true or false, only with regard to their relevant context, and where competing, plausible combinations of propositions and judgements within their context occur, there is no objective means of deciding between them. Although useful as a first approximation, this general construal of relativism does not describe the variety of relativism nor indicate the possible motivation for framing arguments for relativism. In this chapter, I examine several useful descriptions of relativism and adapt one of these such that it foregrounds the role of judgement. I use this description to differentiate
between relativism and pluralism in terms of a requirement to judge. And I consider the
epistemic motivations, rather than social or cultural motivations, for relativism.

Different forms of relativism have been discussed in domains of enquiry such as ethics and
epistemology over the long history of the idea of relativism. In her 2004 *Relativism*, Maria
Baghramian describes the history of relativism about ideas in general. This ranges from
considerations of how different civilisations conceive their gods as being similar to the people
of different civilisations to Progatoras' famous dictum that "man is the measure of all things"
(2004, pp. 22, 23, 25). The historical approach has the advantage of describing the different
forms of relativism in their context. This means that we see both the variety of relativism and
the relation of the various forms have both to their individual contexts and to each other.
When considered in the most general terms possible, relativism relates to the judgements we
can form about the world. These judgements can relate to our knowledge of the world
(epistemological and ontological propositions, both mediated by cognitive processes) and to
our moral and aesthetic judgements about the world. As Baghramian puts it, "Depending on
whether cognitive, moral or aesthetic norms are being considered we can distinguish between
the broad categories of cognitive, moral and aesthetic relativism" (Baghramian, 2004, p. 6).

These different categories of relativism share a common form, as described in the following
formulation of relativism from Baghramian:

The relativist claim, then, is that the presence or absence of properties such as truth, rationality,
goodness, etc., and the correct ascription of predicates such as 'is true', 'is rational', 'is ethical', etc.,
depend not only on the objects to which the ascription is being made but also on factors such as social
and cultural norms, cognitive frameworks, historical epochs, etc. Furthermore, it is assumed that it is
impossible to rank judgements of truth or falsity, etc. or to privilege one over another, for all cultures,
historical epochs or cognitive frameworks that give rise to such judgements have equal standing (2004,
p. 5).

Of the three broad categories of relativism — cognitive, moral, and aesthetic — cognitive
relativism is of most concern in this thesis. Baghramian describes cognitive relativism as "the
view that what is true or false, rational or irrational, valid or invalid can vary from one
society, culture or historical epoch to another and that we have no trans-cultural or ahistorical
method or standard for adjudicating between the conflicting cognitive norms and practices"
(Baghramian, 2004, p. 6). And within this category of cognitive relativism, she differentiates
between "relativism about truth (or alethic relativism); relativism about rationality, norms of
reasoning and justification; relativism about knowledge-claims (or what in this book I call
'epistemic relativism'); and relativism about ontology or theories of what there is (or conceptual relativism)” (Baghramian, 2004, p. 6).\(^1\)

We can unpack this description further to yield uncontroversial definitions or descriptions of alethic, epistemic, conceptual/ontological relativism and relativism about rationality. Accordingly, "Relativism about truth (alethic relativism) is the claim that the truth of an assertion is relative to the beliefs, attitudes and other psychological idiosyncrasies of individuals or, more generally, to their social and cultural background" (Baghramian, 2004, p. 15). And "The relativist about rationality argues that various societies or cultures have different standards of rationality and that we are not in a position to choose between them; the search for universal standards of rationality is futile, she argues, because rationality consists of conforming to the prevalent cognitive norms and different societies may subscribe to different norms" (ibid).

Another form of cognitive relativism, epistemic relativism "claims that what we know, or claim to know, is always bound up with particular historical, cultural and even individual perspectives and conditions and hence cannot be universal or non-contextual" (Baghramian, 2004, p. 180). And "Conceptual relativism relativises ontology, or our theory of what there is, to conceptual schemes, scientific paradigms, world versions, categorial schemes or frameworks" (Baghramian, 2004, p. 7). That is to say, the conceptual relativist argues that "the world does not present itself to us ready-made or ready-carved, rather we supply the different ways of categorising and conceptualising it" (Baghramian, 2004, p. 7). Conceptual relativism has also been referred to as semantic relativism, linguistic relativism, ontological relativism, and even cognitive relativism (Baghramian, 2004, p. 214).

That conceptual relativism is called by so many different names suggests that there are different perspectives on the same phenomena, and indeed, that different nominal forms of relativism about meaning, conceptual relativism, and ontological relativism describe the same phenomenon. For example, relativism about meaning is the view that the meanings of the

\(^1\) This general description of relativism can be used to derive descriptions of the many different forms of relativism we encounter and to classify these different forms with greater precision, as Baghramian does. For example, "Moral relativists claim that the truth or falsity, the appropriateness or inappropriateness of an ethical belief, is relative to its socio-historical background and that moral beliefs cannot be assessed independently of their social framework" (Baghramian, 2004, p. 6). And "Aesthetic relativism rehearses the arguments put forward by the moral relativists, with the difference that it is values such as beauty, originality, creativity (in other words, aesthetic rather than moral values) that are relativised.” (Baghramian, 2004, p. 6)
words, phrases, and sentences of a language are determined by the linguistic communities that use a language and although these meanings can be compared across communities, there is no means of judging between them as to which is correct. But this is just to say that the meanings of a language are determined by the conceptual scheme or paradigm that a community uses. Similarly, conceptual relativism relativises our ontology, our theory of what there is, to conceptual schemes or paradigms. But we can also say that relativism about ontology gives rise to, or is a form of, conceptual relativism. And conceptual relativism also relativises our knowledge of what there is, to conceptual schemes or frameworks. And in turn, relativism about knowledge is a source of relativism about our frameworks so that epistemic relativism gives rise to conceptual relativism.

In addition to the forms listed above, any consideration of relativism should include contemporary developments in what has been variously called new relativism, linguistic relativism, analytic relativism, truth relativism, or semantic relativism (Baghramian and Carter, 2015). The idea underpinning new relativism is that in certain discourses, where the parties share sufficient meaning to communicate, there can arise intractable disagreements due to differences in the context of utterance or the context of assessment of propositions or utterances. This kind of linguistic analysis provides formal explanations for how relativism might occur, for example, when predicates of personal taste or moral or aesthetic propositions are expressed. However, these developments are also a contemporary argument for the ancient idea that intractable disagreement can lead to relativism in situations where meanings are shared between protagonists (see Section 1.5).

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2 The broad categorisation of relativism as either moral, aesthetic, or cognitive, and the descriptions of the forms of relativism that can be distinguished within cognitive relativism are a useful starting point for my analysis. But these categorisations and descriptions do not exhaust the variety of relativism, or at least the variety of ways that relativism has been categorised. For example, social relativism, historicism, cultural relativism, post modernism, and social constructivism describe, respectively, how social norms, the world view of historical periods, cultural practices, conceptions of rationality, and the objects of scientific enquiry are determined by the relevant context. These characterisations of relativism can be accommodated within the general definition of relativism, but they take a different perspective on the phenomenon or apply the idea of relativism to different aspects of human activity and enquiry about the world. These examples also show how some forms of relativism are inter-related or at least share features. So, for example, social relativism, historicism, cultural relativism, post modernism, and social constructivism about knowledge are all concerned to show the primacy of the human mind in constructing the social, cultural, political, intellectual, and material world that we experience (Baghramian, 2004, pp. 7, 8, 105). They share this feature with cognitive relativism. And just like the conceptual relativism forms of cognitive relativism, they arise because of considerations of how conceptual frameworks influence our social arrangement, culture life, interpretation of history, and experience of the world etc.
1.2.1 Relationships between forms of relativism

By describing and categorising varieties of relativism, some of the relationships between the various forms of relativism become apparent. I have briefly referred to the relationship between conceptual/ontological relativism and epistemic relativism. From this, it seems that some forms of relativism are inter-related, that they can give rise to each other, or can be reduced to each other. And I have just considered the interrelationships, in terms of shared features, between conceptual relativism and social relativism, historicism, cultural relativism, post-modernism and social constructionism, also known as "constructivism".

The fact that different forms of relativism are inter-related enables us to take a different perspective on certain forms. That is to say, we can consider different forms of relativism in terms of one or other of their shared features. For example, Baghramian's descriptions categorise relativism broadly as cognitive, moral, or aesthetic. And she indicates that cognitive relativism includes relativism about truth, about rationality, about knowledge claims, and about ontology. But it is possible to categorise these forms of relativism differently, as Baghramian does when considering in detail relativism about truth:

Alethic relativism is at once the most radical and most general of all relativistic positions, for other varieties of cognitive relativism, and even moral relativism, are reducible to it. For instance, relativism about rationality can be restated as the claim that there are no true (universal) standards of rationality: relativism about logic as the contention that logical truths are relative to specific cultures or cognitive schemes and not universal in their scope and application; and moral relativism as the view that the truth of ethical judgements is relative to their context or the cultural background (Baghramian, 2004, p. 121).

It would only take the inclusion of aesthetic relativism alongside moral relativism in this description to allow that all the forms of relativism Baghramian previously described can be examined in terms of relativism about truth, the truth of our judgements about cognitive norms (standards of rationality, systems of logic, conceptual/ontological schemes or scientific paradigms, knowledge claims, and truth claims), moral values, and aesthetic values.

The inter-relatedness of forms of relativism and the different perspectives on relativism we can adopt by investigating it in terms of truth, knowledge, or ontology, will be relevant to my analysis.

1.3 Normative character of relativism
In the course of this chapter, I have proceeded from our commonplace experience of uncertainty about our beliefs or inability to judge between beliefs when faced with competing, plausible accounts, to some descriptions of global relativism, and characterisations of different forms of local relativism in various domains. And I have considered how we can investigate relativism from different perspectives.

In this Section, I will develop a description of relativism, or forms of local relativism, that foregrounds the normative character of relativism. As a first step, I need to consider what might be the common features shared by different forms of relativism: that is, what features of relativism would need to be accounted for within any description of relativism. Baghramian adopts this approach and building on the work of Susan Haack, proposes a description that characterises the different kinds of relativism in terms of variables. She makes use of Susan Haack's 1996, identikit description of various types of relativism (2004, p. 6), which categorises situations where:

(1) Meaning is relative to (a) language.
(2) Reference is relative to (b) conceptual schemes.
(3) Truth is relative to (c) theory.
(4) Metaphysical commitment is relative to (d) scientific paradigm.
(5) Ontology is relative to (e) version, depiction, description.
(6) Reality is relative to (f) culture.
(7) Epistemic values are relative to (g) community.
(8) Moral values are relative to (h) individuals.
(9) Aesthetic values are relative to (i) historical periods.

Baghramian believes that Haack's identikit picture makes the task of classifying relativism overly complicated, but that it still "does not fully capture the various permutations of the relativistic claims" (Baghramian, 2004, p. 6). The complication might occur because the identikit picture does not categorise the variables in terms of their semantic, epistemic, or ontological contexts. For example, moral values can be relativised to individuals, as the identikit shows, but the relativisation will also be affected by the meaning the individual

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3 Paul Boghossian distinguishes between global and local relativism. According to Boghossian, although few philosophers have been tempted to be relativists about absolutely everything, "Many philosophers … have been tempted to be relativists about specific domains of discourse, especially about those domains that have a normative character" (2006a). In the current Section, I am not arguing that science is a normative domain, but rather that relativism itself has a normative character.
associates with terms in their language, with the knowledge processes and knowledge claims they employ, and the social, cultural, and ontological frameworks they operate within. In addition, each of these contextual factors can interact and affect each other to further complicate the situation. But despite its complexity, Haack's identikit fails to fully characterise the forms of relativism it describes. For example, aesthetic values can be relativised to historical periods, but the can also be relativised to geographic locations, cultures, social groupings, and individuals.

Martin Krausz provides another mapping of the various forms of relativism in his introduction to *Relativism: A Contemporary Anthology* (2010). Krausz believes that we can characterise the different forms of relativism with respect to what he calls five variables of relativism (Krausz, 2010, p. 18). These are; the reference frame, domain, level, value, and opposition to different sorts of absolutism such as objectivism, foundationalism, or universalism. According to this description, relativism can be characterised in terms of:
1. Reference Frames (conceptual, cultural, historical, etc.)
2. Domains (cognitive, moral, aesthetic, etc.)
3. Level - (ontic, epistemic)
4. Values - (truth, reasonableness, goodness, praiseworthiness, beauty, etc.)
5. Negated varieties of absolutism (objectivism, foundationalism, universalism)

Krausz intends that his classification or categorisation should be used to set the scene for any debate about relativism. Thus, he says, "the question, 'Who is right, the relativist, absolutist, or neither?' should be preceded by the question 'Which relativism -- with regard to which sort of reference frame, domain, level, value or in opposition to which sort of absolutism?'' (Krausz, 2010, p. 2).

Krausz's approach using the five variables would be useful for generating a full listing, as given by his variables, of the multiple permutations of relativism that can arise. And his classification does point to the difficulty we face in discussions about relativism in virtue of our own perspectives on truth, knowledge, and ontology. But Krausz's classification suggests that the boundaries between reference values, ontic levels, domains, and reference frames are well defined: that they contain what is within and exclude what is outside of them. This suggestion is contrary to even our common sense intuition about relativism: our intuition that even local relativism is difficult to pin down, describe, and debate because of our opponent's seemingly infinite ability to alter the context of the debate by invoking a theory of meaning,
of knowledge, or of truth, or of referencing a distinction between ontic levels, domains, conceptual frames, or values.

However, variables could be used to produce a more general description of relativism that does not specify or require well defined boundaries. Such a description could generate descriptions of forms of relativism, analogously to how the placeholders in a mathematical function determine the resultants of an equation. In her Stanford Encyclopedia of Philosophy article on relativism, Section 1.1. The co-variance definition, Baghramian uses a mapping of variables to provide a less complicated and more comprehensive definition of relativism or of any form of relativism than those offered by Haack or Krausz.

According to Baghramian:

A standard way of defining and distinguishing between different types of relativism is to begin with the claim that a phenomenon $x$ (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable $y$ (e.g., paradigms, cultures, conceptual schemes, belief systems, language) (2015).

This co-variance definition should be understood in terms of the distinction between relational properties and relativised properties. The relativist is not simply asserting that the phenomenon in question, such as an ethical norm or an experience of the world, varies depending on independent factors within a context. Phenomena such as our sense of what is ethically reprehensible can vary across a spectrum, so that for example, we might say that torture is more abhorrent than theft. Thus we can relate the concept of torture and the concept of theft to each other and to their respective positions on our scale of what is right and wrong. But the relativist is claiming that the very scale that we use to judge what is ethically reprehensible in both these cases is dependent on an independent variable such as our society, culture, or belief system.

So the ascription of some property to the phenomenon in question can depend on the object itself or on the object and its relation to other factors within the context. But in addition, the ascription, even taking into account these within-context factors, is dependent on an independent variable that constitutes the context and therefore that varies between contexts.
This shows how relational properties can interact with relativised properties. Relational properties help us to order the world that we live in: one person is taller than another, a mature oak tree has lived longer than a mayfly, it is better to suffer wrong than to do wrong. But according to the relativist, the ordering of the world that we generate using such relational properties is only one possible version. A case from the physical rather than the human sciences might help to clarify the issue. For example, the disk of the sun changes position with respect to other objects such as the surface of earth and the horizon. Therefore, we might ascribe properties to the disk of the sun itself or to the relationships we perceive it to share with other objects. But there are at least two different ways of understanding the relationship between the disk of the sun and the Earth. Within a geocentric context, we believe that the sun moves around the earth, whereas in a heliocentric context, observers believe that the Earth moves around the sun.

1.3.1 Adapting the co-variance definition

The co-variance definition allows us to distinguish forms of relativism in terms of what phenomenon is relativised and in respect of what phenomenon it is relativised.

As I interpret it, the co-variance definition implicitly includes the specification that it is always the case that relativisation occurs, the specification that any and every combination of variable plus context is just a version of the state of affairs. This implicit specification means that no combination of variable plus context can give rise to an objectively correct account of the state of affairs in the world.

Without this implicit specification, the co-variance definition could also describe forms of pluralism: the idea that because moral values, epistemic norms, and even facts about the world vary depending on the context to which they belong, we should expect that there may be a plurality of correct accounts of morality, epistemology, and even scientific fact.

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4 To avoid any confusion, it is also useful to differentiate between relativism, as I have briefly described it, and relativity, the dependence of physical phenomena such as the behaviour of light, space, time, and gravity, on the relative motion of the observer and observed objects.

5 In *The Copernican Revolution*, Kuhn points out the importance of context in determining what we understand is going on when we stand upon the Earth and observe the apparent motion of the disk of the sun across our sky (Kuhn, 1957). Compared to modern children, whose common sense is re-educated by authority figures such as parents and teachers, “The Greeks could only rely on observation and reason, and neither produced evidence for the earth's motion” (Kuhn, 1957, p. 44).
Although what Baghramian and Carter call the co-variance definition of relativism describes the dependence of the phenomenon on the context, it only implicitly includes a restriction on judging between contexts, that is, on judging the resultant of the interaction between the dependent and independent variable (the context), either from outside of all the contexts in question, or from within our own context viewing all the relevant contexts, including our own (2015).

So although the co-variance definition of relativism is adequate, it can usefully be modified slightly by including an explicit specification against judging between relativisations. As previously quoted, in the relativists claim, "it is assumed that it is impossible to rank judgements of truth or falsity, etc. or to privilege one over another, for all cultures, historical epochs or cognitive frameworks that give rise to such judgements have equal standing" (Baghramian, 2004, p. 5). The single restriction explicitly described by Baghramian is an inability to judge between contexts or between the judgements of different contexts. But this qualification on a general definition of relativism also implicitly includes a specification that we can compare, although not judge, between contexts.

I suggest that we can improve the specificity of the co-variance definition of relativism by including the possibility of comparing contexts and the impossibility of judging between contexts. This modified co-variance definition is that relativism claims that a phenomenon x (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable y (e.g., paradigms, cultures, conceptual schemes, belief systems, language) and although it may be possible to compare different resultants of this (dependent-independent) co-variation, there is no means of judging between the relativisations.

I will refer to the modification to the definition (the inclusion of the possibility of comparing contexts and the impossibility of judging between contexts) as the "constraint on judging." The constraint on judging includes the specification that it may or may not be possible to compare between competing accounts of a phenomenon. In situations where meaning is shared between contexts, it may be possible to compare relativisations across contexts, and where meaning is not shared, it will not be possible to compare relativisations across contexts. The definition of relativism makes no mention of from what perspective, internal to a context or external to any of the contexts in question, any comparison might be made, but this will be a factor in my analysis later in this thesis. Although comparison might be possible, judging
between relativisations is, according to the definition of relativism, not possible. This is because, although each relativisation, each judgement within a context, is correct by its own lights, there does not exist an objective standard by which to judge between them. However, implicit in this specification that judgement is impossible is the idea that objective judgement, if it were possible, would settle the matter of which competing account correctly represents the state of affairs in the world. The modified definition of relativism shows how the relativist is in tension, constrained both by the impossibility of judging between contexts and the desirability of doing just that.

Modified by the inclusion of the constraint on judging, the co-variance definition of relativism allows us to distinguish between relativism and one form of pluralism based on the incipient requirement to judge between relativisations, between co-variations of dependent and independent variables, although this is impossible.

But before taking the constraint on judging as the definitive difference between relativism and all forms of pluralism, it is worth considering different forms of pluralism. In doing so, I aim to show that the constraint on judging can be used to distinguish between relativism and pluralism, whether pluralism is epistemically or ontologically motivated.

1.3.2 Distinguishing relativism from pluralism

Pluralism is the idea that we can encounter or come to know a plurality of accounts of some phenomenon in the world. The pluralist can account for this plurality either epistemically, because of how we know, or ontologically, because of what there is in the world to know. Two different comparisons of pluralism and relativism illustrate the distinction between epistemic and ontological pluralism.

Krausz distinguishes between relativism and epistemic pluralism as follows:

Relativism is not pluralism. Pluralism, as here defined, affirms that for a given reference frame a distinct subject matter, object of interpretation, or world exists. A pluralist could hold that for any scientific paradigm, for example, another world exists. In contrast, relativism requires that, with respect to the same subject matter, competing reference frames exist. If a systematic plurality of subject matters answered to different reference frames, then pertinent frames could not compete. They would be talking past each other. Competition between reference frames requires that they address the same thing (Krausz, 2010, p. 17).
For Krausz, the plurality of accounts of phenomena in the world can occur because phenomena can be addressed as different subject matters from within many alternative frames of reference. Krausz distinguishes between pluralism and relativism not just in terms of frames of reference, but in terms of whether or not the frames of reference can compete. In the next section of this chapter, I will consider how the perspective we adopt, internal or external to a frame of reference, can affect our ability to frame arguments for relativism. In brief, viewed from within a frame of reference, frames of reference talk past each other and there is no relativism for the adherents within any framework, whereas, viewed externally, we can say, as Krausz's definition seems to specify, that the frameworks compete and we can thus frame an argument for relativism.

But for now, it is sufficient to say that for the epistemic pluralism that Krausz describes, the distinction between relativism and pluralism can be made in terms of a constraint on judging. The pluralist contends that for different frames of reference, different subjects exist, so that accounts of those subjects are assessed as correct or "objectively" correct only within the frame of reference. In contrast, according to Krausz, the relativist claims that the plurality of reference frames address the same subject matter and provide competing accounts of the subject. Once again, the accounts are correct within the frame of reference, but the relativist cannot judge which of the competing accounts is correct with respect to the state of affairs in the world. So the relativist concludes that no objectively correct account is attainable.

Baghramian characterises pluralism in a manner that allows for the epistemic pluralism Krausz has described, but also for ontological pluralism. She characterises pluralism as the claim that "for many questions in the domains of metaphysics, aesthetics, ethics, and even science, there could be more than one appropriate or correct answer" (Baghramian, 2004, p. 9). And she continues to say that "The pluralist, like the relativist, rejects absolutism and monism but does not accept the relativists' claim that issues of truth, right and wrong, etc., can be arbitrated only relative to and in the context of their cultural or conceptual background. For the pluralists, in many domains and situations, there can be more than one correct context-independent evaluation and description." So for Baghramian, we can come to know a plurality of accounts of some aspect of the world not only because we can address the phenomenon from within different frames of reference, but also because the world can be plural in this regard.
If the pluralist's claim about the ontological plurality of the world is correct, then they have a good reason for not feeling constrained to judge between non-competing accounts of the world. But the ontological claim about the plurality of the world is also a claim by the pluralist to know how the world in fact is. This means that the pluralist claims that they have access to a mind-independent world and that they know this mind-independent world is plural in some respects. The difficulty in supporting such claims is that the world we encounter will appear the same whether or not the claims are true. What to the pluralist appears to be a plurality of correct accounts in a mind-independent world will appear to the non-pluralist, such as the relativist, as a plurality of competing accounts, which may be the product of different conceptual frameworks.6

So however the pluralist accounts for a variety of accounts of some phenomena, whether they claim the world is plural or that we can only acquire context-specific accounts of the world, the relativist is faced with a plurality of accounts and will acknowledge that it is desirable but impossible to judge between them to determine which is objectively correct. Thus in the co-variance definition of relativism, the constraint on judging can be used to distinguish between relativism and pluralism, whether pluralism is epistemically or ontologically motivated.

1.3.3 Relativism and pluralism: the internal / external perspective

Distinguishing relativism and pluralism in terms of a requirement to judge draws attention to the perspective from where an argument for relativism or pluralism might be framed.

The difference that I am drawing between the internal and external perspective is akin to the distinction that Bernard Williams has made, in his study of relativism, between "real" and "notional" confrontation (1981). According to Williams, some encounters between systems of belief (S's) are notional rather than real confrontations for those involved. For example, we can notionally consider what it would be like to live the life of a medieval samurai warrior, but it is not a real option for us to live this way and retain our hold on reality and also

6 The two definitions of pluralism indicate that there should be difference between the two forms of pluralism. One type of pluralism is based on conceptual schemes, so there is no shared meaning between alternative accounts of the world, and the other is based on a mind-independent world, so there is shared meaning between alternative accounts, but the world itself is plural. The difficulty is that, unless we accept, as the pluralist does, that we can access a mind-independent world and that this world is in fact plural, the second form of pluralism will appear like the first form, to be based on conceptual frameworks and a lack of shared meaning between alternative schemes.
acknowledge, in so far as rational comparison is possible, our transition from one system of belief to the other (Williams, 1981, pp. 138, 140). Williams acknowledges that the problems of relativism that he is investigating concern communications between systems of belief, "which are to some extent self-contained" (1981 pp. 132, 133). But in addressing ethical questions, he frames his discussion in terms of what he calls "incommensurably exclusive" actions that might belong to different systems of belief, rather than the incommensurability of language terms, which would be of greater interest in my discussions of science (Williams, 1981, p. 137). However, he does welcome that fact that "whether a given S is a real option to a given group at a given time is, to some extent at least, a matter of degree" (Williams, 1981, p. 139). Following up on a related idea, in Chapters 5 and 6, I will describe how being internal or external to a scientific paradigm can determine what is a real option for us and how it can constrain whether we may frame arguments for relativism.

According to the distinction I am drawing here between the internal and external perspective, from within their conceptual framework or world view, the pluralist judges that there may be many answers available to any given problem, either because we experience the world only through the intermediation of conceptual frameworks or because the world is plural, noumenally. In contrast, the relativist, from within their conceptual framework, judges that they cannot make the judgement the pluralist allows themselves.

The pluralist accepts that there are many answers available, because the world is plural (there just are a plurality of solutions, from within the pluralist perspective) or because different accounts of the world are generated through the operation of different conceptual frameworks. The epistemic pluralist judges that these answers are equally valid, on their own terms, as determined by assessment from the pluralist's position. The ontological pluralist judges that the world is plural and that some accounts of aspects of the world are objectively correct, not in respect of some conceptual scheme but objectively in respect of the world.

So there is an implicit standard of judgement at play, because the pluralist sits outside of the different frameworks and reviews them according to the pluralist's own standard of what is valid and what is equally valid. The pluralist reviews the various frameworks, bracketed, as it were, within their own perspective and judges that each is valid by its own lights. The pluralists needs to assess each framework on its own terms and to do so, they need to bracket each away from the pluralist's perspective.
Thus in pluralism, we may explicitly state or accept that there is no objective standard to judge between alternatives, but we implicitly assume that there is some standard because we have assessed the alternatives according to our reading of them and decided they are all equally valid on their own terms to their own adherents. So our reading of the alternatives is done with respect to our "objective" standard, which we impose from our overall perspective outside of the paradigms under consideration.

In contrast, in relativism we say there are a plurality of answers, each valid on its own terms to its own adherents, but we make explicit the effect of framing this argument from within a conceptual framework of relativism. We say, we can try to bracket and describe and assess the alternatives on their own terms. But we are doing this from our perspective, and we feel there should be an objective criterion by which to judge them from outside of their respective terms, but such is not available.

The difference is that pluralism explicitly denies that there is any objective standard, but then implicitly uses one to judge equal validity of alternatives or disagreement positions each on their own terms. Whereas relativism explicitly denies that any objective standard exists, even though we feel there should be some means of judging.

Pluralism implicitly accepts or proposes that we can, in a bracketed way, assess different answers or world views as valid, each on their own terms. There are many answers available, perhaps because the world is plural in its very nature or a plurality of answers is the best we can offer because of our cognitive limitations as a species. That is to say, the pluralist claims that these answers or world views all seem equally valid on their own terms, with respect to the pluralist's assessment of them. Thus, the pluralist has an implicit sense of some objective criteria by which to judge when something is valid and when several things are equally valid.

In contrast, relativism explicitly states that we can not judge between paradigms, alternatives, theories, answers, but, because of our position outside the world views, we can frame the concept that there should be an objective standard by which to judge. So relativism claims that there are many alternatives or world views that seem valid on their own terms, each to their respective adherents, but we cannot judge which is correct with respect to our own paradigm, because we have no objective standard by which to judge. Nor can we from our position external to the various world views, assess them each with respect to each other as
being equally valid, because this would imply that we had some objective standard of validity and of equal validity.

All we might say is, for the relativist, there seem to be many answers, and to those who adhere to different ones, they are valid. X is valid to adherents of X, Y is valid to adherents of Y. And from our position, external to these paradigms, the adherent behaviour seems to indicate that the validity of paradigm X to adherents of X is equal to the validity of paradigm Y to adherents of Y. We can argue or assume this based on empirical observation of behaviour etc., but we cannot judge it for certain from our position external to the paradigms.

1.4 Motivating Relativism: alternatives and disagreements

To understand relativism more fully, and to understand the arguments for relativism that can be framed in different domains and from different perspectives, we need to consider how arguments for relativism are motivated.

In *The Metaphysics and Ethics of Relativism*, Carol Rovane analyses the distinction between alternatives and disagreements as part of her project to formulate relativism (2013). Perhaps because she is offering a novel formulation, she begins with what may be familiar ideas about relativism, and subsequently re-casts them in a new perspective. I read her as making and then over-writing several distinctions on her way to asserting her main thesis: that relativism occurs only in the moral domain where it is due to multimundialism or the fact that the truth value bearers of different worlds, as she conceives them, are not in logical relations (Rovane, 2013, p. 92).

In what follows, I suggest that we should retain the useful distinction between disagreements and alternatives and continue to conceive of both of them as motivations for relativism. And I suggest that Kuhn's account of science is not characterised by her Davidsonian conception of science as a single, unimundial domain of meaning. Indeed, my argument for this latter position is similar to the argument Rovane uses for the multimundiality of the moral domain, namely, that our values are the product of our history and culture. In the case of science, the meanings of scientific terms are the product of the equivalent of these historical and cultural factors: the scientist's induction into the profession by means of a scientific education.
Initially Rovane sets up what we take to be her argument: that there are different formulations of relativism. She characterises these as the contemporary Semantic Relativism based on disagreement (and perhaps we should include arguments for relativism from Plato to Kant which are also based on disagreement) and the older 20th century formulation, as manifested in exchanges between Donald Davidson and Thomas Kuhn, which was based on alternatives (Rovane, 2013, p. 11). However, Rovane then explicitly changes her own setup and argues that we need to reject the idea that relativism can be grounded in disagreement (what she calls the "Disagreement Intuition", which Rovane says is often supplemented by the "Relative Truth Intuition") and she proposes that disagreements do not give rise to relativism (Rovane, 2013, p. 32). For my analysis, the key distinction between these two possible motivations for relativism is that disagreement occurs where the meaning of terms is shared between protagonists, whereas alternatives arise when meaning is not shared and protagonists talk past each other. I refer to these motivations, following Rovane, as "disagreements-induced" and "alternatives-induced" arguments for relativism.

According to Rovane, it is a commonplace that in cases of disagreement about an issue, one side or the other is simply wrong (or indeed, both sides might be wrong) (Rovane, 2013, p. 22). In cases such as the attribution of taste predicates, each side defines the correct use of the term in question using their own contextually determined standard. And so we cannot say that one side or both sides are wrong, and we must admit that both sides may be right, relative to their individual contexts, even though they contradict each other. But this position faces the threat of logical incoherence because it breaches the law of non-contradiction (LNC), which can be rendered as Not (P & Not P). To avoid this fate and bolster the disagreement intuition, contemporary relativists invoke the Relative Truth Intuition, whereby truth is relativised to context. This means that we can state that "P is true for context X and -P is true for context Y" without risking contradiction. For Rovane such disagreements or faultless disagreements do not give rise to relativism.

So Rovane maintains that disagreement, whether tractable or intractable, and disagreement where both parties are right or at least not wrong (as described by Crispin Wright, and by Max Kolbel as faultless disagreement) does not give rise to relativism (Rovane, 2013, pp. 27, 28). For Rovane, Semantic Relativism offers a formal solution to the formal problem of avoiding

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7 In her discussion of what she calls the "Disagreement Intuition", Rovane refers to relativism-inducing disagreement (Rovane, 2013, p. 32). She later contrasts the Disagreement Intuition with what she calls the "Alternatives Intuition" (Rovane, 2013, pp. 58, 70). I derive my terms for disagreements-induced relativism and alternatives-induced relativism from her distinctions.
contradiction. But the situations these authors describe lack the distinctive normative significance of disagreements (Rovane, 2013, p. 30). According to Rovane, these situations lack the normative character of disagreements because once the relativising intuitions are invoked, there is nothing left to resolve between the parties. Whereas Rovane believes "Every disagreement, no matter what kind, whether it is an ordinary one or an allegedly relativism-inducing one, registers some contradiction" (2013, p. 31).

I want to suggest two reasons why we should retain the idea, against Rovane's argument, that disagreements can induce relativism. The first is simply that Rovane seems to be blaming the Disagreements Intuition (with the Relative Truth Intuition) for its success in avoiding contradiction. But invoking these intuitions has not changed the situation whereby the protagonist in context X states P and the protagonist in context Y states -P. Relativism, as I have characterised it previously, is one of a range of responses we can make to the failure of our knowledge or our ability to judge situations. But that response does not alter the situation that we are responding to, only our response to it. After we have relativised the propositions to their respective contexts, we have some means of dealing with the contradiction that presented itself and still presents itself. But we have not dissolved the contradiction or altered the situation whereby the protagonist in context X states P and the protagonist in context Y states -P. In arguing thus, I am not misinterpreting Rovane's stated aim of formulating relativism in metaphysical rather than only in epistemic terms. It is not that the protagonists in different contexts cannot know or judge which, if any, of them is correct. It is that they each posit that they are correct, but propose contradictory propositions. That is the state of affairs, rather than simply a state of knowledge (Rovane, 2013, p. 18). The relativist responds to this state of affairs by proposing that both protagonists are correct, by their own lights, and furthermore that this is possible because truth can be relativised to their respective contexts. This too is a metaphysical rather than simply an epistemic stance. The relativist, as Rovane describes the situation, is not proposing that we can interpret each protagonist as if they were correct by their own lights; rather, the relativist says that it is the case that the protagonists are each correct, although they contradict each other, and that truth is relativised to their respective contexts. So metaphysically, the contradiction remains.8

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8 Rovane faults Semantic Relativism (Truth Relativism) by saying that it resolves the contradiction that engenders a disagreement so that the distinctive character of disagreement - that there is something to disagree over - is gone. But the contradiction remains, and all that Semantic Relativism has done is offer a perspective for understanding or a way of responding to the world that allows us to accommodate the contradiction. Semantic Relativism allows that the parties to a disagreement share the meanings of relevant terms, so they are not living under alternative world views and they are not talking past each other. But they disagree about the attribution of the shared meanings because they have different standards of assessments. They agree on the meaning of "rhubarb" and on the meaning of "delicious," but one party states "Rhubarb is delicious" is True whereas the
It is interesting to note that as Rovane describes alternatives, multimundially, as truths that cannot be embraced together because logical relations do not run everywhere, alternatives-induced relativism might also fail her normative significance test of leaving the contradiction in place. In her example of Indian and American culture, Rovane proposes that there are alternatives at play (different bodies of truth, the different worlds that Rovane ascribes to the moral realm) and that there exists relativism about values. But in this example, when the relativist encounters a contradiction between the values of two cultures, ascribing relativism to the situation does not resolve the contradiction such that the situation no longer has the normative significance of a dispute. Rather than saying the relativist resolves the contradiction, we should see the relativist as proposing a response to the contradiction, a contradiction that persists even after their resolution is implemented. And once again, the relativism, in this case alternatives-induced relativism, is a metaphysical claim about how the world is (contradictory, but not flouting the LNC because truth is relativised to contexts) rather than simply an epistemic claim about what we can know about the world.

It is also interesting to note how close to being a case of alternatives is the disagreement situation as rendered by the Semantic Relativist. The protagonists share sufficient meaning to contradict each other, but each is correct relative to the standards of their own context. If they did not share the meaning of the terms they use, but were each considered correct relative to the standards of their own context, we would say they were operating with alternative conceptual schemes or living in different worlds. Rovane seems to recognise this close relation between disagreements (which she denies induce relativism) and alternatives (which she claims do induce relativism) when she admits that "part of my brief for the Alternatives Intuition is that it actually subsumes the Disagreement Intuition" (2013, p. 58). It is likely that the boundary between disagreements-induced relativism and alternatives-induced relativism is fluid, and on my characterisation, it will be dependent on whether meaning is shared between contexts, or as Rovane might put it, on whether holism about meaning is "contained" or "uncontained" (2013, p. 155).

Rovane's dismissal of the Disagreement Intuition because the relativism it induces dissolves the contradiction upon which it is based also overlooks the issue of the perspective, internal or

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other party evaluates the statement as False. Although the parties are not disagreeing about the meaning of the terms involved, they are nonetheless disagreeing about a state of affairs in the world as they experience it. Allowing that the truth of each statement is relative to the speaker does not dissolve the grounds for their disagreement.
external to the protagonist contexts, the argument for relativism is or can be framed. This points to the second reason why we should retain the idea, against Rovane's argument, that disagreements can induce relativism: namely, because a contradiction may not appear thus to the protagonists within their contexts but might appear thus to an observer in an external perspective from whence an argument for relativism could be framed.

Rovane's example from the moral domain, concerning "duty" in the American and the Indian context, and her consideration of disputes of inclination (2013, p. 27) and Semantic Relativism suggests that there is an important difference between the protagonists on either side of a contradiction and the relativist external to the protagonists' contexts. In Rovane's example from the moral domain, she as a protagonist seems capable of framing an argument for relativism, of proposing something like: I am right by American standards and Anjali is right by Indian standards, we appear to contradict each other, but do not because we live in different worlds and mean different things by 'duty'. But in the cases she references from the work of Semantic Relativists, it is more likely that the argument for relativism is framed by someone other than a protagonist, someone external to the contradiction who is looking for a means to respond to the contradiction.

By my characterisation, these are cases of relativism, or to be more precise, these cases allow for the framing of an argument for relativism. Given the protagonists share sufficient background context such as language, they share sufficient meanings to agree what it is that they mean by the predicate "delicious." But they disagree about the attribution of that predicate to rhubarb. Each protagonist might view this as an ordinary disagreement in which one of them is wrong and both of them cannot be right. Only if one or other of the protagonists allows that both of them can be right will that protagonist perceive a contradiction and be in a position to frame an argument for relativism in response to this contradiction. From a point of view external to both protagonists, whether or not the protagonists perceive a contradiction, the third party can conceive of the situation as involving a contradiction, and they can frame an argument for relativism in response. The third party can say that it appears the taste predicate "delicious" is not attributed absolutely, but relative to some other contextual factors, such as a person's cultural history, the foods they have been accustomed to since childhood, their scale of sweet and sour, their appreciation of sour tastes as delicious etc. So unless one or both of the protagonists allow that their opponent could also be right, the protagonists each maintain their own view of whether or not rhubarb is delicious, they have their own internal standard with which to judge the issue, and so they suffer no
effects of relativism. But outside of their views, a third party does not possess an objective
criterion with which to judge the issue and so can frame or are forced to frame an argument
for relativism.

In the case of disagreements within science or disagreements about natural facts as
investigated by science, it is unlikely that scientists would allow that their opponents are also
correct and go on to frame arguments for relativism. Scientists are much more likely to
believe that they are engaged in ordinary disagreements, as Rovane describes them, where
they assume one side or the other is in the wrong and that in time the issue will be decided or
everyone will converge on another, correct solution. But it is possible and likely that people
outside of science might perceive the disagreements within science as irresoluble and as
candidates for disagreements-induced relativism arguments. And non-scientists could also
mistakenly construe disputes between science and non-science or pseudo-science as involving
shared meaning sufficient to render them irresoluble disagreements that could be the subject
of arguments for relativism about scientific knowledge.

Rovane's rejection of the Disagreement Intuition may suit her purposes in formulating
relativism as occurring in the moral domain, but not in the realm of science. However, the
idea of disagreements-induced relativism, framed internal to or external to disagreement
positions, should be retained for investigations in the philosophy of science. Of course,
according to Rovane's initial setup of her investigation, this still leaves the question of
whether relativism due to alternatives can occur in the realm of natural facts as studied by
science.

Having made and then cancelled the distinction between disagreements-induced relativism
and alternatives-induced relativism, Rovane describes the alternatives-induced relativism as
derived from Kuhn's account of science in The Structure of Scientific Revolution (1996) and
as opposed by Davidson's classic argument in 'On the Very Idea of a Conceptual Scheme'
(1974). The scientific paradigms that Kuhn described constituted alternatives because they did
not share their meanings and were talking past each other, Rovane says, and this is the reason
Kuhn's account gave rise to arguments for relativism about scientific knowledge (Rovane,
2013, p. 24). However, Rovane subsequently over-writes, as it were, these statements, by
saying that because of the background that all sciences share, because of holism about
meaning, science is unimundial and no alternative schemes exist and so no relativism is
possible (2013, p. 156). Only in the domain of morals does Rovane find multimundialism, the
existence of alternatives, such that truth value bearers are not comparable between worlds (Rovane, 2013, p. 195).

Rovane's reading of Kuhn is surprising and likely controversial. In her early remarks, Rovane says that we should take the many worlds talk of Nelson Goodman and Thomas Kuhn literally (2013, p. 10). But she subsequently claims that Kuhn's account of science in terms of paradigms does not describe alternatives, that is, situations where truth value bearers are true, but cannot be embraced together (2013, p. 77) in contrast with the moral domain where these kinds of alternatives do exist (2013, p. 195).

Rovane adapts Davidson's argument from meaning holism, originally from Quine, to argue that in science, and in science as described by Kuhn, there cannot be relativism, because there are not alternatives, only disagreements, and (as she describes it) disagreements do not induce relativism. There are no alternatives in science because, Rovane says, meaning holism in science ensures that scientists from different paradigms agree on "many banal details" (2013, p. 162). She bases this argument on the idea of "uncontained" holism about meaning that she derives from Davidson.

Rovane says Davidson's argument against conceptual schemes, based on the impossibility of an untranslatable language, does not rule out the existence of conceptual schemes, but only shows that if conceptual schemes exist they are inaccessible to us (2013, p. 179). She doesn't follow Davidson's original argument from the impossibility of non-translatable languages, but uses what she calls the Davidsonian strategy. This strategy is an appeal to holism about the meaning of terms, to differentiate between the realm of scientific facts (where holism is "uncontained" because scientists across paradigms share meanings and agree many "banal details" such as the proposition that "grass is green") and the realm of moral values (where holism about meaning is "contained" within worlds) (Rovane, 2013, p. 156, p. 247).

We could argue that although scientists across different paradigms may seem to agree on banal details, they do not because, according to Kuhn, their use of terms is theory laden. So for example, "mass" means something very different for a Newtonian and for an Einsteinian scientist. But this would be just begging the question against Rovane's contention that there is uncontained holism about meaning in science.
A more serious challenge arises because in her arguments, Rovane does not apply the same test to the domain of science as she applies to the domain of morals. In science, she says, uncontained holism about meaning applies and so scientists can agree on a huge number of banal details about the world, such as "grass is green" (Rovane, 2013, p. 161). But in arguing for the multimundiality of the moral domain, Rovane says that "the co-tenability of moral truths will rest on whether they can be jointly embraced" (2013, p. 219). However, if this "transitive ordering" was applied to science as she applies it to morals, we quickly see that scientists do not agree on the details of their world view. We see that we cannot conjunct banal details such as "the earth is flat" and "the earth is static" and "the earth is spherical/geoidal" and "the earth is in motion orbiting the sun". For the moral domain, Rovane uses the failure of transitive ordering as an argument for multimundialism, when in fact, the same failure could be used as an argument for multimundialism in science.

Another component of Rovane's argument for the multimundiality of the moral domain can be adapted to an argument for the multimundiality of science. In making her strongest case for multimundialism for the moral domain, Rovane argues that it is history and culture, which are not generally within our intentional control, that have produced different bearers of truth that cannot be embraced together, so that we should adopt the multimundial stance in the moral domain (2013, p. 239). We could argue, based on Kuhn's account, that the scientific education through which a novice is inducted into a scientific discipline can fulfil this role of history and culture from the perspective of a multimundial stance on science (Kuhn, 1996, p. 167).

Rovane is clear that the distinction she is making regarding Kuhn's account of science is not about incommensurability, that is, the lack of shared meaning between paradigms. She allows that incommensurable scientific theories can fail to share the meanings of their key terms, but asserts that "the thesis of uncontained holism ensures that they are all logically related at least indirectly, by virtue of their many complicated relations to a mass of shared agreement-relations in the light of which they emerge as being in conflict" (Rovane, 2013, p. 156). This is Rovane's Davidsonian strategy, to argue that in science, holism about meaning is uncontained and we agree on many banal details, whereas in morals, we agree on only a few very general moral platitudes and so holism about meaning is not uncontained in the moral domain (2013, p. 249).

Rather than argue against Rovane's Davidsonian strategy, later in this thesis (Chapter 7), I will argue that Kuhn's account of science, where the meaning of terms is maintained within
incommensurable paradigms and holism about meanings is "contained" or local to paradigms, is compatible with Davidson's ideas. Thus, it may be that there exists a substratum of meanings for all the terms of our languages, an uncontained holistic network of relations generated through unmediated access to the world, and that all terms in all languages are in principle inter-translatable. But the existence of this substratum would not preclude the development of contained, locally holistic networks of meanings derived from interactions with the world, the substratum of meanings, and the application of new concepts, ideas and interpretations to the world. Rovane's detailed analysis allows us to see Kuhn's account of science not just in terms of incommensurable paradigms, or in terms of holism about the meaning of terms within paradigms, but in terms of the difference between uncontained and contained, global or local holism about meaning.

The distinction that Rovane points out between disagreements-induced relativism and alternatives-induced relativism can be described in terms of the sharing of meaning. To read Rovane's distinction without contextualising it within a unimunial versus multimundial framework, we might say that in disagreements, the protagonists share the meaning of terms, that is, the couplet of reference and referent, but they disagree about the attribution of the terms. Whereas in cases of alternatives, the protagonists do not share the references that are in contention and are thus talking past each other.

1.5 Describing relativism in terms of alternatives and disagreement

I have interpreted Rovane as making a useful distinction between disagreements-induced relativism and alternatives-induced relativism. And I have interpreted this distinction in terms of shared meaning and lack of shared meaning, respectively, between different positions on a topic.

We can now modify my adapted co-variance definition of relativism so that it describes both alternatives-induced arguments for relativism (which can be framed where proponents of alternatives do not share sufficient grounds in terms of meaning, logic, world view etc. to engage in a genuine discussion) and disagreements-induced arguments for relativism (which can be framed where proponents share sufficient common ground for genuine discussion leading to intractable disagreement).
Introducing this distinction into the modified co-variance definition of relativism, we can now say that relativism claims that in cases of intractable disagreement positions (where meanings are shared between protagonists) or alternative world views (where meanings are not shared between protagonists), the disputed phenomenon x (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable y (e.g., paradigms, cultures, conceptual schemes, belief systems, language) and although it may be possible to compare different resultants of this (dependent-independent) co-variation, there is no means of judging between the relativisations.

Briefly, we can say that relativism is the claim that apparently contradictory alternative world views or disagreement positions can be correct by their own standards, and that we lack a means to prioritise one over the other.

In our experiences of the world, we commonly encounter views or disagreement positions that appear to be correct by their own standards, but nevertheless contradict each other. For example, slavery was an integral and accepted part of life in ancient Greece, but slavery or indentured servitude are not accepted cultural practices in most modern societies. We are disinclined to condemn the culture of ancient Greece from our modern perspective, but it seems contradictory that slavery is both acceptable and unacceptable. Relativism is one response to situations such as this. It allows us to avoid the contradiction, by positing that the practices of the different cultures are correct by their own standards, but that we lack a means of judging between the practices of cultures and the cultures themselves from an overarching or objective vantage point outside of our own or any culture. So we relativise when we decline to decide between two or more alternative views or disagreement positions that seem to contradict, by reasoning that each seems correct by its own standards and there is no objective standard by which to decide between them.

This kind of relativisation can be useful in dealing with disputes in the everyday world of our experiences. But is it rational for us to accept apparent contradictory positions as both being correct in some way? And is the claim that opposing views can be simultaneously correct not open to a charge of self-refutation? How are we to decide on a course of action or assess any claim to knowledge in a world of relativisations? Questions such as these show why relativism is of interest to philosophers. And the issues of how relativism can be described,
defined, supported or opposed are of most interest to philosophers in the domains of ethics and epistemology.

I began this section by describing relativism as the idea that apparently contradictory alternative views or disagreement positions can be correct by their own standards, and that we lack a means to prioritise one over the other. Another way of considering the notion of relativism is in terms of the context within which we make or seek to make judgements about the world. In the slavery example cited above, the different cultures, ancient and modern, are the contexts for the judgements made about slavery. Thus, relativism is the idea that our judgements about the world are correct only within a context, that there are more than one contexts, and that we have no means of determining which is the correct judgement-context combination.

Thomas Kuhn's historically-informed account of how science functions, as described in The Structure of Scientific Revolutions (SSR), seems to offer grounds for an argument for relativism about science (1962, 1970, 1996). Kuhn's account has the advantage, compared to a cumulative reading of the history of science, of not portraying previous practitioners as foolish because their beliefs are so at variance with current science orthodoxy. Kuhn's account depicts these practitioners as carrying out research and reporting their discoveries in accordance with the prescribed practices of their time, their historical context. But according to Kuhn, there have been dramatic changes in these practices over time so that there have been many different contexts, and it is difficult or impossible to judge between scientific contexts as to which was or is objectively correct. Whether or not arguments for relativism based on Kuhn's account of science constitute good arguments is the subject of this thesis.

1.6 Conclusion: Chapter 1

In this chapter, I have considered how relativism can be described in general terms and the forms of relativism that can be described in different domains. I began by describing relativism as a response to the commonplace failure of our ability to know or judge the truth of a situation, and progressed to considering descriptions of global and local relativism, and to definitions of forms of relativism within different domains of enquiry. I adapted a non-controversial definition of relativism by including a constraint to judge, although judging per se is impossible. And I argued that the definition can be used to distinguish between pluralism
and relativism, based on the requirement to judge between positions in a dispute. I considered how arguments for relativism have been motivated by the presence of, or the perception of, alternative world views or intractable disagreements positions. And I further adapted the modified definition of relativism so that it functions for both alternatives-induced and disagreements-induced relativism. I have also suggested that in our talk about relativism, we should take account of the perspective from whence an argument for relativism can be framed. In the following chapter, I will apply the definition and distinctions described here to begin my investigation of Kuhn's account of science in *The Structure of Scientific Revolutions* (SSR) (1962, 1970, 1996).
Chapter 2: Kuhn's account of science

2.1 Introduction

In this thesis, I am investigating whether Thomas S. Kuhn's historically-informed account of science in his influential *The Structure of Scientific Revolutions* (SSR) leads to relativism (1962, 1970, 1996). In this chapter, I consider several aspects of Kuhn's account of science in SSR that will be important in this investigation. These concern Kuhn's introduction of "incommensurability," the lack of common measure between scientific paradigms, which occurs after his initial descriptions of science; the seemingly antithetical functions of incommensurability at different stages in Kuhn's account; and his descriptions suggesting that there might be different forms of incommensurability.

In SSR, Kuhn provides an account of science as a cyclical, two-phase process, whereby periods of normal science, conducted within or according to a scientific paradigm and mostly characterised by puzzle solving, are separated by periods of extraordinary science (science in crisis or revolutionary science), mostly characterised by the search for a replacement paradigm. The periods of extraordinary science are brought about by the perceived failure of the normal science paradigm, resulting in crisis, and resolved with the adoption of a new paradigm and a return to normal science under the new scientific paradigm. Kuhn's account is in marked contrast to the "received view" of science as a cumulative process.

Kuhn initially describes the different aspects of his account and ascribes specific meanings to the terms he uses to describe them: the scientific paradigm within which normal science is conducted; normal science as puzzle solving; the rules of scientific paradigms; novelty and anomaly handling; crisis; extraordinary science and scientific revolution to a new paradigm. In these initial descriptions, Kuhn relies upon the idea that communications between paradigms is constrained, but he does not draw attention to this nor articulate it in terms of incommensurability, the lack of a common measure. In providing further details on the nature and necessity of scientific revolutions and how they can be thought of as changes of world view, Kuhn explains the role of incommensurability in his account.
Thus, the main phases in Kuhn's account of science, normal science conducted within a paradigm and the extraordinary research that precedes a scientific revolution from a current paradigm in crisis to a replacement paradigm, both involve incommensurability, as he conceived of it: the lack of common measure between paradigms. But the operation of incommensurability between paradigms seems to be very different during these phases, insulating the dominant paradigm from competing theories, such as the previous normal science tradition, during normal science, but allowing communications between the dominant paradigm and alternative theories that are potential alternative paradigms for the discipline, during extraordinary/revolutionary science.9

Although Kuhn seems to describe forms of incommensurability, he does not describe a scale of incommensurability. This means that Kuhn's account does not explain how the same "lack of common measure" between scientific paradigms can insulate the dominant paradigm from competing theories, such as the previous normal science paradigm, during normal science, but be overcome or circumvented to enable the comparison between the dominant paradigm and alternative scientific theories, which are potential alternative paradigms for the discipline, during the extraordinary science that precedes a scientific revolution to a new paradigm.

In this chapter, by working through the details of his account of science in SSR, I show that, incrementally through the text, Kuhn refines his description of the relationship between scientific paradigms such that they are incommensurable and do not share a common measure. But I also show that Kuhn does not explain how this incommensurability can both insulate the dominant paradigm from competing theories, such as the previous normal science paradigm, during normal science, but also allow interaction between the dominant paradigm and alternative scientific theories, which are potential alternative paradigms for the discipline, during extraordinary science. Where relevant, I suggest how the incommensurability between paradigms in Kuhn's account of science can provide the basis for arguments for alternatives-induced relativism about science. And I also point out Kuhn's awareness of the issue of

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9 In SSR, Kuhn uses similar phrases to describe the competition between two scientific paradigms, both of which have been or are still the paradigm of a period of normal science, such as Ptolemaic and Copernican astronomy, and competition between the dominant scientific paradigm during a period of extraordinary science and alternative scientific theories, one of which may be, but is not yet, associated with a period of normal science (Kuhn, 1996, pp. 94, 97, 98, 103, 109, 147, 148, 153, 175). In this thesis, I adopt Kuhn's usage, so that the phrase "between paradigms" can be read as "between paradigms that both have been associated with a period of normal science" and also as "between the dominant scientific paradigm and alternative scientific theories that are potential alternative paradigms for the discipline".
perspective, internal to or external to a scientific paradigm, which I will later argue is an important constraint on framing arguments for relativism.

2.2 The context of Kuhn's account

There are two contexts that we might consider relevant to Kuhn's account of science, namely, the immediate context within which Kuhn developed his ideas and the general background in the philosophy of science against which Kuhn was presenting these ideas. Regarding the latter, Kuhn explicitly sets his historically-informed conception of science against the predominant view, which was at the time and still is called the "received view" of science as the accumulation of facts about the world. As he begins his *The Structure of Scientific Revolutions*, Kuhn clearly explains that the book's objective is to change the reader's understanding of science, based on the historical record of science (1996):

This essay attempts to show that we have been misled by them [the classics and science textbooks] in ways. Its aim is a sketch of the quite different concept of science that can emerge from the historical record of the research activity itself (Kuhn, 1996, p. 1).

Our common sense notion of science is that scientific knowledge is derived from facts about the world. This conception of science, which is still called "the received view," has its roots in the work of the British Empiricists and was formalised by the Logical Positivists or Logical Empiricists of the Vienna Circle and the Berlin Circle from the 1920s. A.F. Chalmers begins his introductory text *What is this thing called Science?* with the observation that it is a widely held, common sense view of scientific knowledge that "science is derived from the facts" (1999). What is claimed, he explains, is that science is distinctive (among our epistemic enterprises) because it is based on the facts, and the facts "are presumed to be claims about the world that can be directly established by a careful, unprejudiced use of the senses" (Chalmers, 1999, p. 1). Chalmers goes on to briefly describe how two schools of thoughts, the British Empiricists and Logical Positivists, attempted to formalise this view of science. To do so, they needed to address the issues of how scientists are meant to have access to the "facts" and how the laws and theories that constitute scientific knowledge, according to this view, are derived from the facts once they have been obtained (Chalmers, 1999, p. 3). The Logical Positivists argued that theories are verified, if not confirmed, by the relevant facts as observed by scientists. In their enthusiasm for science, the positivists proposed that this verificationist conception of scientific knowledge should be the model for philosophical enquiry. But the
key tenets of their approach were criticised, because verification is subject to the problem of induction: the problem that no amount of positive instances of a theory can absolutely confirm the theory: and because observation of facts about the world is theory-laden or theory-dependent rather than objective. An opponent of both relativism and verificationism, Karl Popper proposed falsification, which uses deduction rather than induction in the generation and refutation of scientific conjectures about the world, as the correct account of science. The Logical Positivist's verificationist view of science and criticisms of this view, such as Popper's falsificationism, were part of the context against which Kuhn wrote his SSR.

The immediate context in which Kuhn developed these ideas was varied. Describing the genesis of SSR, Kuhn credits the works of philosophers such as Alexandre Koyré and A. O. Lovejoy as being second only to primary sources in influencing his ideas on "what the history of scientific ideas can be" (1996, Preface viii). Lovejoy's book on the "great chain of being" was one of the founding texts of the discipline of the history of ideas. And according to Kuhn, it was Koyré's published lectures that suggested to him that what Lovejoy had done tracing the history of an idea could be done also with science (2000, p. 285). Kuhn also cites influences from Jean Piaget on "the various worlds of the growing child and the process of transition from one to the next" (1996, Preface viii). He mentions reading papers on the psychology of perception, in particular on Gestalt psychology. He references B.L. Whorf's "speculations" on how language affects our world view and W.V.O. Quine's ideas on the analytic-synthetic distinction (Kuhn, 1996, Preface viii). And he references "an almost unknown monograph" by Ludwick Fleck that contributed to him thinking that his ideas should be "set in the sociology of the scientific community" (Kuhn, 1996, Preface viii).

We can detect a common theme in these influences: the notion that our conception of the world influences, and is influenced by, our perception. In _The Road Since Structure_, Kuhn reflects on how Piaget's work caused him to see that the socialisation of children and of scientists is similar, because in both cases the subjects are not learning "spontaneously," but rather they are "learning what it is that is already in place" (2000 Kuhn, p. 279). Kuhn's readings in Gestalt psychology would have exposed him to the idea that cognitive schema or frameworks affect how we perceive the world, and Whorf's ideas about language determining world view could suggest at least one mechanism through which conceptual frameworks could have such an effect. At the time, Kuhn was looking for an explanation of how scientists in different contexts can see the world very differently. In the preface to _The Essential Tension_ (1977), Kuhn describes how he struggled to understand how Aristotle could have said
so many "apparently absurd things" about the subject we now call "mechanics" (1996, Preface xi). And "above all, why had his views been taken seriously for so long by so many of his successors?" (ibid). Kuhn realised that he needed "an alternate way of reading the texts", which took account of the fact that "the permanent ingredients of Aristotle's universe, its ontologically primary and indestructible elements" were very different to our own, being qualities rather than bodies (1996, Preface xii). And in Fleck's original Polish German (1935) version of what would be translated as *Genesis and Development of a Scientific Fact* (1979), Kuhn found someone who was, "thinking about the historical material" the way that he himself was (2000, p. 283).

Kuhn says that Quine "opened" for him "the philosophical puzzles of the analytic-synthetic distinction" (1996, Preface viii). Quine's argument against the analytic-synthetic distinction in his famous 'Two Dogmas of Empiricism' can be read as an attack on the conceptual framework or world view or philosophical assumptions of empiricism (1951). On this reading, Quine argues that we cannot describe the concept of analyticity without resorting to terms such as synonymy and necessity, which also require description and can be interpreted as involving the very idea of analyticity that we are using them to describe. Quine concludes that for empiricists, the analytic-synthetic distinction is an "unempirical dogma of empiricism, a metaphysical article of faith" (1951). This may have influenced Kuhn because it implies the "puzzle" of the analytic-synthetic distinction is about the beliefs and assumptions of the world view of empiricism as much as it is about actual distinctions in the world.

Kuhn's immediate work context may have contributed to the formation and clarification of his ideas in SSR. At the time of working up his ideas, Kuhn was a historian of science, not a philosopher of science, working for a year within a community "composed predominantly of social scientists" (1996, Preface ix). Here he was struck by the fact that modern science does not normally provoke the "controversies over fundamentals that today often seem endemic among, say psychologists or sociologists" (Kuhn, 1996, Preface x). Kuhn proposed that these disciplines lack, and science is characterised by, what he calls a "paradigm," and which he describes as "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (ibid).

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10 Learning a new way of interpreting Aristotle's *Physics* was intellectually formative for Kuhn. He also describes this "Aristotle experience" in 'What are Scientific Revolutions?' (1987) and mentions it in "A Discussion with Thomas S. Kuhn" in *The Road Since Structure* (RSS) (2000).

11 Part of Quine's paper addresses the analytic-synthetic distinction in terms of how meaning is generated in language. In *The Road Since Structure*, Kuhn says that the paper had a considerable impact on him at the time because he was "wrestling already with the problem of meaning" (2000, p. 279).
2.3 *Kuhn's descriptions of normal science, paradigm, novelty, crisis, revolution*

Rather than prescribe a model for how science should be conducted based on logical deduction or induction, Kuhn studied events in the history of science to determine how science is carried out. He concluded that science does not proceed in a straightforward cumulative manner, but rather that it is a cyclical process alternating between two main phases, normal science and revolutionary science.

Kuhn initially describes his cyclical account of science in terms of normal science and paradigms, puzzle solving, rules, novelty and anomaly handling, and crisis and scientific revolution. Kuhn attributes specific meanings to these terms as he introduces and uses them; for example, he defines "normal science" with respect to the concept of a "paradigm" and vice versa (1996, p. 10). He provides sufficient detail to inform, but not overwhelm the reader with new concepts and he provides examples from the history of science to support his interpretation. After describing the different aspects of his account of science, Kuhn recapitulates his ideas, but this time explaining in greater detail the feature that underpins his account: the incommensurability between successive scientific paradigms. Although Kuhn describes several aspects of incommensurability, he does not explain how the same feature, incommensurability, can insulate the dominant scientific paradigm from alternative theories, such as the previous normal science tradition, during normal science, but allow communication between the dominant paradigm and alternative theories, which are potential alternative paradigms for the discipline, during extraordinary science and scientific revolution. This presents difficulties for Kuhn's account of science. Is his account inconsistent, using different senses of "incommensurability" at different points? Or is the concept of incommensurability wrongly defined or misunderstood?

2.3.1 *Normal science and paradigms*

In SSR, Kuhn argues that we have been misled by the traditional view of science as the continuous accumulation of knowledge through the application of the rational scientific method (observation, measurement, experiment, and the formulation, testing, and
modification of hypotheses). Rather, the history of a science can be described as a period of immature science, which ended when it became mature science with the adoption of a paradigm. During the immature phase, competing schools or sub-schools within a field such as optics can "take no common body of belief for granted" (1996, p. 13). As a result, the practitioners disagree about the fundamentals of their subject, about what methods they should employ or what phenomena they should try to explain (ibid). These "initial divergences" disappear with the adoption of a paradigm. Kuhn initially describes a scientific paradigm as "one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice" (1996, p.10). Once it has left the pre-paradigm or pre-consensus phase, science is characterised as a cyclical movement between periods of normal (paradigmatic) science, crisis, and revolutionary (extraordinary) science, and a new period of normal science under a new paradigm.

Kuhn introduces the concept of normal science with a definition that is, he admits, circular with his definition of a scientific paradigm (at least in one of his usages of the term paradigm, where Kuhn uses it to signify an example of previous achievement). He says, "In this essay, 'normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice" (1996, p. 10). Linked to this description is the idea that textbooks or the classics "expound the body of accepted theory, illustrate many or all of its successful applications and compare these applications with exemplary observations and experiments." These examples for a time, "define the legitimate problems and methods of a research field for succeeding generations of practitioners" (1996, p. 10). This is because the achievement was unprecedented and "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" (1996, p. 10). Kuhn then links these ideas with one definition of a paradigm, being achievements that share these two characteristics.

Paradigm formation occurs "when, in the development of a natural science, an individual or group first produces a synthesis able to attract most of the next generation's practitioners, the older schools gradually disappear" (Kuhn, 1996, p. 18) and the older men who cling to the old beliefs "are simply read out of the profession, which thereafter ignores their work" (Kuhn, 1996, p. 19). Adherents to the new paradigm can take the paradigm for granted and they no longer attempt to build the field from anew. This fosters the development of scientific journals, syllabus, societies etc.
Further considering the nature of normal science, Kuhn expands a little on his choice of the word paradigm. He is not using it in the normal sense of something that one would copy. He admits that he could not find a word to communicate exactly what he wanted. In science, Kuhn explains, "a paradigm is rarely an object for replication. Instead, like an accepted judicial decision in common law, it is an object for further articulation and specification under new or more stringent conditions" (Kuhn, 1996, p. 23).

To see why this can be so, we must realise how limited in both scope and precision a paradigm can be at first. Initially, a new paradigm is largely a promise of future research success in selected and still incomplete examples. Then "normal science consists in the actualization of that promise, an actualization achieved by extending the knowledge of those facts that the paradigm displays as particularly revealing, by increasing the extent of the match between those facts and the paradigm's predictions, and by further articulation of the paradigm itself" (Kuhn, 1996, p. 24). Kuhn then proposes that most scientists spend their careers mopping up, or in "an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies" (1996, p. 24). The work of determining which facts are significant, matching facts with theory, and articulating the theory (the paradigm, in a different sense) "exhausts the literature of normal science. They do not, of course, quite exhaust the entire literature of science" (Kuhn, 1996, p. 34).

Thus, the two main senses in which Kuhn uses the term paradigm are: 1. a paradigm is a template or exemplar and 2. a paradigm is a disciplinary matrix (world view). Kuhn uses "paradigm" in many senses.\(^{12}\) But these two main senses of the word paradigm, which he emphasises in his SSR Postscript, are inter-related, since the exemplar is a manifestation of best practice within the disciplinary matrix, and the disciplinary matrix allows the scientist to make sense of or interpret the exemplar (Kuhn, 1996, pp. 182, 187).

In his initial descriptions of normal science, Kuhn does not explicitly preclude interactions across paradigms. It is apparent that Kuhn's account of science in SSR as cyclical, paradigm-bounded, normal science is opposed to the positivist and the Popperian view of science as a

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\(^{12}\) In 'Second Thoughts on Paradigms,' Kuhn says, but provides no reference, "One commentator, who thought the matter worth systematic scrutiny, prepared a partial subject index and found at least twenty-two different usages, ranging from 'a concrete scientific achievement' (p.11) to a 'characteristic set of beliefs and preconceptions' (p. 17)." http://eu.pravo.hr/_download/repository/Second_Thoughts_on_Paradigms.pdf Page 1, viewed 06 June 2013
cumulative process. And in a sense, this is the most revolutionary aspect of Kuhn's account. By examining empirical evidence from the history of science, he has concluded that we cannot evaluate all previous science from our current position, but must assess it on its own terms, with regard to its own standards. Sharrock and Read (2002, p. 101) believe that the idea of normal science, rather than the idea of scientific revolution, is Kuhn's most fundamental contribution to the philosophy of science. And it was the idea of the paradigm, a type of conceptual scheme, and the conceptual relativism that can issue from it, that Davidson attacked in his famous paper 'On the Very Idea of a Conceptual Scheme' (1974). But these authors are addressing the concept of a scientific paradigm as more fully described by Kuhn, including the property of incommensurability, the lack of common measure between paradigms. In his initial descriptions of a scientific paradigm, which relates to normal science, Kuhn has only implied that paradigms are insulated from each other, that the fundamentals of a discipline and the phenomena the discipline chooses to consider as relevant facts are not shared across paradigms. In the initial descriptions, he has not specified that communication between paradigms is not possible, merely that it does not occur. Thus, Kuhn says that those older practitioners who do not embrace the new synthesis "are simply read out of the profession, which thereafter ignores their work" (1996, p. 19). This means that, in the absence of the constraints on communicating and sharing meaning between paradigms that Kuhn will later specify, it is legitimate to consider that disagreements between, as well as within, paradigms might provide grounds for arguments for disagreements-induced relativism. In describing the effects of scientific revolution to a new paradigm, Kuhn introduces incommensurability as the constraint or constraints on the sharing of meaning between paradigms. And with the inclusion of incommensurability as a property of paradigms, Kuhn's account seems to provide grounds for alternatives-induced arguments for relativism.

2.3.2 Normal science and puzzle solving

Kuhn's description of a scientific paradigm, where adherents work within the paradigm's specifications and ignore the work of non-adherents, does not preclude adherents attending to matters outside of their paradigm, risking exclusion from their discipline if they so wished. And his description of normal science as puzzle solving seems to imply that adherents within a paradigm are simply focussed on the work set by their paradigm and are unconcerned with matters outside of it. As a result, according to Kuhn's description, science is almost assured of its success, because it has set the parameters of the contest.
Normal science, Kuhn says, does not aim to produce major novelties, either conceptual orphenomenal (1996, p. 35). Usually the result of scientific research is known and expected, andindeed if the result does not fall within the narrow range of expected values, it is seen as afailure of the scientist, not a failure of the paradigm. According to Kuhn, even if the scientistis working to develop a new articulation of the paradigm, for example, by applying theparadigm to a new area, the scientist does not aim at unexpected novelty. It is the way inwhich the scientist achieves an expected result, the way in which they solve the puzzle, thatmakes the research worthwhile. Kuhn means puzzle in the normal sense (1996, p. 36), as aproblem that can serve to test ingenuity or skill, with a possible solution and a set of solutionsteps that are bounded by rules. All other puzzles are beyond the concern of the scientist.Therefore, science appears to progress so rapidly because "its practitioners concentrate onproblems that only their own lack of ingenuity should keep them from solving" (Kuhn, 1996,p. 37).

Kuhn's description of normal science as puzzle solving shows how comprehensively,according to Kuhn's account, the scientist working within a paradigm is constrained by theparadigm, in terms of meaning and ontology, theory and knowledge, truth. But in describingnormal science as puzzle solving, Kuhn has not specified that the scientist is unable to explorebeyond the scope of the paradigm. It seems from Kuhn's description that the scientist is notconcerned to do so. As he proceeds to describe other aspects of normal science andextraordinary research, Kuhn will refine the nature of the relationship between paradigms.And when he comes to describe the aftermath of a scientific revolution, Kuhn does specifythat the scientist cannot investigate beyond the boundaries of their paradigm because "The normal-scientific tradition that emerges from a scientific revolution is not only incompatiblebut often actually incommensurable with that which has gone before" (1996, p. 103).

2.3.3 Paradigms and rules: internal versus external perspectives

Kuhn's description of the rules derived from a scientific paradigm shows that he considersthere to be at least two important perspectives we can take on a scientific paradigm, or wemight say, two possible modes of engagement with a paradigm — internal and external. Kuhnbelieves that scientists can share the same paradigm, but not the same rules, assumptions etc.,
which are developed from the paradigm. He believes that shared paradigms, rather than shared rules, are the source of coherence for normal research traditions (1996, p. 42).

In working through his distinctions between paradigms and rules, Kuhn illustrates the fluid nature of both of these guides to scientific practice. Paradigms are of a priority status to rules, and both have a complex relationship to normal science. Kuhn offers another definition of paradigm: "Close historical investigation of a given speciality at a given time discloses a set of recurrent and quasi-standard illustrations of various theories in their conceptual, observational, and instrumental applications. These are the community's paradigms, revealed in textbooks, lectures, and laboratory exercises" (Kuhn, 1996, p. 43). In contrast, to determine the community's rules, "...the historian must compare the community's paradigms with each other and with its current research reports" (ibid). They do this to find out "what isolable elements, explicit or implicit, the members of that community may have abstracted from their more global paradigms and deployed as rules in their research" (ibid). This is frustrating work because researchers "agree in their identification of a paradigm without agreeing on, or even attempting to produce, a full interpretation or rationalization of it" (Kuhn, 1996, p. 44). Kuhn refers to Ludwig Wittgenstein's idea (in the Philosophical Investigations) of language games. "Something of the same sort may very well hold for the various research problems and techniques that arise within a single normal-science tradition" (Kuhn, 1996, p. 45). I take him to mean that they bear a family resemblance, but no one of them has all the characteristics. Kuhn then presents four reasons for believing that paradigms determine normal science without the intervention of discoverable rules. These are 1. the difficulty of discovering the rules that have guided research, because they are language game members. 2. through science education, scientists never learn concepts, laws, and theories in the abstract and by themselves — these tools are presented in a prior unit, the paradigm, that displays them with and through their applications. Scientist may abstract them through their training, and as a results, scientists can carry out scientific research, but they can't articulate the rules any better than could a non-scientist (Kuhn, 1996, p. 47). 3. rules are only of concern when the paradigm or models are felt to be insecure, and 4. "Explicit rules, when they exist, are usually common to a very broad scientific group, but paradigms need not be" (Kuhn, 1996, p. 49). Kuhn summarises, "In short, though quantum mechanics (or Newtonian dynamics, or electromagnetic theory) is a paradigm for many scientific groups, it is not the same paradigm for them all" (1996, p. 50).
Regarding paradigms, it is important to note that Kuhn is always talking about different fields of enquiry as adhering to their own paradigms, rather than as different periods or cultures of science adhering to different paradigms. For example, the Copernican revolution had an impact on all science, but it was only a paradigm shift in the field of astronomy and maths. It is tempting to believe that individual scientists operate as members of the overall scientific community to agree or assent to the overall paradigm of science. Perhaps they do, but that is not what Kuhn argues. This distinction might help to make sense of the apparent contradiction in Kuhn's statements, quoted above, with regard to paradigms. Kuhn says that scientists share the same paradigms but not the same rules (1996, p. 42), but also that rules are more common to a broad scientific group but paradigms need not be (1996, pp. 49, 50). Thus, "explicit rules, when they exist, are usually common to a very broad scientific group, but paradigms need not be" (Kuhn, 1996, p. 49). I interpret Kuhn as meaning that for practicing scientists, the rules are useful for implicitly or explicitly customising the paradigm for application within a discipline.

Kuhn's ideas on the relationship between paradigms and rules holds implications for our conception of progress in science and for how arguments for relativism might be framed based on Kuhn's account of science.

Regarding progress in science, Kuhn has not indicated at this point in his description whether the group's agreement, the consensus the group shares by sharing a paradigm, can in theory correctly reflect the reality of the world. But his account at its very beginning raises the question of the realist versus the antirealist conception of our knowledge about the world. The issue of whether progress in science is progress towards describing reality will be further complicated by Kuhn's proposal that scientists within the same paradigm can operate according to different sets of rules.

Regarding relativism, in describing further the application of the paradigm through rules by different groups, Kuhn seems to leave his concept of science open to the possibility of relativism at the level of concepts. But such an argument would not succeed because Kuhn has not specified in his initial descriptions that there is any kind of disruption of communication or difficulty in translating meaning between scientists within a paradigm working to different sets of rules. With Kuhn's subsequent description of incommensurability as characteristic of the relationship between paradigms, an argument for conceptual relativism based on how scientists within paradigms use different rule sets might succeed.
I have said that Kuhn's description of the rules derived from a scientific paradigm shows that he considers there to be at least two important perspectives we can take on a scientific paradigm, or we might say, two possible modes of engagement with a paradigm — internal and external. But it may be useful to consider this distinction in terms of adherence and non-adherence in order to differentiate it from the distinction within the historiography of science between internalist accounts, which offer explanations for the development of scientific ideas in terms of the scientific world only, and externalist accounts that examine how the development of scientific ideas are affected by the scientific context and also the world in which scientists find themselves.  

The adherent to a scientific paradigm engages from within or takes the internal perspective on the paradigm. They work within the paradigm and can use the rules their discipline or sub-discipline has developed from the paradigm to solve the questions about the world that have been set or sanctioned by the paradigm. However, as Kuhn says, they find it difficult or impossible from their position internal to the paradigm, to address questions about the paradigm itself. Although they can use the rules of the paradigm in their work, they are, Kuhn says, no better able to describe these rules than is the non-scientist.

According to Kuhn's description, the non-adherent such as the historiographer of science, is external to the paradigm. They do not adhere to the paradigm and they cannot use the rules of the paradigm to solve scientific problems that have been set or sanctioned by the paradigm. But from their external perspective, they can address meta-questions about the paradigm itself. As Kuhn says, the historiographer can, with difficulty, determine the rules of the paradigm.

The distinction between the internal adherent and the external non-adherent perspectives that Kuhn makes when describing the function and derivation of the rules of a scientific paradigm has implications for how arguments for relativism might be based on Kuhn's account of science. As I described in Chapter 1, those internal to a conceptual scheme, such as a scientific paradigm, might be relativist or pluralist depending on their sense of a constraint to

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13 In RSS, Kuhn describes how it pleased him that Koyré believed that in SSR Kuhn had brought the internal and external accounts together, although Kuhn himself "thought of it as pretty straight internalist" (Kuhn, 2000, p. 287).
judge between paradigms, despite the perception they share that there is no objective means of judging.

2.3.4 Plurality of non-adherent perspectives

Kuhn's account of science in SSR, and especially his description of the incommensurability between a current and a previous paradigm of normal science, shows that there are a number of different perspectives from which to view a scientific discipline's paradigm. The paradigm in question can be considered from the internal, adherent perspective or from the external, non-adherent perspective.¹⁴

In his account of science, Kuhn describes in detail the adherent's behaviour toward the paradigm as this behaviour varies, after the initial, once-off transition from the schools phase, during periods of normal science and extraordinary research, through crisis and scientific revolution, and during normal science after the shift to a new paradigm. As I have detailed using Kuhn's descriptions, the scientist, adherent to their paradigm, is insulated from the theories of the schools during the first normal science a discipline achieves. During subsequent, post-revolutionary phases of normal science, the paradigm adherent does not consider as even potentially correct about the world, the incommensurable previous paradigm and articulations of that superseded paradigm developed during extraordinary science.

While the internal adherent to a paradigm is, by definition, a member of the discipline that the paradigm determines, the external, non-adherent perspective presents other possibilities. As Kuhn describes, a person external to a given scientific discipline's paradigm could be a historian or philosopher of science, investigating science from their historian's or philosopher's perspective, but not investigating as a scientist, not doing science. As, for example, when Kuhn describes how the historian tries to determine the rules of a discipline, those "isolable elements, explicit or implicit, the members of that community may have abstracted from their more global paradigms and deployed as rules in their research"(1996, p. 43).

¹⁴ Kuhn introduces the term "adherent" early in SSR, when summarising how "Section XII describes the revolutionary competition between the proponents of the old normal-scientific tradition and the adherents of the new one" (1996, p. 8). And he uses the term later when describing how classics such as Aristotle's *Physica*, Ptolemy's *Almagest*, and Newton's *Principia* were able to fulfil a function similar to textbooks because "their achievement was sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously it was sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" (Kuhn 1996, p. 10).
A subject external to a paradigm could also be a layperson, someone with no adherence to the paradigm in question, as the discipline's practitioners have, and with no knowledge of the normal science paradigm, as we might expect the philosopher of science or the historian of science to have. Kuhn mentions the layperson's perspective in SSR, for example, when comparing it to that of the scientist working within a discipline, and noting that "to an extent unprecedented in other fields, both the layman's and the practitioner's knowledge of science is based on textbooks and other types of literature derived from them" (1996, p. 137).

But the person external to a paradigm in question could also be a scientist who is a member of a different scientific community and is therefore adherent to a different discipline's normal science paradigm. Indeed scientists who are adherent to their own disciplines but non-adherent to a particular paradigm in question would be a source of a great plurality of non-adherent perspectives. These are people who are, by definition, interested in science, as evidenced by their adherence to their own scientific paradigm, but who are not committed or adherent to the paradigm in question. The number of non-adherent perspectives they represent would be the total number of scientific paradigms, minus one.

In SSR, Kuhn alludes to the possible perspective of scientist who is adherent to their discipline's paradigm, but is external, non-adherent to the paradigm of another discipline. He allows that there can be communication between scientific disciplines, for example, when he says that "new instruments like the electron microscope or new laws like Maxwell's may develop in one speciality and their assimilation create a crisis in another" (Kuhn, 1996, p. 181).

But in SSR, Kuhn is mostly concerned with scientific revolution within a discipline, rather than the interactions between scientific disciplines. He is mostly describing, after the initial, once-off transition from the schools phase to normal science, the revolutionary transition of any particular scientific discipline through the phases of normal science and extraordinary science, with incommensurability characterising the relationship between successive

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15 In *The Essential Tension*, Kuhn describes briefly how scientist are focussed on their own paradigm, rather than attending to other disciplines or to science overall (1997). Towards the end of his response to Karl Popper's criticisms, Kuhn is discussing the progress of science, the proliferation of theories, and the improved precision of the match between theories and nature. Kuhn says that "despite occasional spectacular successes, communication across the boundaries between scientific specialities becomes worse and worse" (1997, p. 289). And he implies that although the "unity of the sciences is clearly a value for scientists," they may be willing to "give it up" if required to do so in order to "achieve the gains that a new theory invariably offers" (ibid).
traditions of the discipline (Kuhn, 1996, p.64). After the initial pre-consensus phase, Kuhn is concerned with the transitions a particular discipline makes from normal science through extraordinary science to a new phase of normal science. He mostly describes the activities of the practitioners, that is the adherents, of that discipline, and when he considers non-adherents, he looks at the perspective the layperson, historian, or philosopher would take on a scientific discipline. Kuhn does not describe in any detail the perspective of the scientist who is adherent to their own community's paradigm but not to the paradigm of the discipline in question.

Although Kuhn does not describe in any detail the interactions between different normal science traditions, it is possible to infer a position on this subject. The scientist in one discipline should be able to communicate, but not share certain meanings with the scientist in another discipline. But this does not mean the traditions are incommensurability, according to by Kuhn's description of this term, because incommensurability characterises the relationship between successive paradigms of the same discipline. However, because of the way a paradigm determines the world that any practitioner responds to, the scientist committed to their own paradigm will not share meanings, methods and standards, and the phenomenal world of a scientist working in a different discipline, committed to a different paradigm.

In this respect, the scientist who is by definition non-adherent to the paradigm of a different discipline, takes a perspective external to that paradigm, and no more shares the paradigm's view of the world than does a non-scientist, someone who is external to all scientific paradigms. But in another respect, the scientist who is non-adherent to the paradigm in question is similar to the practitioners who are adherent to that paradigm, because both these groups of scientists consider the practitioners to be the experts in the discipline in question. According to Kuhn's account, for any discipline, normal science cannot function without the community's commitment to the discipline's paradigm. Although a scientist might disagree with individuals from a different discipline, to be consistent, every scientist must agree that the community of practitioners of that discipline are the experts on the aspect of the natural world that that discipline investigates. This means that the scientist, non-adherent to a different discipline's paradigm will defer to the members of that paradigm as the arbiters of questions in the subject matter the discipline investigates.

What are the implications for this deference on the possibility that a scientist non-adherent to a particular paradigm might frame arguments for relativism about that paradigm? It is likely
that a scientist who is non-adherent to a paradigm in question will defer to adherents of that paradigm and will not make arguments for relativism about the discipline in question. The external scientist who is non-adherent to the paradigm in question will defer to the scientists adhering to the paradigm in question as the authority on its puzzles. The scientist non-adherent to the paradigm in question understands that the paradigm presents the correct science on the issue and so they would not frame arguments for relativism about the issues which that discipline addresses.

I have described in Chapter 1 how my analysis employs the distinction between two possible motivations for relativism, the distinction between disagreement-based arguments where the meaning of terms is shared between protagonists, as opposed to alternatives-based arguments that arise when meaning is not shared and protagonists talk past each other. We can consider the positions of the scientist non-adherent and the scientist who is adherent to the paradigm in question in terms of whether meaning is shared or not shared. Although the scientist non-adherent to the paradigm in question is not subject to the incommensurability Kuhn describes between paradigms of the same discipline, as a member of a distinct discipline, the non-adherent would not share the meanings of key terms with the community of the paradigm in question. Despite this, as scientists they defer to the community of the paradigm in question and they will not form arguments for relativism based on apparent alternatives between that paradigm and other potential paradigms for a discipline that they are not part of. Nor will they frame disagreement arguments for relativism about the paradigm in question because, as scientists, they will consider disagreements internal to the paradigm (those involving shared meaning within the paradigm under consideration) as matters to be resolved by the normal processes of scientific investigation under that paradigm, not as grounds for relativism. Even though the scientist non-adherent to the paradigm in question will have a different attitude to the paradigm in question than the paradigm adherents have, the outcome in terms of arguments for relativism is the same; the scientist non-adherent to the paradigm will not frame arguments for alternatives-based or disagreement-based relativism based on the appearance of shared meaning or a lack of shared meaning respectively.

Although Kuhn does not attend to it, the distinction between the scientist, adherent to a particular paradigm in question and a scientist who is non-adherent to that paradigm but adherent to their own, is useful and introduces nuance to my analysis. Later in this thesis (Chapters 5, 6), I consider how arguments for relativism might be based on Kuhn's account of science from the perspective of the adherent and the non-adherent to a particular paradigm,
and I analyse such arguments in terms of the ability of an adherent to a scientific paradigm in crisis to judge between potential alternatives by choosing a replacement paradigm. In terms of these arguments, I can enrich the notion of the scientist non-adherent to the paradigm in question "deferring" to the practitioners of that paradigm. The scientist non-adherent is external to the paradigm of the discipline in question, but as a scientist they defer to the scientists belonging to the discipline in question on issues about the world that the discipline investigates. In at least this respect, the scientist non-adherent is like the philosopher or historian external to any particular science paradigm - they are not committed to the paradigm in question and do not share its meanings, methods and standards, or the world as presented by the paradigm. But in another respect, the scientist external to the paradigm in question is similar to the adherent to that paradigm, this is because, as scientists, they are committed to their own paradigm and so can conceive of judging a paradigm by choosing it. This means that although the scientist non-adherent's attitude to the paradigm is different to the adherent's in that they are not committed to the paradigm, they can conceive how those who are committed to the paradigm judge it to be correct in terms of the meanings, methods and standards, and world that it determines, and they consider disagreements within that paradigm to be matters for the discipline to resolve.16

The scientist who is non-adherent to the paradigm in question does not view the world through the intermediation of that normal science paradigm, but they do view the world as a scientist through the intermediation of their own paradigm. However, unlike the non-scientist who is external to a particular scientific paradigm, the scientist can conceive of the community of practitioners adherent to that paradigm as judging between apparently equivalent alternatives during extraordinary science and choosing their paradigm as their new standard of "objectivity". The scientist non-adherent to a paradigm in question therefore will not frame arguments for alternatives-based relativism, as the non-scientist can do, based on their inability to conceive how scientists can judge between apparently equivalent alternative paradigms. And because the scientist non-adherent to a paradigm in question considers disagreements within that paradigm to be matters for the discipline to resolve, neither will they frame arguments for disagreements-based relativism.

16 This argument is not intended to promote Carol Rovane's argument for global holism about meaning in science, as considered in Chapter 1. The scientist non-adherent to a paradigm cannot be subject to incommensurability as Kuhn describes it, because incommensurability characterises the relationship between successive normal science paradigms of a single discipline. However, the scientist non-adherent to a paradigm in question will employ the meanings of their native paradigm, and clearly cannot share the technical vocabulary of meanings of the community of practitioners who do adhere to the paradigm in question.
In my arguments in Chapters 5 and 6, I do not consider the perspective of the scientist non-adherent to a particular paradigm, and like Kuhn, I focus my investigation on the distinct perspectives of the scientist versus the non-scientist with respect to a scientific discipline as it passes through phases of normal and extraordinary science. Although the steps in the arguments would be different, the outcome of my arguments would be the same for the scientist, whether adherent or non-adherent to a paradigm. Namely, according to Kuhn's account of science, whether adherent or non-adherent to a paradigm in question, a scientist will not develop alternatives-based or disagreements-based arguments for relativism about a scientific paradigm.

I have argued for this conclusion about arguments for relativism from the premise that a non-adherent scientist can conceive of scientists within the discipline in question being able to judge by choosing among apparently equivalent competing paradigms during extraordinary science to select the one that will determine their standard of what is "objectively" correct during the next period of normal science. But this line of reasoning might seem to suggest an argument that scientists across different disciplines share some overarching criterion for judging between paradigms. This is not the case, because what scientists share is not a methodology of selecting paradigms, or an overarching "paradigm" of science; what they share as scientists is adherence to their own paradigm. They know from their own research how a scientific discipline works, they adhere to their community's paradigm, and as Kuhn says, this adherence characterises normal science (Kuhn, 1996, Preface x). The reciprocal of this characterisation of normal science is that a scientist will acknowledge that practitioners of any scientific discipline that is progressing through cycles of normal and extraordinary science can judge between competing paradigms during extraordinary science by choosing their next normal science paradigm. My conclusion that scientists non-adherent to a paradigm in question will not frame arguments for relativism is therefore a consequence of the role the scientific paradigm plays in Kuhn's account of science.17

17 Although it is tempting to believe that "adherence to a scientific paradigm" is a global paradigm covering all science or a methodology that all scientific disciplines share, Kuhn does not argue for this. In fact, early in SSR, Kuhn says that the first thing, in order of presentation, that he will show is the "insufficiency of methodological directives, by themselves, to dictate a unique substantive conclusion to many sorts of scientific questions" (1996, p. 3). According to Kuhn's account of science, adherence to a scientific paradigm is a condition for the possibility of normal science, within which scientists can address the puzzles sanctioned by the paradigm (Kuhn, 1996, p. 100 - 101). Adherence to a paradigm is therefore not a methodology that the sciences share, but the condition for the possibility of normal science. When discussing science in SSR, Kuhn is always focused on disciplines within the overall scientific enterprise, which develop their own rules, meanings, methods, standards, and ontology, rather than on characteristics of the overall enterprise. This emphasis on the community of practitioners within a discipline is evident, for example, when Kuhn defines normal science to mean "research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice" (1996, p. 10). And it is
2.3.5 Novel and anomalous facts: theory-ladenness and holism

Having described the operation of normal science, paradigms, and rules, Kuhn needs to consider some difficulties arising from the all-enveloping nature of the pervasive scientific paradigm. Namely, how can such a description of science allow for novelty — the discovery of new facts and new theories? How can it cope with anomalies, observations that resist explanation by science's best theories? And how can it allow for change to the paradigm itself, and ultimately, the shift to a new paradigm?

In SSR, Kuhn considers novelties of fact and novelties of theory, beginning with the discovery of novel facts and dealing with novel theories in the subsequent section on crisis and scientific revolution. Kuhn has described normal science as puzzle solving and as such, he can account for why it is very successful in its aim "the steady extension of the scope and precision of scientific knowledge" (1996, p. 52). But normal science also uncovers new and unsuspected phenomena. How can this come about if it does not aim at novelty? Kuhn says that novelties of fact and novelties of theory are not isolated events, but "extended episodes with a regular recurrent structure" (1996, p. 52).

Kuhn summarises how scientific discovery proceeds within normal science, thus (1996, p. 64). The first paradigm is quite successful at explaining the easily accessible observations and experiments. Further development requires elaborate equipment, vocabulary, skills, and concepts. This professionalism restricts the scientist's vision, but allows detailed work, with specialist apparatus, that finds novelty that would not otherwise be found. Anomaly can only appear against the background of expectations. The paradigm changes to accommodate anomaly, and resistance to paradigm change is useful in ensuring the paradigm is not too easily surrendered (Kuhn, 1996, p. 65).

Kuhn's account of how novel and anomalous facts are handled within a scientific paradigm involves two related concepts: the theory-ladenness of observation and holism about (testing) theoretical systems.

with such disciplines, as they pass through cycles of normal science, crisis, extraordinary science and revolution, that Kuhn is most concerned (1996, p. 64).
In introducing a role for history in the philosophy of science, Kuhn explains why "a new theory,…. is seldom or never just an increment to what is already known. Its assimilation requires the reconstruction of prior theory and the re-evaluation of prior fact" (Kuhn, 1996, p. 7). Thus, for Kuhn, what is considered to be fact, relevant data, correct observation, is influenced by the theoretical framework in which the scientist is working. And, by corollary, any facts or observations that might seem to test some aspect of the theoretical system, can only test the entire system. And if the system fails the test, it is impossible to tell which component was at fault. This means that modifications can be made to the system to accommodate novel or apparently anomalous observations and preserve the theoretical framework.

The theory-ladenness of observation argues against confirmation or verification as a reliable means of testing our knowledge claims, and holism about testing theoretical systems argues against falsification as a means of testing theoretical systems. Kuhn's notion of the scientific paradigm manifests both the theory-ladenness of observation and holism about testing theoretical systems and is thus set against verification and falsification as accounts of scientific knowledge.

I note that what is considered to be a fact is influenced by theory, but Kuhn hasn't said that facts are constructed de novo, with no reference to a reality underpinning our perception or construction of our experienced reality. This will be an important consideration in defending Kuhn's ideas against the charges of ontological relativism in Chapter 6.

Kuhn's description of how novel and anomalous facts are managed by a scientific paradigm illustrates the tension within a scientific paradigm, between the paradigm's role as disciplinary matrix, determining almost entirely the scope of a scientist's work, the world in which adherents work, but leaving sufficient problems with approved solutions to be found. Kuhn's description of this tension within a scientific paradigm is consistent with at least a local holism about paradigms. The puzzle solving work of adherents is not designed to test the paradigm, but to find the solutions to the tautologous puzzles the paradigm has sanctioned. Testing only occurs "as part of the competition between two rival paradigms for the allegiance of the scientific community" (Kuhn, 1996, p. 145). But this holism about theoretical systems presents an opportunity to the relativist. The relativist can argue that the holistic nature of systems such as paradigms means that they are not susceptible to testing, to empirical
falsification. Even when such systems appear to fail a test, this can be blamed on the failure of some component or auxiliary hypothesis. And when these systems appear to pass a test, this provides no information about the probable veracity of any of the system's components. So there seems to be no external, objective, rational means of judging between paradigms, which, according to the definition of relativism I am using, can allow the framing of arguments for relativism about science. I will address the issue of relativism based on holism about theoretical systems, about meaning, or about conceptual schemes later in this thesis (Chapter 5 and 6).

Although Kuhn's ideas on novelty and anomaly handling might seem to portray science as cumulative, this is not what he intends. There is a sense in which, within normal science, the discovery of novel facts and the management of anomalous facts represents cumulative progress. But Kuhn describes how the development of novel theories to account for persistent anomalies and dissatisfaction with the paradigm that cannot accommodate these anomalies leads to crisis and a revolutionary shift to a new paradigm that is by definition not a cumulative process. Kuhn's opposition to the idea of science as a cumulative process set him against both the positivist, verificationist view that science consists of empirically confirmed or potentially confirmable facts and theories, as might be represented by Rudolph Carnap, and against Karl Popper's sophisticated falsificationism, whereby science consists in the accumulation of entire theories rather than discrete facts that are falsifiable but not falsified. As Sharrock and Read point out, referencing Ian Hacking, both of these superficially very different traditions share many underlying assumptions, including the idea that "the growth of knowledge is by and large cumulative" (2002, p. 13).

2.3.6 Crisis and scientific revolution: novel theories

Kuhn has described how a scientific paradigm comprehensively determines the adherent's practice of their discipline, how the adherents occupy themselves with puzzles set by (or in accordance with) the paradigm, and how adherents can only with difficulty describe the rules their discipline has developed from the overarching paradigm. Kuhn has also described how the paradigm is maintained in the face of novel discoveries and anomalous facts that resist
resolution.\textsuperscript{18} But in a sense, novel facts are not the problem, it is novel theories that are developed to account for novel or anomalous facts that threaten to destabilise the paradigm.

In describing the paradigm's measures for novelty and anomaly handling, Kuhn shows that he is aware of the difficulty his idea of a self-correcting, self-maintaining paradigm faces. That is, the difficulty of how to account for the change to a new paradigm. If the paradigm can change to accommodate novel facts, how then can normal science lead to paradigm shifts, that is, to the adoption of novel theories?

Kuhn describes how crisis leads to the emergence of new scientific theories. Anomalies show the failure of the paradigm to resolve its own traditional problems (1996, p. 67). Usually, except in the case of Newton's theory of light, the awareness had lasted so long and penetrated so deeply that we can describe the fields affected as in a state of growing crisis. Then the "failure of existing rules is the prelude to a search for new ones" (Kuhn, 1996, p. 68).

Assuming that crises are a necessary precondition for the emergence of novel theories, we can ask how do scientists respond? The first part of the answer, which Kuhn acknowledges is just a generalisation based on historical fact, is that "they do not renounce the paradigm that has led them into crisis. They do not, that is, treat anomalies as counterinstances" (Kuhn, 1996, p. 77). This is because, "once it has achieved the status of paradigm, a scientific theory is declared invalid only if an alternate candidate is available to take its place" (ibid).

At this point in his account, Kuhn makes a direct attack on what he implies is a competing theory in the history, and by implication in the philosophy of science: falsification. He says that "no process yet disclosed by the historical study of scientific development at all resembles the methodological stereotype of falsification by direct comparison with nature." And he follows by stating that "the decision to reject one paradigm is always simultaneously the decision to accept another, and the judgement leading to that decision involves the comparison of both paradigms with nature and with each other" (Kuhn, 1996, p. 77).

There is also a second reason for doubting that scientists reject paradigms because they are confronted with anomalies or counterinstances. They will, Kuhn says, form \textit{ad hoc}

\textsuperscript{18} In these descriptions, Kuhn has not specified that adherents cannot communicate with those adherent to other paradigms; he has only described how and why they do not. The specification that interactions between competing paradigms are difficult or impossible comes later with Kuhn's introduction and description of incommensurability.
modifications of their theory "in order to eliminate any apparent conflict" (1996, p. 78). In an unusual move, Kuhn uses the example of likely responses to his account of science as an analogy of such ad hoc modification (1996, p. 78). Kuhn says that the reasons he has given for doubting that scientists reject a scientific paradigm are themselves counterinstances to the prevalent epistemological theory (by this, I assume he means Popper's falsificationism). And philosophers have responded to his counterinstances in a similar way to how scientists would respond to the counterinstances they meet in scientific practice. That is, they have formed ad hoc modifications to their theories to accommodate the counterinstances. But Kuhn contends, regarding the philosophy of science and not just regarding science itself, that once a new paradigm takes over, the anomalies become tautologies and simply could not appear any other way to adherents of the paradigm (1996, p. 81).

Returning to consider his original question, Kuhn asks again how do scientists respond to anomalies or scientific crisis (1996, p. 81)? There are, he says, two universal effects: the first effect is that "All crises begin with the blurring of a paradigm and the consequent loosening of the rules for normal research" (Kuhn, 1996, p. 84) and the second effect is that "all crises close in one of three ways: normal science can accommodate the anomalies, normal science shelves the anomalies for a future research effort, or a new paradigm emerges" (Kuhn, 1996, p. 84).

The resulting transition to a new paradigm is a scientific revolution, says Kuhn:

The transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from a cumulative process, one achieved by an articulation or extension of the old paradigm. Rather it is a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications (Kuhn, 1996, p. 84).

Kuhn compares the shift to a new paradigm to a Gestalt shift, except that scientists cannot switch over and back at will between scientific paradigms in the manner available to a person switching between different perceptions of an optical illusion (Kuhn, 1996, p. 84).

Although Kuhn often used the Gestalt comparison, he did come to regret it as "somewhat misleading" (2000 pp. 242, 250). So it is perhaps better to move on from the Gestalt comparison and focus on the conceptual scheme and the semantic aspects of scientific

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19 In *The Road Since Structure*, Kuhn regrets using a term from the psychology of the individual to describe episodes in the experience of a group (2000, p. 242).
revolution that might provide grounds for relativism about science. Kuhn specifies that the
revolution is a "reconstruction of the field from new fundamentals," so the relativist could
argue that this constitutes or requires a switch to a new conceptual scheme, of which there
may be many, and between which we cannot judge. But what could be the source of this
conceptual scheme or paradigm shift? As I will describe in the addendum to this thesis,
through his career, Kuhn developed the idea that such a conceptual scheme change was due to
changes in language and thought and thus to changes in meaning ascription, the semantic
function, the attribution of meaning and reference, and the co-constitution of the phenomenal
world. The notion that paradigm shifts are due to or associated with semantic and ontological
shifts can provide grounds for arguments for relativism about science.

Kuhn's description of novel theory handling represents another step in his incremental
refinement of the relationship between paradigms. To explain the kind of shift to a different
scientific paradigm that Kuhn believes has happened on occasions in the history of science,
his account needs to emphasise the difficulty or impossibility of communication and
understanding between successive paradigms. Although Kuhn's description of how the
paradigm handles novel and anomalous facts refers to adherent's behaviour within the
paradigm, nothing in his account requires that the adherents are insulated within the paradigm
from other, alternative paradigms. Kuhn introduces this aspect of the relationship between
paradigms when he describes how the paradigm contends with novel theories, developed to
account for anomalies. This is because the development of novel theories can cause a crisis
within the paradigm leading to a revolutionary shift to a new paradigm, and this can only
occur with the concurrent rejection of the old paradigm.

If there are reasons why the assimilation of a new phenomenon or the adoption of a new
paradigm can only occur with the rejection of the previous paradigm, Kuhn says, they do not
derive from the logical structure of scientific knowledge (1996, p. 95). By this, I take Kuhn to
mean the idea that inductive knowledge claims can be verified or deductive knowledge claims
can be falsified. Although it appears that knowledge is cumulative, for Kuhn, only normal
science is cumulative (1996, p. 96). Whereas, a scientific revolution involves the
displacement of one paradigm with another, the one discloses the anomaly and the other
renders it law-like (Kuhn, 1996, p. 97). The predictions of the one and the other are different,
and this would not be the case if the theories were "logically compatible" (Kuhn, 1996, p. 97).
It is Kuhn's insistence (based on his reading of cases in the history of science) that science is
not cumulative, that requires this constraint on the relationship between paradigms.
It seems that through his account Kuhn presents successively more detail about the reasons why science is cyclical rather than cumulative. Kuhn initially specifies that normal science occurs within a paradigm, but he does not explicitly state that communication or understanding is difficult or impossible across paradigms (1996, p. 19). Subsequently, Kuhn describes how acceptance of a new paradigm requires the rejection of the old paradigm, that is, he specifies that paradigms are incompatible (1996, p. 92). Later, in SSR Section IX, when describing the nature and necessity of scientific revolution, he will say that not only are paradigms incompatible but in fact they are incommensurable (Kuhn, 1996, p. 103).

2.3.7 Paradigm insulation

Kuhn's account of science in SSR provides evidence that the community of natural scientists that constitute a scientific discipline, working within their paradigm during normal science, are insulated, or insulate themselves, from different accounts of the natural world that can obtain outside of the paradigm. In this section, I describe how this inward focus on the paradigm insulates a normal science community. I detail the insulation based on evidence from Kuhn's account of the transition from the schools phase, during the operation of normal science, under crisis and extraordinary research, and in the aftermath of a scientific revolution. As an example of how the scientific community looks toward its own paradigm even when making practical use of aspects of a previous paradigm, I also consider Kuhn's argument that Newtonian dynamics is not a special case of Einsteinian relativistic dynamics. I show that a community's insulation occurs, not because the paradigm adherents actively engage with, counter, and exclude ideas, alternative theories, or potentially alternative paradigms, but because they focus their energies on their investigation of the natural world as determined by their paradigm and interpret the world only in terms of their paradigm.

2.3.7.1 Turning away from the schools

Kuhn's description of science begins with a consideration of the pre-paradigm, schools phase in the development of a scientific discipline, the period before the consensus adoption of a scientific paradigm. Later in Kuhn's account of science, he says that the relationship between successive normal science paradigms can be characterised by incommensurability (1996, p. 103). Therefore, we cannot attribute incommensurability, which is a relation between
paradigms, to the relationship between competing theories in the transition from the pre-consensus, schools phase to normal science. However, we can understand from Kuhn's description that when this transition occurs, the newly-formed scientific community is insulated within its newly-acquired paradigm. That is, when "an individual or group first produces a synthesis able to attract most of the next generation's practitioners," as Kuhn says, there are always those "who cling to one or another of the older views, and they are simply read out of the profession, which thereafter ignores their work" (Kuhn, 1996, p. 18 - 19).

This description is important in that it draws attention to the fact that the investigators who do not adopt the first paradigm that the discipline accepts by consensus, are no longer considered part of the group. But "it is sometimes just its reception of a paradigm that transforms a group previously interested merely in the study of nature into a profession or, at least, a discipline" (Kuhn, 1996, p. 19). Historically, Kuhn says, those who do not accept the paradigm "have often simply stayed in the departments of philosophy from which so many of the special sciences have been spawned" (ibid). So these researchers, once, but no longer, scientists, "proceed in isolation or attach themselves to some other group" (ibid). And their ideas, which may have been part of the debates that lead to the acceptance of the paradigm, persist but are ignored by the community of scientists, preoccupied by their work under the newly-accepted paradigm.

The community's preoccupation with their newly adopted paradigm plays an important role in the conduct of normal science; "by focussing attention upon a small range of relatively esoteric problems, the paradigm forces scientists to investigate some part of nature in a detail and depth that would otherwise be unimaginable" (Kuhn, 1996, p. 24). But such focus on the paradigm does not always apply. Looking forward beyond the transition from the schools phase to normal science, Kuhn contrasts this concentration on the paradigm during normal science with the community's behaviour under different conditions. According to Kuhn, "normal science possesses a built-in mechanism that ensures the relaxation of the restrictions that bound research whenever the paradigm from which they derive ceases to function effectively" (ibid). And "at that point, scientists begin to behave differently, and the nature of their research problems changes" (ibid). That is to say, during extraordinary research, the community ceases to focus internally on the world as described by the paradigm and begins to

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20 Regarding the role of the ideas promoted by the schools in Newton's discoveries, Kuhn says "At various times all these schools made significant contributions to the body of concepts, phenomena, and techniques from which Newton drew the first nearly universally accepted paradigm for physical optics" (1996, p. 13).
look outward, beyond the paradigm for a resolution to the crisis they are experiencing (Kuhn, 1996, p. 91). The resolution of the crisis will likely come about through the adoption of a new paradigm of normal science, under which, the scientific community will once again look insulate itself within the world of the paradigm (Kuhn, 1996, p. 92).

2.3.7.2 Concentrating on normal science puzzles

Kuhn describes the activities of the scientific community during normal science in terms of fact gathering and theoretical investigation (Kuhn, 1996, p. 25). There are, he says, three, not always distinct foci for the experimental and observational work of scientists (ibid). Firstly, there is the work of determining with precision those facts that "the paradigm has shown to be particularly revealing of the nature of things" (ibid). Secondly, scientists investigate "facts that can be compared directly with predictions from the paradigm theory" (Kuhn, 1996, p. 26). And thirdly, there is the empirical work undertaken to "articulate the paradigm theory, resolving some of its residual ambiguities and permitting the solution of problems to which it had previously only drawn attention" (Kuhn, 1996, p. 27). This third class of experiment and observation is the most important of the three, and Kuhn further describes it in terms of work "in the more mathematical sciences," such as the search for physical constants, such as the universal gravitational constant, searching for quantitative laws, such as Boyle's Law, and experiments to articulate the paradigm, that is, experiments to determine how to apply the paradigm to nature, such as the experiments on how to apply the caloric theory of heat to chemical reactions, to friction between bodies, and the compression of gasses (Kuhn, 1996, p. 27 - 29).

In all these activities, the community is working within the paradigm, focussing internally on the research work sanctioned by the paradigm. The community is not looking beyond the paradigm to reconcile the paradigm with contrary facts, such as those identified by the schools that would be superseded by the consensus adoption of the successful scientific paradigm at the discipline's "transition to maturity" (Kuhn, 1996, p. 21). Nor is the community concerned with the facts identified by any paradigm that previously dictated the normal science tradition of the discipline. Once a phenomenon had been established as paradigmatic, all further experiments in the area are "paradigm-dependent" (Kuhn, 1996, p. 29 – 30).

According to Kuhn, the theoretical research problems of normal science fall into very nearly the same classes as the experimental and observational puzzles (1996, p. 30). And Kuhn's
descriptions make it clear that in this research, the scientific community is focussed internally on resolving these research problems within the rubric of the paradigm, rather than addressing any theories, solutions, or challenges external to the paradigm.

Kuhn classifies the theoretical work undertaken under a normal science paradigm as involving scientists using theory to "predict factual information of intrinsic value", such as the computation of lens characteristics, a task that is usually left to engineers (1996, p. 30). Scientists also seek new applications of the paradigm or look to increase the precision of an application of the paradigm (Kuhn, 1996, p. 30). This research is necessary because of the "immense difficulties often encountered in developing points of contact between a theory and nature," as exemplified by the history of dynamics following Newton's publication of the *Principia* (Kuhn, 1996, p. 31). And this history also demonstrates the third kind of theoretical work that occurs during normal science, that is, theoretical problems of paradigm articulation (Kuhn, 1996, p. 33). For example, Kuhn says, after Newton, several eighteenth and nineteenth century mathematical physicists "repeatedly endeavoured to reformulate mechanical theory in an equivalent [that is, equivalent to an apparently unrelated set of Continental techniques] but logically and aesthetically more satisfying form" (Kuhn, 1996, p. 33).

Both the fact gathering and the theoretical investigations undertaken during normal science are what Kuhn has described as "highly directed or paradigm-based research" (1996, pp. 18, 25). Kuhn has said that most scientists spend their entire careers mopping up, or in "an attempt to force nature into the preformed and relatively inflexible box that the paradigm supplies" (1996, p. 24). This enterprise involves "drastically restricted vision," but this focus on a "small range of relatively esoteric problems" is essential to the development of science (Kuhn, 1996, p. 24). We should remember that the scientist is under some constraint to restrict their vision in this way, because any scientist who refuses to work within a newly-adopted paradigm, who "continues to resist after his whole profession has been converted," will "ipso facto" be considered to have ceased to be a scientist (Kuhn, 1996, p 159).

But there will also be times in the Kuhnian cycle, during extraordinary research, when scientists will turn their attention beyond the paradigm, without risking ostracisation from their discipline. A newly adopted paradigm presents scientists with a "promise of success discoverable in selected and still incomplete examples” (Kuhn, 1996, p. 23). And "normal science consists in the actualization of that promise, an actualization achieved by extending the knowledge of those facts that the paradigm displays as particularly revealing, by
increasing the extent of the match between those facts and the paradigm’s predictions, and by further articulation of the paradigm itself" (Kuhn, 1996, p. 24). The work of determining significant facts, matching facts with theory, and articulating the paradigm "exhausts" the literature of normal science, "both empirical and theoretical," Kuhn says, but "they do not, of course, quite exhaust the entire literature of science". (1996, p. 34). This is because, "there are also extraordinary problems" (Kuhn, 1996, p. 34). But as Kuhn later says, when considering examples of anomalies during normal science, the solution to each of the problems "had been at least partially anticipated during a period when there was no crisis in the corresponding science; and in the absence of crisis those anticipations had been ignored" (1996, p. 75).

### 2.3.7.3 Investigating beyond the paradigm during extraordinary research

Kuhn's initial description and subsequent explanation of normal science in SSR shows that the scientific community during normal science is focussed internally on the world and the research work dictated by their scientific paradigm. This is particularly clear where Kuhn summarises the transitions from the schools phase to normal science and from normal science to extraordinary research (1996, p. 64).

In the development of any scientific discipline from the schools phase to normal science, the first accepted paradigm is usually "felt to account quite successfully for most of the observations and experiments easily accessible to that science's practitioners" (Kuhn, 1996, p. 64). Further development of the discipline requires "the construction of elaborate equipment, the development of an esoteric vocabulary and skills, and a refinement of concepts that increasingly lessens their resemblance to their usual common-sense prototypes" (ibid). This "professionalization" of the discipline leads to "an immense restriction of the scientist's vision and to a considerable resistance to paradigm change" (ibid). However, the restriction of vision and the resistance to change brings with it the advantage that "within those areas to which the paradigm directs the attention of the group, normal science leads to a detail of information and to a precision of the observation-theory match that could be achieved in no other way" (Kuhn, 1996, p. 65). The success of the paradigm, however, contributes to its downfall. This is because novelty could not occur "without the special apparatus that is constructed mainly for anticipated functions" and even if it did, "novelty ordinarily emerges only for the man who, knowing with precision what he should expect, is able to recognize that something has gone wrong" (ibid). In the same way, "anomaly appears only against the background provided by the paradigm" (ibid). The resistance of scientists to paradigm change will ensure that their
investigation of anomaly will "penetrate existing knowledge to the core" (ibid). And by this mechanism, "the traditional pursuit prepares the way for its own change" (ibid).

We can contrast Kuhn's description of normal science with his account of the scientific community's activities during extraordinary science. Kuhn points out that, in contrast to normal science, during extraordinary science the scientists within a discipline turn their attention to matters external to their native paradigm. Indeed, when listing the symptoms of the transition from normal science to extraordinary research, Kuhn states that "it is upon their existence more than upon that of revolutions that the notion of normal science depends" (Kuhn, 1996, p. 91).

The symptoms of a scientific community's transition from normal to extraordinary science are "the proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals" (Kuhn, 1996, p. 91).

When an anomaly "comes to seem more than just another puzzle of normal science," early attacks on the resistant problem follow the paradigm rules "quite closely," but "with continuing resistance, more and more of the attacks upon it will have involved some minor or not so minor articulation of the paradigm" (Kuhn, 1996, p. 82 - 83). And although there is still a paradigm, "the rules of normal science become increasing blurred" (Kuhn, 1996, p. 83). Or as Kuhn later says, "All crises begin with the blurring of a paradigm and the consequent loosening of the rules for normal research" (1996, p. 84). And importantly, "In this respect research during crisis very much resembles research during the pre-paradigm period …" (ibid).

Using visual metaphors, Kuhn describes how the rules of the paradigm and the paradigm itself is "blurred" and how the community cannot "see" clearly how to conduct its research. This suggests that the scientific community cannot clearly differentiate between the facts and theories internal and those external to their paradigm. Under such conditions, scientists such as Copernicus and Einstein, recognise and express their discontent with the state of their discipline as, respectively, "inconsistent" and "with no firm foundation" (Kuhn, 1996, p. 83).

When faced with an "admittedly fundamental anomaly in theory," the scientist will "push the rules of normal science harder" to see how far they can be made to work, but also to make the
breakdown of the rules more striking and "perhaps more suggestive" (Kuhn, 1996, p. 86, 87). In this effort to foreground where the rules fail, the scientist will often seem to be "searching at random, trying experiments just to see what will happen, looking for an effect whose nature he cannot quite guess" (Kuhn, 1996, p. 87). And just as they are willing to "try anything" in terms of experiments, the scientist will "constantly try to generate speculative theories, that if successful may disclose the road to a new paradigm…” (ibid).

During normal science, researchers can work within their paradigm without seeking the explicit rules that guide their investigations (Kuhn1996, p. 88). But during crisis and extraordinary research, they may resort to philosophy as a means of identifying such rules. And Kuhn suggests that such philosophical analysis can be "an effective way to weaken the grip of a tradition upon the mind and to suggest the basis of a new one" (ibid). Such analysis can also involve the use of thought experiments, such as those in the writings of Galileo, Einstein, and Bohr, calculated to "expose the old paradigm to existing knowledge in ways that isolate the root of crisis with a clarity unattainable in the laboratory" (ibid).

By means of the various strategies scientists pursue during extraordinary research, new theories are developed to explain anomalies in nature discovered by normal scientific investigation (Kuhn, 1996, p. 97). These theories are logically incompatible with the paradigm within which they have been developed. To illustrate and argue this point, Kuhn describes the logical incompatibility between Newtonian and Einsteinian dynamics, as seen after the scientific revolution from the former to the latter (1996, p. 94). Before examining this example in detail, I briefly consider how the scientific community focusses on their new paradigm after such a revolution.

2.3.7.4 Committing to the new paradigm after a scientific revolution

In his initial description of normal science, Kuhn was contrasting normal science after the consensus adoption of a scientific paradigm with the pre-paradigm, pre-consensus, schools phase in the development of a scientific discipline (1996, p. 18). Toward the end of this description, Kuhn explains how the activities of normal science can give rise to novelty and anomaly that can precipitate a crisis and cause the paradigm rules and the paradigm itself to become "blurred" (1996, pp. 83, 84). In his further explanation of how a scientific paradigm determines research during normal science, Kuhn is describing the transition from a normal science paradigm in crisis to a new scientific paradigm by way of a scientific revolution.
(1996, p. 92). He specifies that the normal science tradition that emerges from a scientific revolution "is not only incompatible but often actually incommensurable with that which has gone before" (Kuhn, 1996, p. 103).

With the scientific revolution to a new paradigm, the various extraordinary research activities that Kuhn has described come to an end. The community no longer expresses discontent with the paradigm, develops different articulations of the paradigm, attempts unorthodox experiments, makes recourse to philosophy, or questions the fundamentals of their discipline. The scientific community, under a newly adopted paradigm, no longer looks outward, beyond their paradigm, but focusses their attention and activities inward, to the work set for them by the new paradigm and the "future promise" of success under that paradigm (Kuhn, 1996, p. 158). So the community turns away from several things – from the old paradigm and from the competing articulations of that paradigm developed during extraordinary research. Kuhn also says that "new instruments like the electron microscope or new laws like Maxwell's may develop in one speciality and their assimilation create a crisis in another" (1996, p. 181). This indicates that each discipline might also be ignoring theories or resources from other scientific disciplines. And logically, a scientific community could also be ignoring challenges from outside of their paradigm from, for example, from pseudo-science and from non-science practitioners, such as philosophers, historians, and the religious.

2.3.7.5 Newtonian dynamics is not a special case of Einsteinian relativistic dynamics

Against the cumulative conception of science, Kuhn is arguing that the discovery of novel facts and the invention of new theories occur through "paradigm destruction," the displacement of one paradigm with another (1996, p. 97). To illustrate this, Kuhn chooses the relationship between "the dynamical equations that descend from Newton's Principia" and "Einsteinian dynamics" (1996, p. 98). Kuhn argues against the predominant contemporary interpretation, whereby "Newtonian theory seems to be derivable from Einsteinian, of which it is therefore a special case" (1996, p. 99)21.

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21 Kuhn is arguing against "the most prevalent contemporary interpretation of the nature and function of scientific theory," which is, "closely associated with early logical positivism and not categorically rejected by its successors" (1996, p. 98). For this, Kuhn chooses "the best-known and the strongest case for this restricted conception of a scientific theory" (1996, p. 98). Sharrock and Read commend Kuhn on his bravery in this, saying that he, "takes on his opponents on one of their strongest turfs. For it is virtually a verity, and a widely accepted one, that Newtonian mechanics is true as a special limiting case of Einsteinian Relativity" (2002, p. 143).
Kuhn's example shows clearly, as I have argued, that the normal science community is insulated from ideas outside of its paradigm by the community's concentration on the world and the work described by their paradigm. The normal science community can view an "out-of-date theory" as a special case of its "up-to-date successor," that is, the community can view Newtonian dynamics as a special case of Einsteinian dynamics, but the older theory "must be transformed for the purpose" (Kuhn, 1996, p. 102 – 103). The community of scientists can only view the older theory as they interpret it through the intermediation of their current, "up-to-date" paradigm. This is because, in relation to the example Kuhn considers, "the physical referents of the(se) Einsteinian concepts are by no means identical with those of the Newtonian concepts that bear the same name" (Kuhn, 1996, p. 102). So for example, "Newtonian mass is conserved; Einsteinian is convertible with energy" (ibid).

For Kuhn, Newtonian dynamics and Einsteinian dynamics are "fundamentally incompatible in the sense illustrated by the relation of Copernican to Ptolemaic astronomy: Einstein's theory can be accepted only with the recognition that Newton's was wrong" (1996, p. 98). Kuhn addresses the objection to this position, the idea that Newton's dynamics are a special case of Einsteinian dynamics, first in a pragmatic argument based on his account of science, and then in a logical argument based on his developing ideas about semantics and ontology within scientific paradigms.

According to Kuhn, Newtonian dynamics can only be seen as a special case of Einsteinian dynamics by limiting the application of the former theory to the evidence that supports it (Kuhn, 1996, p. 99). Such restriction "can make any theory that has ever been used by a significant group of competing scientists immune to attack" (ibid). But to save theories such as the phlogiston theory in this manner, "the range of application must be restricted to those phenomena and to that precision of observation with which the experimental evidence in hand already deals" (Kuhn, 1996, p. 100). And such restriction would prohibit the scientific community from speaking "scientifically" about any phenomenon not already observed and forbids scientists from relying on their own research "whenever that research enters an area or seeks a degree of precision for which past practice with the theory offers no precedent" (ibid). In short, without commitment to their paradigm, scientists could not carry out the work of normal science, extending the range of the paradigm, nor could they conduct extraordinary research, and so "the community would return to something much like its pre-paradigm state" (Kuhn, 1996, p. 100 – 101).
Although this is not the most important aspect of the two arguments Kuhn advances regarding Newtonian/Einsteinian dynamics, it does show that the paradigm adherents must be "committed" to their paradigm to believe that it "must extend to areas and to degrees of precision for which there is no full precedent" (1996, p. 100). That is, the community must believe that their paradigm can, in principle, provide solutions for all the puzzles the discipline faces, without restriction. This means that the scientists during normal science must believe that only their paradigm is applicable to the world, and that nothing else will solve the problems they are addressing.

But the practical difficulty that positivist's argument, which "saves" theories by restricting their range of application, would condemn science to a pre-paradigm state is less important for Kuhn than the logical problem the argument involves (1996, p. 101). In his logical assault on the argument, Kuhn denies the idea that "Newtonian dynamics" can "really be derived from relativistic dynamics(?)" (ibid).

According to Kuhn's argument, we can imagine rendering Einsteinian dynamics as a set of statements that contain "variables and parameters representing spatial position, time, rest mass etc." (ibid). And we can add to these, statements that restrict the range of parameters and variables. This enlarged set could then be manipulated to yield "Newton's laws of motion, the law of gravity and so on" (ibid). The variables and parameters that in the Einsteinian statements represent spatial position, time, mass etc., will occur in the Newtonian-like statements (ibid). But "the physical referents of these Einsteinian concepts are by no means identical with those of the Newtonian concepts that bear the same name" (Kuhn, 1996, p. 102). For example, "Newtonian mass is conserved; Einsteinian is convertible with energy" (ibid). According to Kuhn, unless we change the definitions of the variables in the Newtonian-like statements, "the statements we have derived are not Newtonian" (ibid). And, of course, if we do change these definitions, "we cannot properly be said to have derived Newton' Laws" (ibid).

Assuming Einsteinian dynamics is the dominant dynamics paradigm, we see from Kuhn's example that scientists can communicate with the ideas of a previous paradigm in their discipline. But they read or interpret the world of that older, superseded paradigm through the intermediation of their current paradigm. They do not engage with and resist ideas from the older paradigm as if these concepts and theories, which are outside, external to their
paradigm, that might turn out to be correct about the world and threaten their paradigm. Rather, the community is focussed on their current paradigm, and if scientists consider the previous paradigm's ideas, perhaps because they provide some utility, such as a simplified mechanics for automobile driving or earth-centred astronomy for navigating and land surveying, they read the other paradigm as interpreted by the lights of their own paradigm.

The argument that Kuhn has constructed by imagining a set of statements that together "embody the laws of relativity," and from which might be derived Newton's laws, has failed to do what it purported to do (Kuhn, 1996, p. 101 - 102). It has not shown that Newton's Laws are a limiting case of Einstein's because "in the passage to the limit it is not only the forms of the laws that have changed. Simultaneously we have had to alter the fundamental structural elements of which the universe to which they apply is composed" (Kuhn, 1996, p. 102).

This "need to change the meaning of established and familiar concepts", this "displacement of the conceptual network through which scientists view the world", ensures that an older theory can only be viewed as "a special case of its up-to-date successor" if it is "transformed for the purpose" (Kuhn, 1996, p.103). And although this restatement of the older paradigm in terms of the successor paradigm might have some utility in virtue of its "economy", it "could not suffice for the guidance of research" (ibid).

Using the example of Newtonian versus Einsteinian dynamics, Kuhn has been building towards his introduction of incommensurability as characterising the relationship between paradigms. And he proceeds to explain how incommensurability characterises the relationship between scientific paradigms, a paradigm that previously determined normal science and the successor paradigm that replaced it and currently determines normal science. His descriptions in SSR show that the insulation between a normal science paradigm and the ideas outside of the paradigm, whether the theories of schools, the alternative articulations of extraordinary science, or the incommensurable, superseded paradigm of a discipline, occurs not by the active exclusion of what is "outside" the paradigm, but by a community's focus on the world of the paradigm and the world, including any external ideas, as read by the paradigm.

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22 Kuhn has stated elsewhere that superseded paradigms can still have practical utility. For example, "The theory and practice of both navigation and surveying can be developed with great simplicity and precision from models build to the specifications of Figure 11 (Astronomical functions of the two-sphere universe), and, since the model demanded by modern astronomy is far more complex, the two-sphere universe is normally used in preference to the Copernican when teaching these subjects" (Kuhn, 1957, p. 38). But in these cases, the interpretation of the older paradigm by its successor paradigm is made explicit and "Most handbooks of navigation or surveying open with some sentence like this: 'For present purposes we shall assume that the earth is a small stationary sphere whose centre coincides with that of a much larger rotating stellar sphere'" (ibid).
When describing the disjunction between successive normal science paradigms in SSR, Kuhn uses both perceptual and linguistic metaphors. So, for example, he describes scientists as "responding to a different world" (Kuhn, 1996, p. 111) and says that to the extent "that two scientific schools disagree about what is a problem and what a solution, they will inevitably talk through each other when debating the relative merits of their respective paradigms" (Kuhn, 1996, p. 109). Later in his argument, Kuhn characterises the relationship between competing scientific paradigms in terms of incommensurability, whether semantic incommensurability, methods and standards incommensurability or "world change" incommensurability (1996, p. 103). I am pointing out that, according to Kuhn's account of science, these forms of incommensurability or, as I argue, manifestations of semantic incommensurability, insulate a normal science paradigm because the community looks inward to the world of the paradigm rather than outward to meanings, methods, and worldviews outside of the paradigm. This may occur because the network of similarity relations that experts use in their work and which they teach to novices during their induction into the discipline refer to other members of the network of similarity relations (Kuhn, 1996, p. 189).

In summary, Kuhn describes the manner in which scientists focus on the research set by their paradigm in his elaboration of the pre-consensus schools phase, in his description of the "mopping up" work most scientists are occupied with for most of their career under normal science, in the contrast he draws between research under normal science and during extraordinary research, and in his description of the incommensurability that characterises the relationship between competing paradigms in the aftermath of a scientific revolution and the adoption of a new scientific paradigm (1996, p. 103). During the pre-paradigm, schools phase the scientific community attends to the variety of theories advanced by different schools, but after the transition to normal science, with the adoption of a paradigm, the members of the new discipline ignore these theories and concentrate on their new paradigm (Kuhn, 1996, p. 19). Kuhn's description of normal science as puzzle solving shows that paradigm adherents focus on the puzzles set by their paradigm, rather than the theories of the schools, which have been superseded (1996, p. 21). In contrast, during crisis and extraordinary science, scientists

23 In 'Second Thoughts on Paradigms,' Kuhn describes how a parent uses both similarity and difference, the similarity between geese and the difference between geese and swans, to teach the concept of "goose" to a young child (1997). Although in SSR Kuhn does describe how meanings are taught and learned through a network of similarity relations within a language, his focus is more on the perceptual than on the linguistic process, on how a novice comes to "see his problem as like a problem he has already encountered" (1996, p. 189). Scientists may, of course, also view a problem in hand as different from problems already encountered, but, they focus on similarity rather than difference, and as Kuhn says, "scientists solve puzzles by modeling them on previous puzzle-solutions" (ibid).
develop and debate alternative articulations of their paradigm, in an attempt to deal with anomalous findings (Kuhn, 1996, p. 91). And in the aftermath of the scientific revolution that can resolve the crisis, the scientists focus on their new paradigm, ignoring the previous paradigm and the various articulations of it that were developed (Kuhn, 1996, p. 92). Kuhn's descriptions show that scientific community is insulated within their paradigm, not because the paradigm adherents actively engage with, counter, and exclude ideas, alternative theories, or potentially alternative paradigms, but because they focus on their investigation of the natural world as determined by their paradigm.

2.3.8 Phase transitions

Before beginning the next section of my analysis, it is important to be clear that normal science in crisis, extraordinary science (extraordinary research), and revolutionary science are different terms for the same phase of science as described by Kuhn in SSR. In the text, Kuhn presents his account of science from different perspectives, as if discovering it for the first time. This narrative structure and the variations in terminology can confuse. But Kuhn has described a cyclical, two-phase account of science that can, despite its complexity, be summarised. According to Kuhn, periods of normal science, science conducted within or according to a scientific paradigm and mostly characterised by puzzle solving, are separated by periods of extraordinary science (science in crisis or revolutionary science), mostly characterised by the search for a replacement paradigm. The periods of extraordinary science are brought about by the perceived failure of the normal science paradigm, resulting in crisis, and resolved with the adoption of a new paradigm (a paradigm shift, a scientific revolution) and a return to normal science under the new scientific paradigm.

The phase transitions are important. Thus, there is a gradual progression from normal science in crisis into extraordinary science. As Kuhn puts it, "the proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals, all these are symptoms of a transition from normal to extraordinary research" (Kuhn, 1996, p. 91).

All of the work of accessing and evaluating alternative paradigms is carried out during extraordinary science. And this period and this activity ends, whether suddenly or gradually
over a long period, with the scientific revolution, the paradigm shift, the adoption of a new paradigm.

Hoyningen-Huene provides admirable clarity on this point.

In the development of the “mature” sciences of today we can generally find an initial phase, which I will call "prenormal science." There follows the transition to maturity, one phase of which is referred to as "normal science." After a "scientific revolution" of variable length, there follows another phase of normal science, and so on. Between two periods of normal science the phase called "extraordinary science" may occur (Hoyningen-Huene, 1993, p. 27).

And regarding the transition into extraordinary science and the research undertaken in this period, he says, "When a crisis affects a given field of research, research practice in that field changes progressively by comparison with normal science. Kuhn calls this altered practice 'extraordinary science' or 'science in the crisis state'" (Hoyningen-Huene, 1993, p. 233). Also, "The task of extraordinary research is then to change the regulations in such a way as to preserve as many previously attained problem solutions as possible, on the one hand, while dissolving those stubborn anomalies which triggered the crisis, on the other" (Hoyningen-Huene, 1993, p. 233).

2.4 From description to justification

With the introduction of the concept of "incommensurability", Kuhn's text moves from describing his account of science to offering an explanation or justification of that account. Having initially described his conceptions of normal science and paradigms, puzzle solving, rules, novelty and anomaly handling, crisis and scientific revolution, Kuhn provides additional details, explaining why scientific revolutions are necessary, how they can be seen as changes of world view, why they are invisible to us, how they are resolved by a paradigm shift, and in what sense they lead to progress in science.

Kuhn introduces the term "incommensurable," which is a key component in his account of science, and offers three articulations of what we might call the general, paradigm incommensurability he has introduced. This highlights two important aspects of Kuhn's description of incommensurability. Firstly, Kuhn has not described or defined different types of incommensurability, such as semantic, conceptual, or ontological. Secondly, in his description of a general, paradigm incommensurability, Kuhn does not distinguish a scale of
incommensurability, for example, from strict to permissive, from strong to weak, from total to partial.

### 2.4.1 Incommensurability: forms or manifestations, and degrees

According to Kuhn's account in SSR, once science has left the initial immature pre-consensus phase, it consists of cycles of normal science and extraordinary (revolutionary) science. The transition between the two phases of science, normal science and extraordinary science, occurs with a scientific revolution, the adoption of a new paradigm, after a period of crisis and extraordinary science research. Kuhn begins his discussion of the nature and necessity of scientific revolutions with a definition of scientific revolution: "...scientific revolutions are here taken to be those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one" (1996, p. 92). He calls these developmental episodes revolutions because of their parallels with political revolutions. In both cases, revolution occurs because of a sense, among a small group, that the paradigm is malfunctioning. But also, "political revolutions aim to change political institutions in ways that those institutions themselves prohibit" (Kuhn, 1996, p. 93). Kuhn infers that this is the same with scientific revolutions. Political and scientific revolutions both involve "a choice between incompatible modes of community life" (Kuhn, 1996, p. 94).

Adherents to a new scientific paradigm must use persuasion to convert other scientists, because paradigms argue circularly that they are the best and arguments "cannot be made logically or even probabilistically compelling for those who refuse to step into the circle" (1996, p. 94). Kuhn emphasises, against the tradition of positivism (and perhaps Karl Popper), that science is not cumulative. He poses the rhetorical question "Are there intrinsic reasons why the assimilation either of a new sort of phenomenon or a new scientific theory must demand the rejection of an older paradigm?" (Kuhn, 1996, p. 95) This must be the case, because, he contends, "the normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" (Kuhn, 1996, p. 103).

Further developing his ideas of incommensurability, Kuhn suggests that after revolution, "scientists are responding to a different world" (1996, p. 111). But Kuhn seems to encounter difficulty articulating the concept of incommensurability and using the metaphor of different
worlds or world views. He offers the Gestalt switch again as an "elementary prototype" of what a paradigm shift involves, a switch to a new and incommensurable world. "Therefore, at times of revolution, when the normal-scientific tradition changes, the scientist's perception of his environment must be re-educated in some familiar situations — he must learn to see a new gestalt. After he has done so the world of his research will seem here and there, incommensurable with the one he had inhabited before" (Kuhn, 1996, p. 112). A source of his difficulty is that "what occurs during a scientific revolution is not fully reducible to a reinterpretation of individual and stable data." (Kuhn, 1996, p. 121). This is because the data are not unequivocally stable and after revolution, the scientist doesn't just interpret the data, as it were, in isolation from a paradigm; there has been a paradigm shift and the data have been transformed, because they have been interpreted under a new paradigm (Kuhn, 1996, p. 122). We have no neutral observation-language to help us overcome this difficulty (Kuhn, 1996, p. 125).

Kuhn returns to the subject of incommensurability to summarise the different reasons why "the proponents of competing paradigms must fail to make complete contact with each other's viewpoints" (1996, p. 148). We can interpret Kuhn's descriptions as either descriptions of different forms of incommensurability within a general paradigm incommensurability or as different manifestations of a single form of incommensurability. The first reason why the proponents of competing paradigms fail to understand each other's viewpoint completely is that "their standards or their definitions of science are not the same" (Kuhn, 1996, p. 148). This means that they disagree about the list of problems to be solved, giving rise to what we might call methodological incommensurability. The scientists across different paradigms do not simply disagree about the correct solution to certain problems presented by the world; they disagree about what problems science should address, how any proposed solutions should be evaluated, and by what methods the answers should be investigated. Secondly, even though successive paradigms employ the vocabulary and apparatus of a previous paradigm, they deploy them differently so that "communication across the revolutionary divide is inevitably partial" (Kuhn, 1996, p. 149). This, we might call semantic incommensurability. And finally, Kuhn says, "in a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds" (1996, p. 150). This we might call experiential or perceptual or ontological incommensurability. And because of incommensurability, the paradigm change cannot be made step by step but only as a switch. "Like the gestalt switch, it {the transition} must occur all at once (though not necessarily in an instant) or not at all" (Kuhn, 1996, p. 150).
It appears that Kuhn has described a general, paradigm incommensurability that occurs in forms or manifestations as semantic, methods and standards, and ontological. By constituting a block on communication or translation between paradigms, the general paradigm incommensurability and these forms or manifestations of it can provide grounds for alternatives-induced arguments for relativism.

The descriptions of incommensurability represent a significant refinement in Kuhn's description of the relationship between paradigms. As I have suggested, we can describe a progression in Kuhn's account as he presents more detail about why, according to his account, science is cyclical rather than cumulative. At first Kuhn describes how normal science occurs within a paradigm, but he does not specifically say that communication or understanding is difficult or impossible across paradigms (1996, p. 19). Then he specifies that to accept a new paradigm requires the rejection of the old paradigm, that is, he specifies that alternative paradigms cannot both be adhered to, that paradigms are incompatible (1996, p. 92). When describing the effects of a scientific revolution, he says that not only are paradigms incompatible but in fact incommensurable (Kuhn, 1996, p. 103). And he indicates that this incommensurability can take the form or be manifested as semantic, methods and standards, or world change incommensurability (Kuhn, 1996, pp. 149, 150).

But throughout his account of science, Kuhn is describing science in terms of paradigms and different aspects of paradigms. Therefore, this refinement in his description of the relationship between paradigms can and should be applied retrospectively to his initial descriptions of paradigms, normal science, puzzle solving, rules, etc. The general incommensurability Kuhn has introduced, and the forms or manifestations of incommensurability he describes, do not conflict with his initial descriptions of paradigm operation during normal science.

But Kuhn's descriptions of incommensurability raise a number of issues. If the relationship between paradigms is characterised by incommensurability, a lack of common measure, how can the transition from a normal science paradigm in crisis to a replacement paradigm occur? Can we describe different degrees of incommensurability such that it varies through the Kuhnian cycle of scientific revolution? Is the relationship between paradigms characterised by different forms of incommensurability or by different manifestations of a single phenomenon, such as semantic incommensurability? And what impact would describing a scale of
incommensurability or manifestations rather than forms of incommensurability have on the arguments for relativism that might be grounded in Kuhn's account of science?

At this point in my analysis, it appears that Kuhn has described a general, paradigm incommensurability that occurs in forms or manifestations as semantic, methods and standards, and ontological incommensurability. But Kuhn has not explained in his descriptions of incommensurability how a general paradigm incommensurability, or forms or manifestations of incommensurability, can both insulate the prevailing paradigm from alternative theories, such as the previous normal science tradition, during normal science, but allow communication across that paradigm and alternative theories, that are potential alternative paradigms for the discipline, during extraordinary science. By constituting a block on communication between paradigms, the general paradigm incommensurability and the forms or manifestations Kuhn describes can provide grounds for alternatives-induced arguments for relativism. This is because the general paradigm incommensurability can be interpreted as semantic incommensurability sufficient to entail relativism about meaning between paradigms and conceptual scheme relativism between paradigms. The general paradigm incommensurability can also be seen as including methods and standards incommensurability and ontological incommensurability, which, respectively, could lead to epistemic and ontological relativism. In addition, these and other forms of relativism could also be grounded on semantic relativism.

In Chapter 4, I will consider the issues raised here — whether we should describe forms or manifestations of incommensurability, whether we should describe a scale of incommensurability, and what effect these distinctions might have on the articulation of arguments for relativism based on Kuhn's account.

2.4.2 Paradigm shifts

Kuhn reinforces his refinement to his description of the relationship between paradigms as characterised by incommensurability when considering why scientific revolutions are usually invisible to us and how scientific revolutions are resolved by a paradigm shift. His account of these features emphasises again that science, other than normal science, is not cumulative.
According to Kuhn, scientific revolutions are normally invisible to us because textbooks, popularizations and the philosophical works modelled on them record the outcomes of previous revolutions, but in terms of the current paradigm (1996, p. 136). Kuhn says that there are good reasons why textbooks should be systemically misleading (1996, p. 137). They present a truncated history, they are re-written after every revolution and once re-written "they inevitably disguise not only the role but the very existence of the revolutions that produced them" (Kuhn, 1996, p. 137). Partly by selection and partly by distortion, the scientists of the past are implicitly represented as having worked on the same set of fixed problems and in accordance with the same set of fixed canons. This is why we perceive science as being largely cumulative: successive revolutions have rewritten history backwards, from their own perspective, with the current paradigm presented as the culmination of a cumulative effort.

Kuhn moves on to describe how scientific revolutions are resolved by a paradigm shift. How are scientific revolutions resolved?, asks Kuhn, and "what is the process by which a new candidate for paradigm replaces its predecessor?" (1996, p. 144). The scientists involved have invariably been focussed on the crisis-provoking problems and these scientists are "so young or so new to the crisis-ridden field that practice has committed them less deeply than most of their contemporaries to the world view and rules determined by the old paradigm" (Kuhn, 1996, p.144). When puzzle solving, the scientist is not testing their paradigm. Testing only occurs "as part of the competition between two rival paradigms for the allegiance of the scientific community" (Kuhn, 1996, p. 145). I note here that Kuhn speaks in terms of allegiance, and later in the text, he will talk about scientists having faith in the new paradigm (Kuhn, 1996, p. 158). This is because, "the competition between paradigms is not the sort of battle that can be resolved by proofs" (Kuhn, 1996, p. 148). The adherents in the different traditions are incommensurable in their standards, conceptual web, and the world they practice their trade in. Kuhn says, "in a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds" (1996, p. 150).

Kuhn's explanation of how paradigm shifts occur is informed by his views on verification and falsification. Kuhn says that his theory shows parallels with verification, including probabilistic verification, which needs a neutral observation language, which is not possible, and in this tradition, the comparison always occurs within one paradigm-induced tradition (1996, p. 146). There are also parallels to Popper's position, falsification, but Kuhn states that "nevertheless, anomalous experiences may not be identified with falsifying ones. Indeed, I doubt that the latter exist" (1996, p. 146). Here Kuhn is refuting a naïve falsificationism,
whereby facts or the results of single experiments are thought to falsify individual scientific statements. But sophisticated falsificationism proposes that entire theories, rather than individual statements, should be tested and if found wanting, replaced by theories that account for the results that falsified the previous theory, thus by accumulation, having a greater explanatory power.

Kuhn believes that the two prevalent and opposing views about the underlying logic of scientific inquiry, verificationism and falsificationism, have tried to compress two largely separate processes into one (Kuhn, 1996, p. 147). Kuhn sees his thesis as bringing both these together. According to Kuhn, anomalies cause competition between paradigms, but falsification only occurs together with a process we might call verification, that is, the triumph of the new paradigm over the old. However, "this formulation makes the task of choosing between paradigms look both easier and more familiar than it is" (1996, p. 147). The competitors are "always at least slightly at cross purposes" (Kuhn, 1996, p. 148). They cannot convert the other, because they're bounded by their own tautology. As Kuhn puts it, "though each may hope to convert the other to his way of seeing his science and its problems, neither may hope to prove his case" (1996, p. 148). The paradigms are incommensurable in their standards, conceptual web, and the world they form for scientists to practice their trade in (Kuhn, 1996, p. 149). And because of incommensurability, the paradigm change cannot be made step by step but only as a switch (Kuhn, 1996, p. 150). But, "the transfer of allegiance from paradigm to paradigm is a conversion experience that cannot be forced" (Kuhn, 1996, p. 151).

The arguments are not made on "relative problem-solving ability, although for good reasons they are usually couched in those terms. Instead, the issue is which paradigm should in the future guide research on problems many of which neither competitor can yet claim to resolve completely" (Kuhn, 1996, p. 157). And the conversion might involve faith more than reason. "The man who embraces a new paradigm at an early stage must often do so in defiance of the evidence provided by problem-solving. He must, that is, have faith that the new paradigm will succeed with the many large problems that confront it, knowing only that the older paradigm has failed with a few" (Kuhn, 1996, p. 158). There is no one argument that converts the group, rather, "what occurs is an increasing shift in the distribution of professional allegiances" and "at most he, the historian, may wish to say that the man who continues to resist after his whole profession has been converted has ipso facto ceased to be a scientist" (Kuhn, 1996, p. 159).
2.4.3 Normal science, extraordinary science and scientific progress

The non-cumulative account of science that Kuhn offers in place of verificationism or falsificationism seems to lack the connection with reality that these other accounts offer. During normal science, the cumulative phase of the Kuhnian cycle, scientists are engaged in solving problems set by and sanctioned by the paradigm. And during extraordinary research, scientists are largely occupied with finding a replacement paradigm, by comparing paradigms with each other and with nature.

Although Kuhn has presented this account of how science proceeds, he "cannot quite provide a conclusion" by answering the question of why science seems to progress (1996, p. 160). Kuhn does however explain why we seem to experience progress through normal science and progress through extraordinary science. What he calls "the more usual answer to this question", which I take to be the answer offered by verification and falsification, is that science accumulates knowledge about the world as it really is. In contrast, Kuhn provides an answer by taking an overview of the effects of successive periods of normal science and extraordinary (revolutionary) science, both of which, in a tautologous way, guarantee progress.

Regarding progress in normal science, he says that "In short, it is only during periods of normal science that progress seems both obvious and assured. During those periods, however, the scientific community could view the fruits of its work in no other way" (Kuhn, 1996, p. 163). There are other reasons, besides the tautological setup of a paradigm, for example, the insulation of a community and the education system (Kuhn, 1996, p. 164).

Regarding progress in extraordinary (revolutionary) science, Kuhn looks at the characteristics of the scientific community and concludes that "The scientific community is a supremely efficient instrument for maximizing the number and precision of the problems solved through paradigm change" (1996, p. 169). This gives us continued growth, across paradigms, in problems solved.

24 “The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgement leading to that decision involves the comparison of both paradigms with nature and with each other” (Kuhn,1996, p. 77).
Kuhn closes by qualifying the idea that a sort of progress seems inevitable through the operation of normal and extraordinary science (1996, p. 170). He counsels us to give up the idea of science leading us towards truth. Kuhn's own thesis has shown evolution from primitive beginnings but not towards a goal. As Darwin did before him, Kuhn is asking his audience to abandon the idea of goal directed evolution (1996, p. 171). It is worth considering Kuhn's brief development of these ideas and their possible relativistic consequences.

Kuhn has left it until the last two pages of his book to reveal that evolution subtends his explanation of apparent scientific progress (1996, p. 171). At best, this seems a late introduction for an idea with such significant explanatory power, at least within science. But this also commits Kuhn to an idea that he has not developed, explained, or defended heretofore in his text.

Kuhn admits that his evolutionary argument "provides no more than the main outlines of an answer" (1996, p. 8) to the question of how progress could be possible if science consists of cyclical phases of normal science and revolution as he proposes. He begins, with some humility, stating that the "conceptual transposition" he is asking us to make is very similar to the one Darwin sought of his readers a century ago (1996, p. 171). Kuhn explains that to his contemporary audience, the most difficult idea to accept in Darwin's *On the Origin of Species* (1859) was not the idea of evolution per se, but the idea of an undirected evolution. Kuhn proposes an equivalent thesis: that science evolves through paradigm replacement, with problem solving as the unit of evolution within the paradigms, but with no goal for the overall evolutionary process.

Kuhn believes that he has not sufficiently addressed the problem of induction, saying that "somewhere in the maze is induction" (Kuhn, 1996, p. 172). But I suggest that Kuhn's application of evolutionary theory to paradigm succession has given us the answer or a clue to the answer. Perhaps through the history of science, we induct, try some solution to a problem, and if it works, we form it into a paradigm. However, if our paradigm didn't fit optimally with nature in our first induction, we get anomaly and crisis. We then form a new paradigm, carry out more induction, and keep trying through successive paradigm shifts. This results in natural selection on the induction choices we make, which are embodied in the paradigms. The process should lead to a better and better fit between the paradigm and the physical reality it describes. I must note however that if Kuhn's evolution of paradigms is equivalent to Darwin's
evolution of species and there is no goal direction, the process is not aimed at such a fit and is thus open to charges of relativism about truth or knowledge.

Why would Kuhn specify a non-goal oriented account instead of a goal-oriented account? Assuming that Kuhn would have been aware of the relativist or sceptical potential of a non-goal oriented account of scientific progress, why did he not specify that the evolution of science is goal oriented and that that goal is Truth, the truth of scientific facts, theories etc.

Perhaps Kuhn believes that he can rescue a telos for science without specifying that it is goal oriented? Maybe it is better, more robust, and more natural, that science approaches truth even though it is not aiming for it? That is to say, perhaps Kuhn believes, as a realist would, that it is inevitable that science will improve the fit between theory and nature.

Whatever Kuhn's reasons for adopting an evolutionary theory of scientific progress, it does seem to leave his account open to charges of relativism that he would not have intended.

2.5 Conclusion: Chapter 2

In this chapter, I have drawn attention to several aspects of Kuhn's account of science in The Structure of Scientific Revolutions (SSR) that will be central in my investigation of arguments for relativism that might be based on this work (1962, 1970, 1996).

Kuhn initially describes the different aspects of his account of science and then provides additional details, explanation, or justification for his ideas. In the course of this description and explanation, Kuhn incrementally refines his description of the relationship between scientific paradigms such that they are incommensurable and do not share a common measure. But Kuhn does not explain how this incommensurability can insulate the dominant paradigm from alternative theories, such as the previous normal science paradigm, during normal science but also allow interaction or communication between the dominant paradigm and alternative scientific theories, which are potential alternative paradigms for the discipline, during extraordinary science. Kuhn's account of science as cyclical is set against the cumulativism of both positivism and of falsificationism and incorporates conceptions of the theory-ladenness of observation and holism about testing theoretical systems. The incommensurability that characterises the relationship between paradigms in Kuhn's account of science can provide the basis for arguments for alternatives-induced relativism about
science. And Kuhn is aware of the issue of perspective, internal to or external to a scientific paradigm, which I will later argue is an important constraint on framing arguments for relativism.

In the next chapter, I will examine some traditional charges that Kuhn's account of science has relativistic consequences. These charges are based on the incommensurability that characterises the relationship between paradigms according to Kuhn's account.
3 Chapter 3: Charges of relativism against Kuhn

3.1 Introduction

In this chapter, I show that the traditional analysis of the relativism that can be based on Kuhn's account focusses on alternatives-induced arguments grounded in the property of incommensurability between scientific paradigms, and does not consider disagreements-induced relativism that might arise; nor does it consider the perspective from where alternatives-induced or disagreements-induced arguments for relativism can be framed. Including reference to the perspective from where arguments can be framed would make any analysis more specific, and including disagreements-induced as well as alternatives-induced relativism would make it more comprehensive.

Using the descriptions and definition of relativism from Chapter 1, I examine examples of the traditional charges that Kuhn's account of science has relativistic consequences. The charges of relativism appear to be based on Kuhn's description of science as revolutionary rather than cumulative, on the notion of the scientific paradigm, and on the incommensurability that characterises the relationship between paradigms in Kuhn's account of science.

I examine the six arguments for relativism that Curd and Cover attribute to Kuhn: the theory-ladenness of observation, meaning variance, problem weighing, shifting standards, the ambiguity of shared standards, and the collective inconsistency of rules. I show that these are arguments for semantic, conceptual or ontological relativism based on the operation of scientific paradigms and particularly the incommensurability that characterises the relationship between paradigms according to Kuhn's account of science. Therefore, although Curd and Cover find arguments for relativism in the revolutionary aspect of Kuhn's account of science, the different arguments they describe are all grounded on incommensurability between scientific paradigms, that is, on there being an absence of shared meaning between paradigms. In describing these arguments, the authors do not make reference to the perspective from where the arguments can be framed. That is to say, they do not differentiate between the perspective of a scientist adhering to a paradigm and working within it and that of a non-scientist, perhaps a philosopher, observing science from outside of any scientific paradigm. Neither do the authors consider that disagreements-induced arguments for
relativism could also be framed under conditions where a sharing of meanings could occur within a paradigm (for example, during normal science) or across paradigms (for example, during extraordinary science).

The arguments I review from Alexander Bird prosecuting a charges of relativism and those considered by Wes Sharrock and Rupert Read defending against such charges, indicate that incommensurability plays a key role in the issue. These arguments show where in Kuhn's account arguments for alternatives-induced relativism originate and indicate how we might respond to them. But this analysis does not describe the origin of potential disagreements-induced arguments for relativism. Nor does it consider the perspective from where either alternatives-induced or disagreements-induced arguments for relativism can be framed.

3.2 Scientific revolution and the scientific paradigm

Relativism about science is the idea that scientific practice and scientific knowledge is correct or true only with reference to a scientific paradigm, conceptual scheme, framework, epoch or culture etc.; that there are more than one such alternative scheme; and that although we may compare these schemes, we cannot judge between them by means of an objective standard. Kuhn's conception of normal science as paradigm-bound and his assertion that the history of science is one of revolutions between paradigms rather than cumulative progress seems to invite notions of relativism. As an example of this critique, I examine Curd and Cover's treatment of Kuhn's account of science for their anthology of the central issues in the philosophy of science (1998).

To set the scene, the authors list six general claims that Kuhn makes about scientific revolutions (Curd and Cover, 1998, p. 219). These are as follows:

- Scientific revolutions are paradigm shifts. They are not just the replacement of one theory by another but "a wholesale shift from one network of scientific commitment, belief, and values to another" (Curd and Cover, 1998, p. 219).
- Scientific revolutions are total. That is, scientific paradigms are mutually exclusive so that "commitment to one paradigm logically precludes commitment to its rival" (ibid).
- Scientific revolutions are relatively sudden and unstructured events. They can be preceded by periods of debate, but when the revolution occurs "it is rapid and unstructured" (ibid).
• Extraordinary (revolutionary) science is non-dogmatic, in contrast to normal science which is dogmatic (ibid).

• Scientific revolutions cannot be decided by rational debate. Because arguments in favour of one paradigm over another are bound to be circular, scientific revolution is "a sociological, not a rational phenomenon" (ibid).

• Scientific revolutions are not objectively progressive. "Time and again Kuhn proclaims that there is no genuine, objective progress through scientific revolutions; changes of paradigms cannot be said to bring us closer to truth" (ibid).

According to Curd and Cover, although all six of these claims have drawn criticism, the last two have been especially criticised. These "deny that science as a whole is either objectively rational or objectively progressive. And so with good reason,…, Kuhn's overall position is aptly described as a version of relativism" (Curd and Cover, 1998, p. 219).

Curd and Cover say that Kuhn has "at least six different arguments for his conclusions about the lack of rationality and objective progress in scientific revolutions" (1998 p. 219). In their section entitled 'Six Kuhnian Arguments for Relativism' they describe these arguments: the theory-ladenness of observation, meaning variance, problem weighing, shifting standards, the ambiguity of shared standards, and the collective inconsistency of rules.25 According to the authors, the first two arguments are based on controversial theses about observation and meaning, whereas the other four are concerned with epistemic values, "the criteria used to choose between competing theories and paradigms" (Curd and Cover, 1998, p. 224).

Curd and Cover construe the idea of the theory-ladenness of observation as meaning "what the scientists observe depends on the theories they accept" (1998, p. 220). They interpret this as meaning that scientists can never see anything contrary to their theories and that rival paradigm scientists cannot see the same thing. They consider some examples of how this might be expected to play out in terms of perception. But they conclude that neither of these

25 Although these arguments could be called Kuhnian, in that they are based on Kuhn's work, it is misleading to suggest (as this phrase does) that Kuhn was proposing arguments for relativism about science based on the concepts Curd and Cover list, such as the theory-ladenness of observation. Neither does Kuhn present philosophical arguments for these ideas, for example, in terms of logic or semantics or epistemology. Rather, Kuhn proposes an account of science based on his reading of the evidence of science history, and he uses ideas such as the theory-ladenness of observation (1996, p. 112) and the theory-dependence of meaning (1996, p. 102) to make sense of the evidence he encounters in the history of science. Kuhn proposes that science is cyclical, with revolutionary shifts between periods of paradigm-determined normal science making theory choice irrational. Although this account clearly has the potential to ground arguments for relativism about science, Kuhn does not make such arguments in SSR.
ideas is plausible (Curd and Cover, 1998, p. 220). And they mention that the idea of theory-ladenness can also be expressed as the idea that there is no neutral observation language (Curd and Cover, 1998, p. 221). But they conclude that while it is true that some of our perceptions are theory laden, "we have been given no reason to think that what we perceive must always agree with what we believe" (Curd and Cover, 1998, p. 222).

The authors have identified in Kuhn's account what I would classify as an argument for conceptual relativism, that is, an argument to the effect that the concepts, theories, and paradigms through which we engage with the world determine our experience of the world, and, importantly, that we have no objective means of comparing experiences under different paradigms to judge which is best or correct. Addressing whether this kind of relativism can follow from Kuhn's account of science is an important theme of this thesis, and I will consider it in the context of Donald Davidson's argument against conceptual scheme relativism in Chapter 7. Suffice to remark here, that an argument for conceptual relativism requires that we have no objective means of comparing experiences under different paradigms to judge which is best or correct, and in Kuhn's account of science, incommensurability is the constraint on communications between paradigms (Kuhn, 1996, pp. 103, 109, 111, 150).

From the theory-ladenness of observation the authors move on to consider the theory-dependence of meaning. As described by Curd and Cover, the theory-dependence of meaning is crucial to the Kuhnian argument for meaning variance (Curd and Cover, 1998, p. 222). The theory-dependence of meaning is the idea that "the theories scientists accept (and the paradigms associated with them) significantly affect what scientists mean by the theoretical terms they use" (ibid). And they say that Kuhn sometimes expresses this idea by saying that rival paradigms and the terms they employ are incommensurable (ibid). The authors admit that claims about meaning variance are "notoriously hard to evaluate" because there is no consensus about what meanings are in the first place (ibid). But they conclude that radical incommensurability fails because "there is more to the meaning of most terms than simply the sense defined implicitly by a particular theory," what they have called the antecedent meaning, the meaning of the term prior to its adoption by the theory, "and there is more to meaning than sense (the 'more' in this case being reference)" (Curd and Cover, 1998, p. 224).

The authors have also identified in Kuhn's account what I would classify as an argument for relativism about meaning, the view that the meanings of the words, phrases, and sentences of a language are determined by the linguistic communities that use a language such that
different communities might use the same word or phrase to communicate different meanings, and although these meanings can be compared, there is no means of judging between them as to which is correct. And the authors have correctly drawn attention to the dependence of an argument for relativism about meaning on semantic incommensurability between paradigms.

The first of the Kuhnian arguments for relativism based on epistemic values that Curd and Cover describe occurs because the problems that scientists address in their work are given different weightings under different paradigms. For Kuhn, they say, the unit of scientific achievement is not true observational consequences, but the successful puzzle solution (Curd and Cover, 1998, p. 224). But this creates difficulties because, according to Kuhn's account, some problems solved by the previous scientific paradigm cannot be solved by the newly adopted paradigm. This means that, according to their reading of Kuhn, "no algorithm or calculation can determine a rational choice between paradigms. A scientist's choice depends on the relative weight assigned to particular problems and this weighting will vary from one paradigm to another" (Curd and Cover, 1998, p. 225). Although the argument concerns epistemic values, we could classify it as an argument for conceptual or ontological relativism, an argument for relativism based on how scientists working under different paradigms experience different worlds or experience the same world differently. And an argument for conceptual relativism must exclude the possibility that the conceptual schemes or ontologies can be objectively compared. In Kuhn's account of science, incommensurability is the constraint on such communication and comparison across paradigms (Kuhn, 1996, pp. 103, 109, 111, 150).

Related to the argument from problem weighting is the argument that the authors identify from shifting standards to relativism. Curd and Cover say that Kuhn's account specifies that paradigms include standards for assessing theories and that these vary between paradigms (1998, p. 225). Therefore, it seems that there is "no higher court to adjudicate" disagreements between paradigms about standards and so "there is no single, rational way of resolving paradigm conflicts" (ibid). In this case, the relativism follows not from the different weighting given to problems in competing paradigms, but from the impossibility of judging between the standards that are used to assess such problems within paradigms. And as with the problem weighting argument, although the shifting standards argument concerns epistemic values and could be classified as an argument for epistemic relativism, we could also consider it to be an argument for conceptual or ontological relativism, an argument grounded on different experiences of the world under different paradigms and the impossibility of judging between
these experiences. As for the previous argument, in Kuhn's account of science, incommensurability is the constraint on comparison between paradigms (Kuhn, 1996, pp. 103, 109, 111, 150).

Although Curd and Cover mention Kuhn's conception of truth and the lack of objective progress in science that they say his account entails, they do not consider an argument for relativism about truth. They are likely correct not to attribute alethic relativism to Kuhn's account, because in his description of science, he does not argue that adherents to different paradigms have different notions of what constitutes truth. Rather, Kuhn very briefly rejects the idea of truth, which is commonly used to signify the match "between the entities with which the theory populates nature and what is 'really there'" (Kuhn, 1996, p. 206). It seems that for Kuhn, truth is an epistemic value, but not one that is important enough for him to consider among those that can be shared between paradigms - accuracy, consistency, scope, simplicity, and fruitfulness (Kuhn, 1977, p. 321, 322).

Following on from the argument from shifting standards, Curd and Cover identify an argument for relativism from the ambiguity of shared standards (1998, p. 225). This argument specifies that there can be some epistemic values shared by scientific paradigms, even though standards vary between paradigms. This is in keeping, the authors point out, with Kuhn's qualification of his ideas in his later writings, namely, his paper 'Objectivity, Value Judgement, and Theory Choice' in *The Essential Tension* (Kuhn, 1977). But the authors point out that Kuhn did not believe an appeal to shared standards could determine the outcome of a debate between paradigms. This is because the interpretation of the standards differ between paradigms, in what they believed constituted an explanation or the simplest account of a phenomenon. Again, although this argument concerns epistemic values, it clearly involves the difficulty or impossibility of interpreting between paradigms the meaning of the terms that different paradigms use to describe their standards. Thus, it could be considered an argument for relativism about meaning. And like the previous arguments, because it concerns the scientists’ experience of the world, in terms of the standards by which their paradigm judges scientific explanation, we can classify it as an argument for conceptual or ontological relativism. Any argument for relativism about meaning or conceptual or ontological relativism must specify that there is a lack of shared meaning, or a constraint on comparing conceptual schemes or ontologies. In Kuhn's account of science, incommensurability is the relevant constraint that any of these arguments must employ (Kuhn, 1996, pp. 103, 109, 111, 150).
In contrast to an argument based on the ambiguity of shared epistemic values, Curd and Cover also identify an argument based on the inconsistency of rules between paradigms. According to Kuhn's account, they say, different paradigms will include different methodological rules and standards for judging theories (Curd and Cover, 1998, p. 226). For example, a paradigm might value a theory that generated quantitatively accurate predictions, that has wide explanatory scope, or that postulates a minimum of unobservable entities. But even if some rules such as these are shared by different paradigms, the set of rules employed by different paradigms provides conflicting advice to the scientist when it comes to choosing between paradigms. Therefore, "Kuhn thinks there is no uniquely rational way of settling the matter," that is, of deciding between competing paradigms (ibid). This argument for relativism based on the inconsistency of rules between paradigms could be seen as an argument for epistemic relativism. It does concern inconsistency between epistemic values, the criteria for judging theories within and between paradigms, whether or not these criteria are shared between paradigms. But the argument can also be seen as an argument for conceptual or ontological relativism. This is because the epistemic criteria, the rules of each paradigm, are a manifestation of that paradigm, and as such, the inconsisteny between rules demonstrates how the paradigm, the conceptual scheme the scientists adhere to, determines their experience of the world in which they work. As with the other arguments for conceptual or ontological relativism, such an argument based on Kuhn's account would specify incommensurability as the constraint on comparing paradigms (Kuhn, 1996, pp. 103, 109, 111, 150).

As I have indicated above, all four of the arguments for relativism based on epistemic values that Curd and Cover describe can be considered as arguments for conceptual or ontological relativism. I have argued here that these arguments depend on incommensurability between paradigms, although I have not specified what form or manifestation of incommensurability is involved.

Therefore, although Curd and Cover find arguments for relativism in the revolutionary aspect of Kuhn's account of science, the different arguments they describe are all grounded on incommensurability between scientific paradigms, that is, on there being an absence of shared meaning between paradigms. As my brief review shows, in describing these arguments, they do not make reference to the perspective from where the arguments can be framed. That is to say, they do not differentiate between the perspective of a scientist adhering to a paradigm and working within it and that of a non-scientist, perhaps a philosopher, observing science.
from outside of any scientific paradigm. Neither do the authors consider that disagreements-induced arguments for relativism could also be framed within a paradigm, where meaning is shared among adherents (such as occurs during normal science), or under conditions where a sharing of meanings could occur across paradigms (for example, during extraordinary science).

3.3 *The scientific paradigm and incommensurability*

In his analysis of Kuhn's relativistic legacy, Alexander Bird assesses the potential sources of relativism in the concepts of the scientific paradigm, incommensurability between scientific paradigms, Kuhn's claims about the "world change" that occurs with scientific revolutions, and Kuhn's conception of truth (Bird, 2011, p. 475).

From this, it might appear that Bird believes that the very notion of a scientific paradigm can provide an argument for relativism about scientific knowledge. But Bird's use of "paradigm," as it is described by Kuhn, includes the property of incommensurability between paradigms. For example, Bird has described the manner in which the standards for evaluation of theories are set by the established scientific tradition "as an instance of a more general phenomenon identified by Kuhn, that of incommensurability …" (Bird 2011, p. 476). Thus, the "paradigm relativism" or "epistemic relativism" that he ascribes to the notion of the paradigm involves incommensurability. In fact, Bird describes methodological incommensurability as operative in this paradigm or epistemic relativism, saying, "the form of incommensurability we encountered in the previous section (about paradigm or epistemic relativism) is methodological incommensurability" (Bird, 2011, p. 480).

Later in his analysis, Bird considers various forms of incommensurability as the bases for arguments for relativism. But we should not interpret him as intending that incommensurability itself, or any form of incommensurability, provides a basis for relativism or indeed can occur independently of a paradigm. It is implicit in Bird's analysis that the notion of a paradigm includes the property of incommensurability and can thus provide a basis for arguments for relativism, and incommensurability and forms or manifestations of incommensurability only occur in the context of scientific paradigms, as a property that characterises the relationship between paradigms, and in this context, provide a basis for arguments for relativism.
Despite his concentration on the notion of the scientific paradigm, Bird does not consider the paradigm as a potential source of conceptual scheme relativism until he examines semantic incommensurability. Here, Bird states that the semantic incommensurability Kuhn ascribes to scientific paradigms is a form of conceptual relativism (Bird 2011, p. 480). But a scientific paradigm can be thought of as a type of conceptual scheme. The existence of such conceptual schemes, determining the concepts, ideas, and meanings we derive from and apply to the world, might allow the framing of arguments for conceptual scheme relativism, and its corollary, relativism about meaning or semantic relativism.

In their analysis, Wes Sharrock and Rupert Read deny that Kuhn's conception of a scientific paradigm leads to semantic (conceptual scheme) relativism (2002, p. 155). Sharrock and Read provide an integrated treatment of Kuhn's historical and his philosophical work, underpinned by but not overburdened by their Wittgensteinian belief in philosophy as therapy (2002, p. 205). They explicitly address the questions of whether Kuhn's philosophical ideas lead to a self-refuting semantic relativism as proposed by Davidson (Sharrock and Read, 2002, p. 155), relativism about truth (2002 p. 155), linguistic idealism (2002, p. 157), and ontological relativism (relativism because of "world change") (2002, p. 173). Not surprisingly, they say not.

As I will deal with Davidson's argument in some detail in Chapter 7, I simply review some Sharrock and Read's findings here. Sharrock and Read consider the charge of semantic

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26 Framing arguments for relativism based on incommensurability is only one means of attacking Kuhn's account of science. Another means, as pointed out by Sharrock and Read, is to challenge the possibility of incommensurability itself. In Chapter 7, I consider two challenges to Kuhn's notion of incommensurability as presented by Donald Davidson and by Hilary Putnam. Donald Davidson's argument against conceptual scheme relativism is articulated in terms of the impossibility of non-intertranslatability between languages (1974). But Davidson makes it clear that his argument is directed against the idea that there can be incommensurability between paradigms stating, "Incommensurability' is, of course, Kuhn and Feyerabend's word for 'not intertranslatable'" (Davidson, 1974, p. 12). In his famous argument, Davidson equates incommensurability with untranslatability and denies that there can exist languages that are not inter-translatable, and thus denies that there are alternative conceptual schemes (1974). If Kuhn's general, paradigm incommensurability, that is, the combination of various manifestations of incommensurability he describes, is in essence semantic incommensurability, then because Davidson argues at the level of language, his argument presents a significant threat to the idea of incommensurability and to Kuhn's account of science, which is dependent on the function of alternative conceptual schemes, that is, paradigms. I argue that whether or not Davidson's arguments against untranslatability and the very idea of a conceptual scheme are correct, they do not preclude scientific paradigms and incommensurability between paradigms. Hilary Putnam also presents a challenge to the notion of incommensurability and to Kuhn's account of science in the form of the Putnam-Kripke causal theory of reference. And like Davidson's argument, Putnam's position seems to require that we have access to the real world. I show how Kuhn can defend his conception of incommensurability against Putnam's essentialist arguments. His response to the challenges presented by Davidson and by Putnam show how Kuhn came to conceive of incommensurability in terms of meaning, and in particular, in terms of reference. They therefore
relativism, which they render as the idea that "systems of meaning are reciprocally closed" (2002, p. 140). Sharrock and Read argue that Davidson's denial in 'On the Very Idea of a Conceptual Scheme' (1974) that natural languages constitute separate conceptual schemes does not contradict Kuhn's thesis that scientific paradigms are conceptual schemes. And against Davidson's argument that there cannot be an un-translatable language, they argue that Kuhn's position is that there can be a failure of word-for-word translation between incommensurable scientific paradigms, but that interpretation between paradigms can lead to understanding. And they say that Kuhn denies Davidson's assumption that translation precedes understanding, arguing that word-for-word translation and also interpretation allow us to understand languages and schemes that are very different to our own. (Sharrock and Read, 2002, p. 148).

This illustrates the importance of incommensurability, the subject of the next section, in any discussion of alternatives-induced relativism based on Kuhn's account of science.

3.4 Incommensurability and alternatives-induced relativism

According to Bird, the next potential source of relativism in Kuhn's description of science is incommensurability. On Bird's account, the different forms (what I would term manifestations) of incommensurability that Kuhn describes can give rise to different forms of relativism. For example, the operation of scientific paradigms, which are methodologically incommensurable, gives rise to epistemic relativism because "the assessment of a piece of scientific research is relative to a paradigm" (Bird, 2011, p. 477).

I note that epistemic relativism can be taken to mean relativism about knowledge claims and / or relativism about the principles used to develop knowledge claims. In the above, Bird seems to use the more inclusive sense, so that "epistemic relativism" refers to knowledge claims and the methods and standards used to originate those claims.

But how could alternative paradigms produce knowledge claims that are incommensurable? And how could competing paradigms produce different methods and standards of evaluation? Kuhn's account of science, as referenced by Bird, describes processes through which

provide some background to Kuhn's later refinement of his conception of incommensurability to be a semantic notion, grounded in the reference function of language.
paradigms in the history of science have produced very different, in fact, incommensurable, methods, standards, and knowledge claims. And in his description of a student's education into a scientific discipline, Kuhn suggests the mechanism that allows these processes to function. That mechanism is semantic, the generation and maintenance of meaning within the paradigm, through similarity relations. As Kuhn puts it,

…the process of learning a theory depends upon the study of applications, including practice problem-solving both with a pencil and paper and with instruments in the laboratory. If, for example, the student of Newtonian dynamics ever discovers the meaning of terms like 'force,' 'mass,' 'space,' and 'time,' he does so less from the incomplete though sometimes helpful definitions in his text than by observing and participating in the application of these concepts to problem-solution (Kuhn, 1996, p. 47).

It is the generation of meanings particular to a paradigm that allows alternative methods, standards, and knowledge claims to develop in different paradigms. Thus, the epistemic relativism that Bird describes as originating in methods and standards incommensurability is underpinned by the semantic function within paradigms, that is, by semantic incommensurability between paradigms. This suggests that what Bird considers to be different forms of incommensurability can more usefully be considered as different manifestations of semantic incommensurability.

This also suggests, in keeping with my description in Chapter 1, that different forms of relativism can be derived from each other. For example, semantic incommensurability might give rise to semantic relativism, which might in turn give rise to relativism about methods, standards, and knowledge. But in addition, semantic incommensurability might be manifested as methods and standards incommensurability, which could also give rise to epistemic relativism.

Moving on from methods and standards incommensurability, Bird considers semantic incommensurability. Bird states that the semantic incommensurability that Kuhn ascribes to scientific paradigms is a form of conceptual relativism (Bird, 2011, p. 480). This seems to be a strange assertion, given that incommensurability is a property of scientific paradigms, as described by Kuhn, whereas conceptual relativism is a disposition towards our experience of the world. Bird may mean that because the semantic incommensurability Kuhn specifies ensures that the meanings of "both theoretical and observational terms change with a scientific revolution," this incommensurability has the same effect on a paradigm adherent as would relativism about theoretical and observational claims or concepts (Bird, 2011, p. 480).
In any case, for Bird, the semantic incommensurability that Kuhn specifies can pertain between scientific paradigms in itself provides grounds for an argument for conceptual relativism.

To clarify the issue, I refer back to Bird's analysis of epistemic relativism. For Bird, as per Kuhn's description, incommensurability is a property of a scientific paradigm, a feature of the relationship between paradigms. Thus, to say that semantic incommensurability exists is equivalent to saying that two or more paradigms exist and a relationship of semantic incommensurability pertains between them. Then, for Bird, the existence of paradigms that are semantically incommensurable provides grounds for an argument for conceptual relativism, since both the theoretical and observational terms used in the paradigms differ, so the meanings of the data and the concepts used to organise the data differ. I would dispute this last step in identifying semantic incommensurability with conceptual scheme relativism. This conclusion depends on the semantic incommensurability between paradigms being absolute, such that there is no translation or interpretation or understanding between paradigms, and this is not certain.

With semantic incommensurability and methodological (methods and standards) incommensurability, "world-change" or what we might call "ontological incommensurability" is the third characteristic relation between scientific paradigms that Kuhn describes. Bird briefly describes how a strong ontological relativism, to the effect that "the world itself is created by our scientific beliefs" and "a strong, ontological version of social construction" have been founded on Kuhn's descriptions of world-change after scientific revolution (Bird, 2011, p. 483).

Although Kuhn argued against the constructivist version of relativism, Bird refers to Hoyningen-Huene's post-Kantian reading of Kuhn's ideas, in terms of the phenomenal and noumenal world, and finds there "an important, idealist species of ontological relativism" (Bird, 2011, p. 484). And Bird says this ontological relativism is also found in Kuhn's final version of the incommensurability thesis, wherein incommensurability arises when classificatory schemes, or taxonomies, change. Although Ian Hacking has a nominalist reading of this incommensurability, whereby "world-change is not a change of the things in the world, but of their natural kinds," Sankey argues that the change also applies to particulars and so "a thorough-going ontological relativism ensues...," (Bird, 2011, p. 485).
But perhaps these arguments for more nuanced forms of ontological relativism are no great load for Kuhn's thesis to bear, given that he bases his description of science on the idea that science is paradigm-bound. The key component in avoiding the possible effects of such relativism that would be detrimental to scientific knowledge must be the contribution of the world. According to the later Kuhn, although the paradigm constrains our co-constitution of the world, it does not determine our co-constitution entirely. So that it is not only the paradigm that determines our phenomenal, experienced world, because the world extant is a constraint on our co-constitution. As Kuhn puts it in SSR, "Whatever he may then see, the scientist after a revolution is still looking at the same world" (1996, p. 129).

I should also remark that the arguments for ontological relativism depend on the description of incommensurability. If it is not absolute or total, the argument from world change incommensurability to ontological relativism does not go through. And it is worth noting that all of Bird's arguments from incommensurability are thus — they depend on the relationship between paradigms being characterised by strong or total or absolute incommensurability. Later in this thesis (Chapter 4), I will dispute this interpretation, based on a different reading of Kuhn's account.

Before moving on from Bird's discussion of the notion of paradigm and of incommensurability, it is worth remarking that all of the arguments for relativism he considers depend on the occurrence of alternatives that cannot be judged between, rather than on opposing disagreement positions.

In addition, the arguments Bird considers can only be framed from a third party perspective — they can only be framed from a perspective external to the paradigm. This is because the arguments from incommensurability to relativism depend on the relationship between paradigms being characterised by strong or total or absolute incommensurability. Under these conditions, adherents to a paradigm could not engage with an alternative paradigm. They could not therefore come to believe that different paradigms are equally likely to be correct, or that their own paradigm does not provide a means to judge which of the alternatives is correct, as would be required by a definition of relativism.

It is also worth remarking that Bird's analysis may be limited by fixing the relationship between forms of incommensurability and forms of relativism and by not articulating how different forms of relativism are interderivable. That is to say, although Bird's categorisation
is convenient, linking semantic incommensurability with semantic relativism, methodological incommensurability with epistemic (methodological) relativism, and ontological incommensurability with ontological relativism, the relationships between incommensurability and relativism may be more numerous, more ramified, than this. And the origin of some forms of relativism may be in other forms of relativism, rather than forms of incommensurability. For example, Bird himself does move from semantic incommensurability to conceptual relativism and from here to ontological relativism (2011 p. 480).

3.4.1 Linguistic idealism

Sharrock and Read consider briefly, but in some detail, the charge that Kuhn is "subject to a sort of mad credulousness. That he is committed to saying that things exist in the world if we think they do" (2002 p. 157). This "linguistic idealism" form of relativism is an extrapolation from Kuhn's (and they say, Peter Winch's) work where they "seem to be taking the view that reality is determined by our ideas expressed in language" (2002, p. 158). But it is a view "that they (Kuhn and Winch) would and should disavow" (Sharrock and Read, 2002, p. 157).

Sharrock and Read show how the form of linguistic idealism described by Bernard Williams is based on the mistaken belief that because a culture (a language) determines the conditions that render a proposition meaningful, then the culture (or language) determines the conditions that make it true or false. But this is not the case, because it is the reality of the world, which we can only access through culture and language, that determines the truth or falsity of a proposition.

Sharrock and Read dismiss Williams' linguistic idealism, based on incommensurability, as a "straw position" (2002, p. 160). And they follow-up by arguing that in fact Kuhn (and Peter Winch) are anti-relativist. As opposed to arguing that the beliefs of adherents to different paradigms are true, Sharrock and Read say that Kuhn argues that we can "never possibly make their way of thinking our own" (2002, p. 161). That is to say, the relativist argues that there are many incommensurable conceptual schemes, each correct on its own terms, and that we cannot judge between them. But Kuhn's position is that incommensurability means that we cannot accept the "very-other's point of view" as legitimate for us, although we can appreciate that it was completely convincing for them (Sharrock and Read, 2002, p. 161). This means
that adherents to a scientific paradigm cannot, by definition, frame an argument for
alternatives-induced relativism. Sharrock and Read are correct in pointing out that adherents
to a scientific paradigm, according to Kuhn's description, cannot accept that an alternative
account of the world is correct on its own terms, even if they could translate or interpret
sufficiently between paradigms to understand the alternative. And so, according to Sharrock
and Read's reading of Kuhn, incommensurability between paradigms guarantees that
adherents cannot frame arguments for relativism. So Kuhn is an anti-relativist in this sense.
But Sharrock and Read do not pursue this line of argument to make the point that I wish to
draw attention to: the relevance of the perspective from where an argument for relativism is or
can be framed. The constraints on a paradigm adherent do not apply to a person, an observer
such as a historian or philosopher, who can frame arguments for relativism from outside of a
scientific paradigm. To such a non-adherent, precise translation between scientific paradigms
is not possible any more than it is possible for the scientist, but the non-adherent does not
require precise translation in order to perceive that alternative paradigms are equivalent. The
non-adherent is vague about the meaning of any scientific term, because they do not adhere to
a paradigm that provides, by virtue of a network of associations, the meaning of terms. And so
they can conclude that different paradigms, which they vaguely comprehend, are equivalent
accounts of the world. Looking at these, for them equivalent, accounts of the world, and being
unable to judge between them, the non-adherent can frame an argument for alternatives-
induced relativism from their third party perspective.

Although our use of language does not call into existence the physical matter of the world, as
linguistic idealism implies it does, language is our means of categorising the entities that we
encounter in the world; it is our means of articulating an ontology. Therefore, Sharrock and
Read investigate whether Kuhn's ideas about incommensurability between conceptual
schemes, and their associated languages, can lead to charges of ontological relativism.

Sharrock and Read do not explicitly describe the relativism that Kuhn's description of "world
change" can be used to support. However, the argument can be rendered as follows: Scientists
before and after a scientific revolution to a new paradigm carry on their trade in
incommensurable, different worlds. Since there is no common measure between these worlds,
although they might be compared, they cannot be adjudicated by an objective standard.
Therefore, the world determined by each paradigm is correct for adherents of the respective
paradigm and the choice between scientific paradigms is not rationally made.
Such an argument, if unchallenged, would allow the relativist to conclude both that different accounts of the world are equally likely to be correct, and that the choice between scientific accounts is not rational. Regarding this argument, I suggest, that the putative "world-changes" or "different worlds" incommensurability the argument requires is a manifestation of semantic incommensurability rather than a distinct form of incommensurability. Our ontology is constructed and articulated in thought and language. So the way we parse, categorise, or describe the world is determined by the meanings that we ascribe to the terms we apply to the entities, patterns, categories that we describe or find in the world. This being the case, as I argue in the next chapter (Chapter 4), the world change incommensurability that has been claimed to occur after scientific revolution is a manifestation of semantic incommensurability.

Sharrock and Read do not articulate or challenge an argument based on world change incommensurability. Instead, they attempt to clarify what Kuhn stated regarding incommensurability and "different worlds", initially and in response to criticism, and what philosophical commitments he did and did not need to make in order to champion his account of science. Their therapeutic reading begins by pointing out the difference between the idiomatic use of the word "world" to mean something like "the world as I experience it" and its use in philosophy where it "operates as (pretty much) a synonym for 'reality'" (Sharrock and Read, 2002, p. 173). Sharrock and Read argue that Kuhn is not asserting that reality itself is changed by a scientific revolution, although he may have believed that he was "seriously putting forward a philosophical consequential position" (2002, p. 173). Rather, they say, Kuhn's "inclination to think that philosophical issues were at stake is encouraged by (at least) Kuhn's commitment to his initial historical objective of doing justice to past scientists and by his strong inclinations … to resort to a Kantian notion of 'phenomenal world'" (Sharrock and Read, 2002, p. 173).

But Kuhn "remained painfully dissatisfied with his own grasp on the idea of 'world changes' and made repeated attempts to reconstruct it" (Sharrock and Read, 2002, p. 173). Sharrock and Read chart some of these attempts, from Kuhn's initial descriptions of incommensurability in *The Structure of Scientific Revolutions* (1962), his regret at the articulations in terms of vision and his use of the Gestalt analogy, to his "taxonomic turn," and an attempt around 1990 at a Darwinian account of phenomenal worlds as evolutionary niches (Sharrock and Read, 2002, pp. 177, 181, 189).
This analysis allows Sharrock and Read to summarise the lesson that Kuhn teaches us, although sometimes disregards himself: …"that the language of scientists-under-a-paradigm is, of its nature, categorical, and … that paradigm shifts involve the retrospective eradication of a prior mode of discourse" (Sharrock and Read, 2002, p. 196). As a result, "what was categorically said under a prior paradigm can no longer seriously be asserted at all" (Sharrock and Read, 2002, p. 196).

However, their therapeutic dissolution of the problems Kuhn encountered with "world changes" is unlikely to convince the relativist. Whether in terms of worlds, or taxonomies, or languages, or conceptual schemes, arguments for relativism based on incommensurability, and the local holism it manifests, can be developed. The best hope for addressing these arguments should be in refining the description and operation of incommensurability itself.

Although Sharrock and Read are defending Kuhn's account against charges of relativism, they do share a certain perspective with Bird. They address alternatives-induced arguments for relativism, effectively by arguing that interpretation and understanding is possible across paradigms, denying a strong or total or absolute incommensurability. But they do not distinguish the perspective from where any arguments for relativism could be framed. Nor do they consider potential arguments for disagreements-induced relativism based on Kuhn's account. This latter must surely be a possibility if, as they contend, adherents to different paradigms can understand each other to some extent, possibly enough to disagree intractably about the tenets of their respective paradigms.

An argument for relativism can also be made based on Kuhn's ideas on truth and progress within scientific paradigms. This argument, which I consider in the next section, also relies on local holism about meaning being rigid or non-adaptive.

### 3.5 Progress, truth and alternatives-induced relativism

Whereas Kuhn's descriptions of semantic, methodological, and world-change (perceptual or ontological) incommensurability relate largely to the relations between scientific paradigms as described in his thesis of scientific revolution, the question of the status of truth occurs more in relation to his evolutionary argument for progress in science.
Alexander Bird considers Kuhn's views on truth after examining the implications of semantic and methodological incommensurability and before looking at its possible ontological repercussions. This may be because Bird examines Kuhn's views from a realist position, and thus places greater importance on the notion of truth than did Kuhn. And in this vein, he suggests how a naturalised epistemology could reconcile the paradigm-relativity of truth for a given scientific tradition with the objectivity of truth for science taken as a whole, as it were, in the long run (Bird, 2011, p. 485).

In his early work, "Kuhn's own approach to truth is principally that it is irrelevant," according to Bird (2011, p. 485). How can this be the case, given that science is the search for knowledge? An antirealist reading helps to make sense of this assertion. Within a scientific paradigm, scientists engage with a phenomenal world that is co-constituted by the interaction of the noumenal world and the paradigm. Thus, it is impossible to access the truth of the noumenal world, independent of the paradigm. Nor does the longer term revolutionary cycle of paradigm replacement that Kuhn describes provide access to truth, in the sense of access to the noumenal world. The truth of the noumenal world transcends our ability, within a paradigm or across paradigms, to access it. Although Bird does not make the point, it seems that an antirealist reading of Kuhn also provides grounds for relativism about truth.

So perhaps it is the realist insistence that we can access a mind-independent world, and determine truth as correspondence between our knowledge of the world and the world itself, that allows the framing of arguments for relativism. Why, we might ask, does realism bring relativism in its train? Is it because realism sets the standard for knowledge so high, and when we fail to achieve it we must submit to antirealism? Ironically, relativism retains the requirement that knowledge must be related to the real world. Although antirealism contends that we fail to access the world in itself, and so there is no objective means to judge between theories, relativism argues that such a standard is a condition of knowledge, and although we cannot access it, we feel the requirement to judge.

Having earlier denied that Kuhn is a semantic relativist, Sharrock and Read consider "a worse suspicion," that he is a relativist about truth (2002, p. 155). The relativism, they explain, seems "to follow from incommensurability." This is because "in so far as there is incommensurability between different scientific paradigms, then so far one is unable to translate (in the strict sense) what can be said in the words of one into what can be said in the words of the other" (Sharrock and Read, 2002, p. 155). Therefore, adherents to one scheme
can assert "p" and adherents to another can assert "p" [or "not-p"]. Incommensurability means that the two schemes cannot be compared with each other in terms of the truth claims they make and so there is no way to judge between them. However, Kuhn specifies that scientific change requires that paradigms are compared with each other, although not by means of a common measure. Someone determined to hold a relativist line might then argue that Kuhn's account leads to relativism about truth because comparing paradigms with each other leaves no room for comparing each paradigm with nature, with reality (2002, p. 156). But Sharrock and Read say, Kuhn rejects the possibility of precisely this kind of comparison "in real, historically existent science, comparison with nature is made by way of paradigms" (2002, p. 156). For Kuhn, it seems that the notion of "truth" is only applicable and operable within paradigms. On this matter, Sharrock and Read quote from Kuhn in his 'Reflections on my critics' where he rejects the idea some philosophers propose that although neither of a pair of competing theories are true, one of them can be a better approximation to the truth (2002 p. 156). So, they say, "Kuhn does accept that there is a minimal sense in which he is willing hereabouts to be regarded as a 'Relativist'" (2002, p. 156).

So Kuhn is not a relativist about truth according to the definition of relativism I am using. He does not claim that there are many schemes of truth and we cannot judge between the different conceptual schemes to determine which one puts us in touch with, or brings us closest to, the truth of reality. Kuhn proposes that normal science adheres to one paradigm and cannot allow that other schemes would have an equally valid version of what is true. Kuhn's denial that any paradigm can link us to the real, to noumenal reality, but only to our version of phenomenal reality, denies us an "objective" criterion for judging between paradigms. But each paradigm provides its own criterion for judging between it and any potential competitors, since for adherents, it is by definition the only true version of reality. Those outside of a paradigm, lacking the paradigm's self-affirmation, can view different schemes as equally likely to be true, although we lack a criterion to judge between then, and so can frame arguments for relativism about truth.

In summary, according to Bird, arguments for relativism based on Kuhn's account of science can be based on the notion of the scientific paradigm, or grounded on paradigm incommensurability (semantic, methods and standards, and world-change incommensurability), or based on the transcendence and irrelevance of truth within and across paradigms, and also on the formation and maintenance of a paradigm by social consensus. Concluding his review, Bird considers how a variant of the argument for underdetermination
of theory by data has been used within the history of science discipline to argue for a "methodological relativism" whereby scientific knowledge and truth are social constructs and should be examined relative to their paradigm (2011, p. 485). He also describes an argument by Barry Barns for a "sociologically inspired relativism" about truth, based on the premise that the past usage of a concept does not suffice to determine future usage (Bird, 2011, p. 485). These ideas hint at a common form and source for the various arguments for relativism based on Kuhn's work. The form is an argument from incommensurability and the source is holism about meaning. I pursue these ideas further in Chapter 7.

Bird's analysis shows that it can be useful to describe sources of relativism in terms of the paradigm, incommensurability, and within-paradigm truth, and to attribute forms of relativism to forms of incommensurability. But I suggest that it is also useful to consider that incommensurability is a property of paradigms, a characteristic of their relationship; that semantic incommensurability can be manifested as semantic, methods and standards, or world-changes incommensurability; and that relativism about meaning, conceptual scheme, epistemic, or ontological/linguistic relativism can be based on semantic incommensurability directly, or on its manifestations, and indeed, that forms of relativism can be derived from other forms, for example, semantic relativism can be seen as an effect of conceptual scheme relativism and vice versa.

So although it might be useful to describe paradigm relativism as a general form of relativism, and describe different forms of incommensurability (such as semantic, methods and standards, and world change) that can each give rise to different forms of relativism (semantic, epistemic, world change), and to consider relativism about within-paradigm truth, this may not help us to determine the source or underpinning of arguments for relativism about science based on Kuhn's account.

### 3.6 Conclusion: Chapter 3

In this chapter, I have used the descriptions and definition of relativism from Chapter 1 to examine examples of the traditional charges that Kuhn's account of science has relativistic consequences. The charges of relativism appear to be based on Kuhn's description of science as revolutionary rather than cumulative, on the notion of the scientific paradigm, and on the
incommensurability that characterises the relationship between paradigms in Kuhn's account of science.

I show that the traditional analysis of the relativism that can be based on Kuhn's account focusses on alternatives-induced arguments grounded in the property of incommensurability, the lack of shared meaning, methods and standards, or ontology, between scientific paradigms. For example, I show that the six arguments for relativism that Curd and Cover attribute to Kuhn — the theory-ladenness of observation, meaning variance, problem weighing, shifting standards, the ambiguity of shared standards, and the collective inconsistency of rules — are arguments for semantic, conceptual or ontological relativism based on the operation of scientific paradigms and particularly the incommensurability that characterises the relationship between paradigms according to Kuhn's account of science. Therefore, although Curd and Cover find arguments for relativism in the revolutionary aspect of Kuhn's account of science, the different arguments they describe are all grounded on incommensurability between scientific paradigms, that is, on there being an absence of shared meaning between paradigms. In describing these arguments, the authors do not make reference to the perspective from where the arguments can be framed. That is to say, they do not differentiate between the perspective of a scientist adhering to a paradigm and working within it and that of a non-scientist, perhaps a philosopher, observing science from outside of any scientific paradigm. Neither do the authors consider that disagreements-induced arguments for relativism could also be framed under conditions where a sharing of meanings could occur across paradigms, for example, during extraordinary science.

The arguments that I have reviewed from Alexander Bird prosecuting a charges of relativism and those considered by Sharrock and Read defending against such charges, indicate that incommensurability plays a key role in any argument for (alternatives-induced) relativism based on Kuhn's account of science. These arguments show where in Kuhn's account arguments for alternatives-induced relativism originate and indicate how we might respond to them. But this analysis does not describe the origin of potential disagreements-induced arguments for relativism. Nor does it consider the perspective from where either alternatives-induced or disagreements-induced arguments for relativism can be framed. My analysis thus far indicates that, rather than addressing putative forms of incommensurability and the relativism they might engender, we can improve the examination of possible sources of alternatives-induced relativism in Kuhn's work by focusing on the operation of semantic incommensurability between paradigms. In addition, we should consider disagreements-
induced arguments for relativism and the perspective internal to a paradigm or external to a paradigm from where either alternatives-induced or disagreement based arguments can be framed. Including reference to the perspective from where arguments can be framed, internal or external to a scientific paradigm, would make any analysis more specific, and considering arguments for disagreements-induced as well as alternatives-induced relativism would make it more comprehensive.

In the next chapter (Chapter 4), I introduce and explain some ideas and distinctions relating to incommensurability that will be useful in my analysis; namely, I propose that we should distinguish between manifestations rather than forms of incommensurability, and I suggest the idea of employing a scale of incommensurability in any analysis of Kuhn's account of science.
4 Chapter 4: Incommensurability: manifestations and scales

4.1 Introduction

In this chapter, I introduce and explain some ideas and distinctions relating to incommensurability that will be useful in my analysis, principally, the distinction between forms and manifestations of incommensurability, and the idea of employing a scale of incommensurability in any analysis of Kuhn's account of science.

On review, it appears from some of the literature that there are different forms of incommensurability and that these can give rise to different forms of relativism. In addition, some of the literature on incommensurability suggests that we might describe scales of incommensurability, from global to local or from partial to total or from strong to weak. To investigate these issues, I consider Kuhn's introduction of "incommensurability," and how the figurative language he uses to expand on his initial description could lead to the idea that there are different forms of incommensurability, rather than various manifestations of semantic incommensurability. I propose that rather than describing different forms of incommensurability, such as epistemological, conceptual or ontological, we should consider these to be different manifestations of semantic incommensurability (which is thus the source for the different types of alternatives-induced arguments for relativism). Describing different manifestations of semantic incommensurability rather than different forms of incommensurability will ensure that my investigation is not adversely affected by Kuhn's later refinement of the concept of incommensurability to mean semantic incommensurability.

I also suggest that it is useful to employ a scale of incommensurability in any analysis of Kuhn's account of science. Kuhn draws a marked distinction in the conduct of science during periods of established normal science and periods of crisis. I argue that, in this regard, we can draw a useful distinction between weak and strong incommensurability. By weak incommensurability I mean that within a paradigm, adherents can be aware of another paradigm but not share it. This means that adherents share sufficient meanings to communicate with the alternative paradigm, but do not understand its meanings, methods and standards, or world view as adherents native to that paradigm do. In contrast, by strong
incommensurability, I mean that from within a given paradigm, adherents cannot even acknowledge or be aware of a different paradigm. This means that adherents to one paradigm do not share sufficient meanings to communicate with an alternative paradigm, they do not understand its meanings, nor its methods or standards, nor its world view.

4.2 Background

The concept of incommensurability is of most interest to the philosophical disciplines of ethics and the philosophy of science. The concept originates in the mathematical discovery by the Pythagoreans that the diagonal of a unit square could not be measured using the same scale as the sides of the square. The idea of incommensurability between moral values can also be traced back to antiquity. For example, in the *Nicomachean Ethics*, Aristotle "suggests that some values were 'so different' that they might not be measurable by a single unit of value, such as that given by money" (Chang, 2014, pp. 2-3).

Notwithstanding the antiquity of the original mathematical usage and the analogical use in moral philosophy, there is broad agreement that the notion of incommensurability as discussed in the philosophy of science was introduced to contemporary philosophical discussion simultaneously by Thomas Kuhn and by Paul Feyerabend in 1962. That was the year, as Howard Sankey writes "in which both Paul Feyerabend's 'Explanation, Reduction and Empiricism' (1981, pp. 44 - 96) and Thomas Kuhn's *The Structure of Scientific Revolutions* (1996) were first published (Sankey, 1999, p. 3).

The notion of incommensurability, as borrowed from mathematics (where it indicates that there is no common measure by which two quantities can be related) is applied analogically within the philosophy of science. But even within the discipline of the philosophy of science, there are a number of reasons to be circumspect in describing precisely what is meant by "incommensurability," how we might classify different forms or strengths of incommensurability, and whether or not the phenomenon of incommensurability is possible.27 This is mainly because underpinning the various positions we can take on these issues, are profound philosophical distinctions about the nature of knowledge, truth, meaning and reference, and the distinction between a realist and an antirealist approach to these questions.

27 In Chapter 7, I describe how Kuhn's account of science can withstand challenges to the very idea of incommensurability, as articulated by Donald Davidson and by Hilary Putnam.
This means that the concept of incommensurability, its unity or multiplicity, and possible classification, raises questions about language, perception, conceptual schema, ontology, and epistemology. We could therefore expect any commentator's decision on how to treat incommensurability to be influenced by their disposition towards reality, knowledge, and meaning. For example, a realist might differentiate between incommensurability at the level of our experiences of the same, shared world, whereas an antirealist would conflate incommensurability at the level of our experience of the world with ontological incommensurability about the worlds we each co-constitute through different conceptual schemes.

This is the kind of disagreement about fundamentals that can cause philosophers to talk past each other in debating incommensurability, as alluded to in exchanges between Sankey and Hoyningen-Huene et al. Sankey's raises questions such as "is the incommensurability of scientific theories some single, unified relation between theories, … Or is it instead the case that there are a number of different things, such as the incomparability of the content of theories, or lack of shared evaluative standards, which are each a source of incommensurability in their own right?" (Sankey, 1999, p. 3). And he suggests "to answer this question one way or the other is already to take a side in the dispute" (Sankey, 1999, p. 3). The problem is so acute, Sankey says, "if one takes an overview of the critical literature concerned with the incommensurability thesis, it can hardly escape notice that this literature contains a variety of separate discussions that are conducted in quite different terms" (1999, p. 4).

Exchanges between Sankey and Hoyningen-Huene show this to be the case, with the latter, in conjunction with Eric Oberheim, proposing a "meta-incommensurability thesis" to explain the lack of shared assumptions and the contrary conclusions of the authors (Oberheim, Hoyningen-Huene, 1997, p. 453).

In a similar vein we read:

Furthermore, because the differences between the two parties touch on metaphysical assumptions that are notoriously difficult to justify, and because these differences feature significantly in the debate between realists and non-realists, we propose a rather risky thesis; namely, that the debate about incommensurability is permeated by a meta-incommensurability between the realist and the non-realist which promotes local communication difficulties between the two parties (Hoyningen-Huene, Oberheim, Andersen, 1996).
These researchers have done us a service in drawing attention to the potential for mis-communication. But the difference between a realist and an antirealist approach to questions in the philosophy of science, or any questions in philosophy, comes down to our intuitions about how the world is. Being aware of the potential for talking past each other regarding incommensurability is a good start in avoiding the problem. To further guard against such mis-communication, I will ensure that my arguments do not depend on any implicit assumptions about realism or antirealism, by which I mean, the mind-dependence or independence of the entities we encounter in the world. Wherever such assumptions impinge on an argument, I will try to make them explicit.

For example, Kuhn's account of science won't resolve the realist versus antirealist issue nor questions of the nature of knowledge, truth, meaning and reference. But his work does bring the distinctions involved in these issues into contrast. Where possible, I intend to offer a reading of Kuhn's work that acknowledges how these distinctions affect our understanding of science. For example, Kuhn's account of science allows for adherents to a scientific paradigm to be realist about the natural world because the paradigm determines what is objectively correct for those scientists. However, this indicates that viewing the history of science across paradigms, historiographers should be antirealist, viewing each successive version of paradigm "objectivity" as demonstrating the mind-dependence of the world. However, because the paradigms co-constitute the world, according to Hoyningen-Huene's reading of Kuhn's account, it is not only the mind that determines features of reality, because the extant reality underpinning the scientist's perceptions also affects their view of the world (Hoyningen-Huene, 1993, p. 29). Thus, we could argue, even when viewed across paradigms, the extant reality that is not contributed by any paradigm constitutes an objective ground. Although it can never be articulated within any paradigm, that is, separately from any paradigm, it is real, extant, and detectable as the unarticulatable ground for the reality co-constituted by different paradigms.

4.3 What might incommensurability mean?

In SSR Section IX, Kuhn introduces the concept of incommensurability, which we can call a general "paradigm incommensurability" (1996, p. 103). Using figurative language, Kuhn articulates several different aspects of this paradigm incommensurability, but he doesn't
specify in SSR types of incommensurability such as semantic, methodological, ontological incommensurability etc.

But nowhere in Kuhn's initial descriptions of incommensurability and his subsequent elaboration on the topic in SSR does he explain how the incommensurability that characterises the relationship between paradigms can both insulate the dominant paradigm from competing theories during normal science but also allow interaction between the dominant paradigm and alternative theories, which are potential alternative paradigms for the discipline, during extraordinary science. One possible explanation of this would be if the incommensurability between paradigms altered during the Kuhn cycle, as it were, on a scale from total to partial or strong to weak.

To address these issues, whether there are forms or manifestations of incommensurability and whether we should classify incommensurability along a scale, it is useful to consider relevant readings from the extensive literature on incommensurability within the philosophy of science.

### 4.3.1 Forms or manifestations of incommensurability

In Chapter 3, I reviewed some of the charges of relativism that have been made against Kuhn's account of science, as described by Curd and Cover, Bird, Sharrock and Read. Many of these arguments are based on Kuhn's conception of the scientific paradigm and the property of incommensurability that he specifies can characterise the relationship between paradigms.

In his review of arguments for relativism, Alexander Bird focusses on arguments for different forms of relativism (semantic, epistemic, methods and standards, and ontological) that seem to be based on different forms of incommensurability (a general, paradigm incommensurability, semantic, methods and standards, and world change incommensurability).\(^{28}\) Alexander Bird describes (paradigm or theory or standards) incommensurability as "the problem of comparing radically different paradigms" (2000, p. 45). According to Bird, "Kuhn says that the world of the Aristotelian physicist is one in which a swinging object is one which is falling, albeit in a slow and constrained manner, while no

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\(^{28}\) In addition to the relativism based on the paradigm/incommensurability concepts, that is, Kuhn's revolutionary argument, Bird also considers the relativism about truth that can be based on from Kuhn's approach to truth within paradigms and progress in science, what we might call Kuhn's evolutionary argument.
such thing is in the world of Galileo, where there is instead a pendulum whose motion is
repeated again and again” (Bird, 2000, p. 46/47). But Bird does not believe that paradigm (or
theory) incommensurability prevents theory comparison. He says that "it looks as if the
difference as regards incommensurability of standards is one of degree not of principle” (Bird,
2000, p. 55). Paradigms or theories are comparable, but "the comparison is just not rationally
decisive" (Bird, 2000, p. 55).

Bird also distinguishes what he calls semantic (or conceptual) incommensurability, and says
that, similarly "conceptual or semantic incommensurability does not mean anything so
dramatic as mutual incomprehension” (Bird, 2000, p. 56). It is simply an issue of the
translatability of concepts between paradigms. And after dealing with different theories of
meaning, he reaches the verdict that "incommensurability (as translation failure) exists, but it
is no big deal" (Bird, 2000, p. 188). Later in his text, Bird goes on to describe taxonomic
incommensurability (Bird, 2000, p. 191), where translation failure is due to changes in the
classification systems that theories impose on the world, and epistemological
incommensurability, a threat to realism about science, the idea of scientific progress, and a
possible basis for weak epistemic relativism (Bird, 2000, p. 240).

In his analysis, Bird seems to be criticising Kuhn for not taking part in a more philosophical
debate than the one he conducted throughout this career. In his preface, Bird draws our
attention to the fact that Kuhn's biography shows that he "was never thoroughly trained as a
philosopher” (Bird, 2000, ix). While acknowledging Hoyningen-Huene's reconstruction of
Kuhn's thought as an invaluable source, Bird intends that his own work should more explicitly
place Kuhn's thought in his intellectual context. And it is Bird's reading of Kuhn's context that
leads him to some of the conclusions previously mentioned.29

Donald Davidson and Hilary Putnam both reject the notion of incommensurability, using
different arguments, on the grounds that we can access aspects of the world independent of a
theoretical system such as a cognitive scheme or scientific paradigm (see Chapter 7). But
those who do allow the possibility of incommensurability, tend to distinguish different types

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29 In his 2002, 'Kuhn's Wrong Turning,’ Bird criticises Kuhn for reverting from a naturalistic philosophy to an a
priori explanation of knowledge generation, meaning and reference, and the possibility of progress in science.
According to Bird, although not available when SSR was published, the connectionist or neural net (network)
view of cognition was developed in Kuhn's lifetime and would have been available to him had he continued to
look for naturalistic, rather than idealistic, explanations of knowledge generation (Bird, 2002, p. 444). And he
says that "Kuhn's philosophical approach betrayed commitments characteristic of the positivists and logical
empiricists he intended to be rejecting” (Bird, 2002, p. 445).
of the general phenomenon or different domains within which we can address the issue. For example, Sankey distinguishes between the concept of incommensurability and the incommensurability thesis regarding scientific theories and further distinguishes the semantic incommensurability thesis, "the thesis that alternative scientific theories may be incommensurable due to semantic variance of the terms employed by theories," and the methodological incommensurability thesis, "the thesis that alternative scientific theories may be incommensurable due to absence of common standards of theory appraisal" (Sankey, 1999, pp. 4, 5).

Philip Kitcher categorises conceptual (for semantic), observational and methodological incommensurability, which together would be the same as Sankey's methodological or Bird's epistemological incommensurability (Kitcher, 1982).

Given the various putative forms of incommensurability, perhaps it is best to consider Kuhn's descriptions of incommensurability in SSR.

4.4 Kuhn's descriptions of incommensurability in SSR

I argue that, although in SSR Kuhn can be interpreted as describing methodological and ontological incommensurability, in addition to semantic incommensurability, these (and other forms of incommensurability, such as paradigm or epistemic or perceptual incommensurability) can be understood as manifestations of semantic incommensurability.

Kuhn introduces the concept of incommensurability during his description of the nature and necessity of scientific revolutions (1996, p. 92). In the course of this description, Kuhn gradually increases the disjunction he describes as existing between successive paradigms. According to Kuhn's account in SSR, once science has left the immature pre-consensus phase, it consists of cycles of normal science (characterised by adherence to a scientific paradigm) and extraordinary (revolutionary) science (characterised by the search for a replacement paradigm) (1996, pp. 6, 182, 187). The transition between the two forms of science occurs with a scientific revolution, the adoption of a new paradigm, after a period of crisis and extraordinary science research (Kuhn, 1996, p. 92). Kuhn calls the developmental episodes "revolutions" because of the parallels he sees between political and scientific change (1996, p.
For Kuhn, like political revolutions, scientific revolutions involve "a choice between incompatible modes of community life" (1996, p. 94). Adherents to a new scientific paradigm must use persuasion to convert other scientists, because adherents to alternative paradigms argue circularly that their world view or disciplinary matrix is superior, so that arguments "cannot be made logically or even probabilistically compelling for those who refuse to step into the circle" (1996, p. 94). This is precisely because the paradigms are "incompatible," by which Kuhn means that we cannot accept them both to be correct. Discussing theories, which he uses synonymously with paradigm, he elucidates this usage "...these two theories are fundamentally incompatible in the same sense illustrated by the relation of Copernican to Ptolemaic astronomy: Einstein's theory can be accepted only with the recognition that Newton's was wrong" (Kuhn, 1996, p. 98). Because successive paradigms are incompatible, Kuhn emphasises, against the tradition of positivism (and perhaps falsificationism), that science is not cumulative. Of course, normal science is cumulative within its paradigm, but in the long run, science is not cumulative across successive paradigms. But more importantly for my analysis, Kuhn's treatment of this case shows why successive theories are so different, because of meaning change. As he says, "the need to change the meaning of established and familiar concepts is central to the revolutionary impact of Einstein's theory," and "...the transition from Newtonian to Einsteinian mechanics illustrates with particular clarity the scientific revolution as a displacement of the conceptual network through which scientists view the world" (Kuhn, 1996, p. 102). So the difference between successive paradigms occurs at the level of meaning, the meaning of concepts, and the referents those concepts have in the world. Thus, "successive paradigms tell us different things about the population of the universe and about that population's behavior" (Kuhn, 1996, p. 103). But because paradigms also act as "the source of the methods, problem-field, and standards of solution accepted by any mature scientific community at any given time," "...the reconception of a new paradigm often necessitates a redefinition of the corresponding science" (Kuhn, 1996, p. 103). Kuhn has now developed his ideas about the differences between successive paradigms such that he needs to increase the disjunction between them. Having begun using "incompatible" to describe the difference, he now proposes that "the normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" (Kuhn, 1996, p. 103).
Kuhn re-iterates the different reasons why "the proponents of competing paradigms must fail to make complete contact with each other's viewpoints" (1996, p. 148). As I have already indicated, we can interpret these as either different forms of incommensurability within a general paradigm incommensurability or as different manifestations of a single form of incommensurability. Firstly, "their standards or their definitions of science are not the same" (1996, p. 148), so that they disagree about the list of problems to be solved, giving rise to what we might call methodological incommensurability. The scientists across different paradigms do not simply disagree about the correct solution to certain problems presented by the world, they disagree about what problems science should address, how any proposed solutions should be evaluated, and by what methods the answers should be investigated. We might call this methods and standards incommensurability.

Secondly, even though successive paradigms employ the vocabulary and apparatus of a previous paradigm, they deploy them differently so that "communication across the revolutionary divide is inevitably partial" (Kuhn, 1996, p. 149). This, we might call semantic incommensurability. And finally, Kuhn says, "in a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds" (1996, p. 150). This we might call experiential or perceptual or ontological incommensurability. And because of incommensurability, the paradigm change cannot be made step by step but only as a switch. "Like the gestalt switch, it {the transition} must occur all at once (though not necessarily in an instant) or not at all" (1996, p. 150).

In the relevant passages of SSR, Kuhn is not directly describing or defining incommensurability. He is describing the nature and necessity of scientific revolutions, how they change scientists' world view, how they remain invisible, and how they are resolved. In all this, Kuhn is concerned with the situation that scientists, the adherents to a paradigm, finds themselves in. Although he provides several descriptions of incommensurability, he does not define it. His language is figurative, analogical rather than technical, philosophical.

From his descriptions of the situation in which the scientist finds themselves after a revolution, we might describe three or perhaps four types of incommensurability. The names of these distinctions are not in themselves important, but the distinctions we might draw are:

- General, paradigm incommensurability, consisting of semantic, methods and standards and world change incommensurability
- Semantic incommensurability, where there is a lack of shared meaning between paradigms
- Methodological incommensurability, where there is a lack of shared standards and problems between paradigms
- Perceptual or experiential or conceptual incommensurability, where there is a lack of shared perception or experience of the world. I note that Kuhn did not describe epistemic incommensurability, where there is a lack of shared knowledge between paradigms, but this form can be inferred from semantic incommensurability
- Ontological incommensurability, where there is a lack of shared world view between paradigms

This kind of list could, of course, be framed in different terms. For example, a realist can distinguish between perceptual and ontological incommensurability, because the realist contends that the world exists and exists independently of our mind's apprehension of it. But for an antirealist, one who denies the mind-independence of the existent world, these two forms of incommensurability amount to the same thing, so that scientists experience a different world and the world is different, for them, after a scientific revolution.

### 4.4.1 General, paradigm incommensurability

We could call Kuhn's first description of incommensurability between paradigms "paradigm incommensurability" or "theory incommensurability" or "mode of community life incommensurability" or "conceptual incommensurability". But I argue that this should not distract from the fact that ultimately this general form of paradigm incommensurability, and the component forms or other manifestations of incommensurability, originate in semantic incommensurability.

Kuhn has provided details on his conception of meaning change during a scientific revolution. He summarises his detailed treatment of the revolution from the mechanics of Newton to that of Einstein, by saying that "the need to change the meaning of established and familiar concepts is central to the revolutionary impact of Einstein's theory" (Kuhn, 1996, p. 102).

And he builds up the contrast between incompatibility, incomparability, and incommensurability in order to emphasise that the differences between successive paradigms
originates at the level of meaning. Prior to his introduction of "incommensurable," Kuhn has described alternative paradigms as being incompatible, in the sense that scientists cannot accept both paradigms as being correct. This implies that the scientists can compare the alternatives, but they cannot accept that both alternatives are correct. In this, Kuhn leaves open the possibility that the paradigms may still be comparable, that is, that adherents have the language, meanings, and references to compare, but they cannot judge between the paradigms, because some of the meanings and references are not shared across the paradigms. For example, Kuhn says that "since new paradigms are born from old ones, they ordinarily incorporate much of the vocabulary and apparatus, both conceptual and manipulative, that the traditional paradigm had previously employed. But they seldom employ these borrowed elements in quite the traditional way" (1996, p. 149). During his description of the difficulty of communicating between paradigms, Kuhn emphasises the disjunction between paradigms by stating that they are not just incompatible but often actually incommensurable. Thus, "The normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" (Kuhn, 1996, p. 103).

This evidence shows that in his first descriptions of incommensurability, Kuhn has indicated that the differences between successive paradigms originate at the level of meaning. Each paradigm specifies what the population of the world is, what objects, entities, forces there are in the world, what concepts we should use to refer to these phenomena, and what meanings belong to the extension of these terms or are beyond the extension of these terms and are therefore incommensurable.

It is important to note that in this, his first use of the term "incommensurable," Kuhn is describing a situation that pertains between scientific paradigms, as he defines them in SSR. He is not describing incommensurability itself. And we could label this form of incommensurability as "paradigm incommensurability," by applying the term "incommensurable" analogically or metaphorically to the disjunction that Kuhn specifies can exist between paradigms. However, this names the effect of incommensurability, that the paradigms are incommensurable, rather than the cause, which is semantic incommensurability.

4.4.2 Methodological incommensurability
To progress his descriptions of incommensurability, Kuhn describes how the work of Newton, Maxwell, Dalton and others changed the problems and standards of science (Kuhn, 1996, p. 105 and following). In this, he shows that "when two scientific schools disagree about what is a problem and what a solution, they will inevitably talk through each other …" (Kuhn, 1996, p. 109).

But this is only a summary of a line of argument Kuhn has been following since shortly after opening his chapter on 'The Nature and Necessity of Scientific Revolutions' (1996, p. 92). That is, that there is not cumulative development in either scientific paradigms/theories or in scientific problems and standards. He begins describing the first of these situations by asking rhetorically, "Are there intrinsic reasons why the assimilation of either a new sort of phenomenon or a new scientific theory must demand the rejection of an older paradigm?" (Kuhn, 1996, p. 95). He answers, Yes, against the Logical Positivists, as we have seen previously. This is because successive paradigms "tell us different things about the population of the universe and about that population's behavior" and because paradigms are the "source of the methods, problem-field, and standards of solution accepted by any mature scientific community at any given time," so that "the reception of a new paradigm often necessitates the redefinition of the corresponding science" (Kuhn, 1996, p. 103). It is important to note here that Kuhn makes his argument at the level of meaning, saying that the population of the world, and that population's behaviour, changes; that is, the terms that scientists use to describe the world changes.

Kuhn is even more definite that there can be no cumulative development in the standards and problems of science, saying, "…the case for cumulative development of science's problems and standards is even harder to make than the case for cumulation of theories" (1996, p. 108). There are no "external standards" to allow us to make a judgement about cumulative development in any situation because, "What occurred was neither a decline nor a raising of standards, but simply a change demanded by the adoption of a new paradigm" (Kuhn, 1996, p. 108). Interestingly, Kuhn frames the disjunction between the adherents of two alternative paradigms in terms of meaning, in terms of talk, as he writes, "when two scientific schools disagree about what is a problem and what a solution, they will inevitably talk through each other"… (1996, p. 109). Therefore, the incommensurability that occurs between paradigm problems and standards is semantic incommensurability, though we may choose to label it methodological incommensurability for our own reasons.
Kuhn has described the non-cumulative nature of scientific paradigms themselves and the problems and standards of paradigms without using any ideas from the psychology of perception. Between paradigms, some problems become irrelevant, other new ones occur for the first time, and standards of what constitutes an answer to any problem change. Kuhn could have describe these features in terms of how the scientist perceives or sees the world. But he chose not to. Instead he describes the differences between paradigms in terms of changes to the population of the world and the population's behaviour, what entities there are in the world, what facts are important for a scientist to attend to and what constitutes a legitimate question and an acceptable answer. Kuhn is describing how the scientist within a paradigm relates to the world, but in terms of knowledge, language, meaning, and reference. So we can conclude that any incommensurability between paradigm problems and standards and between paradigms themselves can be understood in terms of semantic incommensurability. Thus, what we might term methodological incommensurability is a manifestation of semantic incommensurability. But his explanation also hints at the relationship between semantic practices, how our language functions in terms of meaning and reference to the world, and ontology, how we categorise the objects of the world, the "population of the world," as Kuhn puts it.

Kuhn has considered how "changes in the standards governing permissible problems, concepts, and explanations can transform a science." and hints that shortly he will "even suggest a sense in which they transform the world" (1996, p. 106). He links to the section he is referring to with the couplet "I have so far argued only that paradigms are constitutive of science. Now I wish to display a sense in which they are constitutive of nature as well" (Kuhn, 1996, p. 110).

4.4.3 Different worlds incommensurability

Further developing his ideas of incommensurability in SSR, Kuhn suggests that after revolution, "scientists are responding to a different world" (1996, p. 111). This would suggest that incommensurability between paradigms includes incommensurability between paradigm adherents in how they "carve up" or categorise the world, that is, ontological incommensurability. But Kuhn seems to encounter difficulty articulating the concept of incommensurability in terms of the metaphor of different worlds or world views. He had previously warned that parallels with Gestalt psychology can be misleading, saying,
"Scientists do not see something as something else, instead, they simply see it" (Kuhn, 1996, p. 85). But now he offers the Gestalt switch as an "elementary prototype" of what a paradigm shift involves, a switch to a new and incommensurable world (Kuhn, 1996, p. 111). And Kuhn continues, "therefore, at times of revolution, when the normal-scientific tradition changes, the scientist's perception of his environment must be re-educated in some familiar situations he must learn to see a new gestalt. After he has done so the world of his research will seem here and there, incommensurable with the one he had inhabited before" (1996, p. 112). However, although (Gestalt) psychological experiments are suggestive, they cannot be more than this, Kuhn believes. This is principally because the scientists, unlike the subject in a psychological experiment, cannot know that their perception has been switched, because they cannot switch it back. "The scientist can have no recourse above or beyond what he sees with is eyes and instruments" (Kuhn, 1996, p. 112). Thus, the paradigm shift induces a change in perception, so that the scientist sees or perceives the world differently, or we might say, perceives a different world. "Until the scholastic paradigm was invented, there were no pendulums, but only swinging stones, for the scientist to see. Pendulums were brought into existence by something very like a paradigm-induced gestalt switch" (Kuhn, 1996, p. 120). It appears that Kuhn is making a lesser claim, that rather than constituting nature or the world, the paradigm constitutes the scientists perception or experience of the world. Thus, incommensurability between paradigms would include a component of perceptual or experiential incommensurability or ontological incommensurability. The co-constitution of the world changes, but the same existential worlds is the ground for the different co-constitutions.

To investigate further the distinction between perception of the world and constitution of the world, Kuhn considers whether scientists in different paradigms see "different things when looking at the same sorts of objects" or if there is "any legitimate sense in which we can say that they pursued their research in different worlds?" (1996, p. 120). Kuhn cannot supply an explanation, in terms of a new epistemology, for the changes brought about by paradigm shifts, but he believes research "in parts of philosophy, psychology, linguistics, and even art, all converge to suggest that the traditional paradigm is somehow askew" (1996, p. 121). I interpret Kuhn as meaning the traditional epistemological paradigm, which he says was initiated by Descartes, is askew (ibid). Whatever the new epistemological paradigm does, it must help us, Kuhn says, to make sense of statements such as "though the world does not change with a change of paradigm, the scientist afterward works in a different world" (1996, p. 121).
A source of his difficulty is that "what occurs during a scientific revolution is not fully reducible to a reinterpretation of individual and stable data." (Kuhn, 1996, p. 121). This is because the data are not unequivocally stable and after revolution, the scientist doesn't just interpret the data in isolation from a paradigm, there has been a shift, and the data have been transformed because they have been interpreted under a new paradigm (Kuhn, 1996, p. 122). Kuhn considers in some detail again the case of Aristotle observing falling stones and Galileo interpreting observations of a pendulum. He finds it "impossible to relinquish" the viewpoint that sensory experience is fixed and neutral. And in this he is guided by "the epistemological viewpoint that has most often guided Western philosophy for three centuries" (Kuhn, 1996, p. 126). Yet, he concludes, this view no longer functions correctly and "attempts to make it do so through the introduction of a neutral language of observations now seem [to me] hopeless" (Kuhn, 1996, p. 126). And even such a language, were it possible, would "presuppose a paradigm" (Kuhn, 1996, p. 127). The alternative way of seeing the world is not some objective vision, but "vision through another paradigm, one which makes the swinging stone something else" (1996, p. 128). Kuhn considers how a child learns to apply a word to refer to a concept, refining it from a general to a more specific meaning/referent, and he implies the same happens when the scientist changes the way they see the world, "to see oxygen instead of dephlogisticated air…or the pendulum instead of a constrained fall…" (1996, p. 129). The child learning language and the scientist coming to terms with a changed world both use their respective paradigms and "Paradigms determine large areas of experience at the same time" (1996, p. 129).

To further illustrate the "different world" effect of incommensurability, Kuhn considers one last example, that of Dalton's work on chemical compounds / solutions (Kuhn, 1996, p. 129). In this example, Kuhn emphasises the independent existence of the world, whatever impact a scientists understanding may have on their perception of that world:

After a scientific revolution many old measurements and manipulations become irrelevant and are replaced by others instead…But changes of this sort are never total. Whatever he may then see, the scientist after a revolution is still looking at the same world (Kuhn, 1996, p. 129).

And Kuhn explicitly states that the meaning of the scientist's language, in addition to their laboratory equipment and methods, have changed, despite the apparent continuity.
...though he may have previously employed them differently, much of his language and most of his laboratory instruments are still the same as they were before. As a result, postrevolutionary science invariably includes many of the same manipulations, performed with the same instruments and described in the same terms, as its prerevolutionary predecessor. If these enduring manipulations have been changed at all, the change must lie either in their relation to the paradigm or in their concrete results. (Kuhn, 1996, p. 130).

This means that although the scientists' language, the equipment and the methodology i.e. "manipulations," seem to be the same pre- and post-revolution, the shift to a new paradigm has changed the population of objects in the world and the meaning associated with objects in the world. So that, "the data themselves had changed. That is the last of the senses in which we may want to say that after a revolution scientists work in a different world" (Kuhn, 1996, p. 135).

In describing the resolution of scientific revolutions, Kuhn explicitly describes the incommensurability that exists between paradigms as a complex of parts. "We have already seen several reasons why the proponents of competing paradigms must fail to make complete contact with each other's viewpoints. Collectively these reason have been described as the incommensurability of the pre- and postrevolutionary normal-scientific traditions, … " (1996, p. 148).

It is notable that Kuhn has here described incommensurability as a failure by adherents to different paradigms to make complete contact with each other's viewpoints. Kuhn recapitulates the different reasons for the failure to make complete contact with alternative viewpoints. "In the first place, the proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards or their definitions of science are not the same" (1996, p. 148). This is what we might call methodological incommensurability.

Kuhn describes what we might call semantic incommensurability as follows:

Since new paradigms are born from old ones, they ordinarily incorporate much of the vocabulary and apparatus, both conceptual and manipulative, that the traditional paradigm had previously employed. But they seldom employ these borrowed elements in quite the traditional way. Within the new paradigm, old terms, concepts, and experiments fall into new relationships one with the other. The inevitable result is what we must call, though the term is not quite right, a mis-understanding between the two competing schools (Kuhn, 1996, p. 149).

And he uses examples such as the case of "the men who called Copernicus mad because he proclaimed that the earth moved" (1996, p. 149) to illustrate incommensurability of worlds or
world views, what we might call perceptual or experiential or ontological incommensurability.

These examples point to the third and most fundamental aspect of the incommensurability of competing paradigms. In a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds (Kuhn, 1996, p. 150).

As I have argued here, like the nominal methods and standards incommensurability, these too are manifestations of semantic incommensurability.

4.4.4 Manifestations rather than forms

There are three main reasons for opting to talk of manifestations rather than forms of incommensurability.

First, for reasons of clarity. In my analysis, I am investigating the possible grounds for relativism in Kuhn's account of science, and it seems that incommensurability is the source of arguments for alternatives-induced relativism based on his work. But ascribing names to different putative forms of incommensurability seems to needlessly increase the complexity of an already complex situation. Rather than naming different forms of incommensurability, my investigation aims to determine what are the grounds for incommensurability between paradigms, and if possible, to determine what is the source of incommensurability. As Davidson's attack on conceptual scheme relativism indicates (1974), and as the direction of Kuhn's career-long development of his ideas demonstrates, incommensurability concerns language, our ascription of meanings within language, and the possibility or impossibility of translation failure across languages. I have already in Chapter 3, identified local holism about meaning, a semantic phenomenon, as the source of arguments for incommensurability as described by Kuhn. And I argue in the current chapter, that semantic incommensurability accounts for the conceptual and ontological manifestations of the incommensurability between scientific paradigms.

Second, although naming different forms of incommensurability may be a useful shorthand in debate, it can obscure the fact that incommensurability is a semantic phenomenon. Thus, to say that there exists epistemic incommensurability between two paradigms can be a useful shorthand for the existence of semantic incommensurability between two paradigms that is manifested at the level of knowledge. But this usage should not be allowed to obscure the fact
that the knowledge claims of the different paradigms are incommensurable because the paradigms ascribe different meanings to the terms used to frame their respective knowledge claims.

A third reason for opting to talk of manifestations rather than forms of incommensurability, is that Kuhn refined his notion of incommensurability later in his career such that it is a semantic notion (Hoyningen-Huene, 1993, p. 216). I will argue in the addendum to this thesis, that we can apply this refined notion of incommensurability to Kuhn's account of science in SSR. So considering incommensurability to be a semantic phenomenon that can be differently manifested ensures that my arguments are compatible with Kuhn's refinement of the notion.

4.5 The problem answered by a scale

The different manifestations of incommensurability describe some of the consequences of Kuhn's account of science, but do not explain how that account can operate, given incommensurability between paradigms. Kuhn's account of science seems to require incommensurability to both insulate the dominant paradigm from alternative scientific theories during normal science, but allow communication between the dominant paradigm and these alternatives during extraordinary science. In the following section, I will argue that variation in (semantic) incommensurability during the Kuhn cycle can help explain the progress of scientific revolutions. Thus, a scale of incommensurability can do useful explanatory work in analysing Kuhn's account. And indeed some analysis of Kuhn's account in the literature suggest such a scale.

Sharrock and Read begin their treatment of incommensurability with the literal definition of incommensurability meaning "cannot be compared by a common measure" (2006, p. 58). They describe how, for Kuhn, the effects of incommensurability are not felt by scientists, and are mostly the concern of certain philosophers. This is primarily because incommensurable theories are nevertheless comparable (Sharrock and Read, 2006, p. 61). And they point out that even in the original usage in mathematics, incommensurability allows for comparison (Sharrock and Read, 2006, p. 141). In a formulation based on Kuhn's later articulations of the concept, they indicate that incommensurability should be primarily understood as "the 'partial' 'untranslatability' of taxonomies of natural kinds across revolutions" (Sharrock and Read, 2006, p. 183).
Thus Sharrock and Read seem to suggest that incommensurability does not prevent all encounter between or communication across paradigms. Indeed, some of the treatments of incommensurability in the literature have described a spectrum or continuum or scale of incommensurability. This adds a potentially useful analytic tool. It suggests that in addition to forms or manifestations of incommensurability, we can distinguish end points on a scale and perhaps gradations, of incommensurability.

This is important because it suggests an answer to a difficult question: how can the same incommensurability that insulates paradigm adherents within their paradigm during normal science allow adherents to communicate with and investigate potential replacement paradigms during extraordinary research? However, it is important to distinguish the issue of forms or manifestations of incommensurability and scales of incommensurability.

For example, Richard Grandy argues that "there are numerous distinct kinds of incommensurability, as well as distinguishable degrees thereof" (1983). However, his analysis of types of incommensurability consists largely in describing the different components of Kuhn's disciplinary matrix description of scientific paradigms (as he renders them "symbolic generalizations", "metaphysical assumptions", "models", "values", "instruments", and "exemplars") each as giving rise to a separate form of incommensurability. He suggests that we should distinguish small scale "reconceptualisations" within paradigms from large scale scientific revolutions to new paradigms. And he reasons that since there are degrees of revolution, and incommensurability is associated with changes of paradigms, "we should expect that there are extremely various degrees of incommensurability" (Grandy, 1983, p. 140). Grandy also proposes that "the greater the number of components that change in the disciplinary matrix, the greater the number of kinds of incommensurability that arise" (1983, p. 15).

Another useful example is John Collier, who describes weak (relative), strong (absolute) and logical (universal) incommensurability (1984). In his 'Pragmatic Incommensurability', Collier states that "Kuhn's thesis (regarding normal science, paradigms, incommensurability etc.) is compatible with different degrees of incommensurability" (1984, p.146). And based on his reading of Kuhn, Collier provides a description of strong and of weak semantic incommensurability. Thus, he defines for theories T, T', and V:
Weak (relative) incommensurability: T and T' are weakly incommensurable for S at time t if and only if S has no technique at t to semantically compare T and T'.

Strong (absolute) incommensurability: T and T' are strongly incommensurable of S if and only if it is not possible (at any time) for S to obtain a technique for the semantic comparison of T and V.

Collier also describes what he calls Logical (universal) incommensurability and defines it thus: "T and V are logically incommensurable if and only if there is no technique for the semantic comparison of T and V.

In his paper, Collier argues for a weaker form of incommensurability, compared to a stronger form that precludes "direct rational communication across revolutionary divides in science" (Collier, 1984, p. 146). The weaker incommensurability, he says, "allows eventual comparison of incommensurable theories, but is consistent with Kuhn's model of science" (Collier, 1984, p. 146). It is interesting to note that Collier is considering incommensurability exclusively in a semantic sense, that he describes various degrees of incommensurability in terms of semantic comparison, and allows for communication across revolutionary divides in science.

Other classifications of incommensurability in the literature include Ian Hacking in *Representing and Intervening*, where he identifies what he calls "topic-incommensurability, dissociation, and meaning-incommensurability" (1983, p. 67). And Hacking also remarks that there are shallow and deep responses to meaning-incommensurability, Donald Davidson's argument being of the latter kind (1983, p. 73). By "topic-incommensurability," Hacking is referring to the idea that "rival theories may only partially overlap, so one cannot well compare their successes overall" (1983, p 65). By "disassociation", Hacking refers to the idea that "after sufficient time and theory change, one world view may be almost unintelligible to a later epoch" (ibid). And by "meaning-incommensurability" he refers to the idea that "rival theories are always mutually incomprehensible and never intertranslatable, so that reasonable comparison of theories is in principle impossible" (ibid). These descriptions imply that Hacking has in mind a graduation, from the difficulty of comparing success of theories, to the near unintelligibility of theories, to the mutual incomprehensibility of theories.
4.5.1 Exploring a scale of general, paradigm incommensurability

In some of the literature cited, researchers have described putative types or forms of incommensurability such as semantic, paradigm, epistemic, methodological etc. Other authors have described a spectrum or scale of incommensurability. For example, Collier describes strong and weak (semantic) incommensurability. But Granby describes both forms and degrees of incommensurability.

This suggests that there is a potential for confusion between the forms of incommensurability and the scale of incommensurability, if such a scale or scales can be described. Clarifying such a distinction might help my further investigations, if it helps to avoid a category error, such as trying to answer questions about the degree of incommensurability in terms of forms of incommensurability, or vice versa. For example, such an error might occur if Kuhn was accused of relativism based on a form or of a degree of incommensurability that he does not propose in his work.

Leaving aside the question of whether we should describe different forms of incommensurability or various manifestations of a single phenomenon of incommensurability, I want to explore the idea of a scale of general, paradigm incommensurability.

Indeed, there seems to be some grounds for considering a scale of incommensurability in Kuhn's work itself. By his account, incommensurability seems to both insulate the dominant paradigm from competing theories at certain points in the revolutionary cycle and allow communications between them at other points. And this points to a potential problem for Kuhn's account of science, especially given that later in his career he refines his idea of incommensurability to be local, narrow sense non-translatability of terms. We might ask, given this description, how can the same incommensurability insulate a paradigm at one point in Kuhn's cycle of scientific revolution but allow adherents to investigate other alternative paradigms at another point in the cycle and allow for paradigm shifts?

At this point in the analysis, we do not require a very precise conception of the strong to weak scale of general, paradigm incommensurability. Briefly, by "weak" paradigm incommensurability I mean that within a paradigm, adherents can be aware of another paradigm but not share it. This means that adherents share sufficient meanings to communicate with the alternative paradigm, but do not understand its meanings, methods and
standards, or world view as adherents native to that paradigm do. In contrast, by "strong" paradigm incommensurability I mean that from within a given paradigm, adherents cannot even acknowledge or be aware of a different paradigm. This means that adherents to one paradigm do not share sufficient meanings to communicate with the alternative paradigm, they do not understand its meanings, nor its methods or standards, nor its world view.

The distinction can also be made in terms of the semantic incommensurability that I argue can account for the different manifestations of incommensurability. Thus, strong incommensurability pertains when translation or sharing of meaning does not occur between paradigms, and weak incommensurability pertains when translation or sharing of meaning occurs between paradigms. Making the distinction in these terms shows that discussions of incommensurability should take into account questions of meaning and reference, which I considered in Chapter 7 in terms of Davidson's argument against incommensurability and the challenge Putnam's essentialism poses to incommensurability.

4.5.2 Suggesting a strong and a weak sense of incommensurability

In SSR, Kuhn does not distinguish a weak and a strong sense of incommensurability. But according to his account of science, Kuhn seems to be committed to both the strong and the weak sense of incommensurability. For example, Kuhn's account of science specifies that normal science results from the operation of a paradigm. When analysing how the concept of paradigm functions in Chapter 2, I showed that it initially seems to require a strong sense of incommensurability. Indeed, Kuhn himself alludes to the fact that insulation within a paradigm is a prerequisite for work within normal science. The first paradigm is quite successful at explaining the easily accessible observations and experiments. Further development requires elaborate equipment, vocabulary, skills, and concepts. This professionalism restricts the scientist's vision, but allows detailed work with specialist apparatus that finds novelty that would not otherwise be found. (Kuhn, 1996, p. 64) So, paradoxically, according to Kuhn's account, it seems that scientists need incommensurability, the inability to understand any phenomena outside of the paradigm, for there to be understanding within a paradigm. Kuhn seems to be philosophically committed to a strong sense of incommensurability. But after his description of incommensurability in SSR Section IX and his completion of his description of science, we see that scientific progress and the pursuit of truth require what I would term a weak sense of incommensurability to operate.
It would be inconsistent to argue that Kuhn is committed to both of two irreconcilable senses of incommensurability. Instead, I suggest that Kuhn's description may lack clarity on this point and as a result that we misunderstand his description and use of the term incommensurability. In the next chapter, Chapter 5, I will show that during his introduction of the term in Section IX, Kuhn implies that a strong sense of incommensurability applies in his descriptions in Sections I to VIII, concerning the paradigm, puzzle solving, rules, novelty and anomaly handling, crisis and scientific revolution). Then in Chapter 6, my analysis will show that thereafter, Kuhn uses what I would term a weak sense of incommensurability in Sections IX to XIII, where he provides more detailed descriptions of incommensurability, paradigm shift, extraordinary science, and scientific progress. That is to say, Kuhn qualifies his description of his account in Sections I to VIII by his description of incommensurability in Section IX and following.

4.6 Conclusion: Chapter 4

In this chapter, I have considered Kuhn's introduction of "incommensurability," and how the figurative language he uses to expand on his initial description could lead to the idea that there are different forms of incommensurability, rather than various manifestations of semantic incommensurability. I have argued that rather than describe types of incommensurability, it is useful to distinguish manifestations of semantic incommensurability. And it is also useful to apply a scale of semantic incommensurability, from strong to weak, although this scale will need to be modified later in my investigations. Although it can be a useful shorthand to distinguish forms of incommensurability, it is preferable to consider these putative forms as manifestations of semantic incommensurability. But the different manifestations of incommensurability only describe some of the consequences of Kuhn's account of science, and do not explain how that account can operate, given incommensurability between paradigms. In contrast, a scale of incommensurability can do useful explanatory work in analysing Kuhn's account.

Differentiating manifestations of semantic incommensurability as opposed to different forms of incommensurability should ensure that my investigation is not adversely affected by
Kuhn's later refinement of the concept of incommensurability to mean semantic incommensurability.

In the next chapter, I argue that Kuhn's initial descriptions in SSR of a scientific paradigm, puzzle solving, rules, novelty and anomaly handling, imply that what I term strong incommensurability characterises the relationship between paradigms, and I examine the implications of this strong incommensurability on the framing of arguments for relativism based on Kuhn's account of science.
5 Chapter 5: Normal Science, relativism, and incommensurability

5.1 Introduction

In this chapter, I show how Kuhn's initial descriptions in SSR of a scientific paradigm, puzzle solving, rules, novelty and anomaly handling imply that what I term "strong incommensurability" characterises the relationship between paradigms during normal science. Under conditions of strong incommensurability, adherents to one paradigm do not share sufficient meanings to communicate with an alternative paradigm, they do not understand its meanings, nor its methods or standards, nor its world view. I also examine the implications of this strong incommensurability on the framing of arguments for relativism based on Kuhn's account.

In Chapter 3, I have described how incommensurability is the basis of the traditional arguments for alternatives-induced relativism levelled against Kuhn's account of science. In order to examine the detailed workings of such arguments, in this chapter I construct arguments for various forms (semantic, conceptual scheme, ontological, epistemic) of alternatives-induced relativism from Kuhn's initial description of the normal science paradigm and related aspects of his account of science (puzzle solving, rules, novelty and anomaly handling, crisis and revolution). I examine how these arguments fail in the absence of incommensurability and succeed in the presence of what I have termed strong sense incommensurability. To broaden my analysis of potential relativism, I also describe how arguments for disagreements-induced relativism might be framed for these components of Kuhn's account, in the absence of incommensurability or under conditions of what I term strong incommensurability. And I point out that the perspective of the person framing any argument for relativism should be a major consideration in the analysis.

5.1.1 Paradigm and normal science: arguments for relativism about meaning, ontological and conceptual scheme relativism
Relativism about the meaning of the terms we use to describe the world is probably the most basic form of relativism, and so I begin my analysis with this basic but important concept.

5.1.1.1 From paradigms to relativism about meaning

I have described in Chapter 2 how Kuhn introduced the concept of normal science with a definition that is, he admits, circular with his definition of a scientific paradigm, in the sense of an exemplar (Kuhn, 1996, p. 10). There are two main senses in which Kuhn uses the term paradigm. In the first sense, a paradigm is a template or exemplar and in the second sense, a paradigm is a disciplinary matrix or world view. These two main senses of the word paradigm, which he clarifies in his SSR Postscript, are inter-related, since the exemplar is a manifestation of best practice within the disciplinary matrix, and the disciplinary matrix allows the scientist to make sense of or interpret the exemplar (Kuhn, 1996, p. 182, 187).

Kuhn's description of a normal-science paradigm, where adherents work within the paradigm's specifications and ignore the work of non-adherents, suggests his description might allow for a plurality of views about what constitutes scientific facts and theories, etc., and perhaps even relativism about facts, theories, etc. To determine if this is the case, I develop here arguments for relativism about meaning and about facts based on Kuhn's initial description of a paradigm, understood as a disciplinary matrix.

In Chapter 1, I argued for a modified co-variance definition stating that relativism claims that a phenomenon x (e.g., values, epistemic, aesthetic and ethical norms, experiences, judgments, and even the world) is somehow dependent on and co-varies with some underlying, independent variable y (e.g., paradigms, cultures, conceptual schemes, belief systems, language) and although it may be possible to compare different resultants of this (dependent-independent) co-variation, there is no means of judging between the relativisations. I have also described relativism about meaning as the view that the meanings of the words, phrases, and sentences of a language are determined by the linguistic communities that use a language; such that different communities might use the same word or phrase to communicate different meanings, and although these meanings can be compared, there is no means of judging between them as to which is correct. Such semantic relativism might seem trivial or innocuous for natural language communities, which are not overly concerned that they attribute the same meaning to a word as do their neighbours. However, for users of scientific
languages, there is an important issue at stake. Because science conventionally aims at knowledge of the world, that is, true facts about the world, scientists in different contexts, in different time periods, expect to mean the same thing when they use a word or indicate a fact. Relativism about scientific language would jeopardise this expectation. Indeed, Kuhn addresses this very threat to science in his postscript, after conceding that "the proponents of different theories are like the members of different language-culture communities" (1996, p.205).

Kuhn's description of science as determined by a paradigm suggests the following argument for alternatives-induced relativism about meaning. Individual scientists operate as a group in a given time and place to agree or assent to their paradigm, their disciplinary matrix. The paradigm defines the accepted theory, legitimate problems, methods, and facts of science, that is, the objects in the world and the information about them that is relevant to scientists working within the paradigm. The paradigm determines how the facts are to be reconciled with theory: that is to say, the paradigm determines the meaning of the facts. Thus by assenting to a paradigm, a group of scientists determines, internally to the paradigm, what facts they will attend to and the meaning of the facts they employ in their work. Therefore, a different group or any different groups of scientists could agree to a different paradigm and thus to other meanings for these or other facts considered relevant under other paradigms. Therefore, the meaning of facts and the definition of what phenomena are considered legitimate facts is determined relative to a paradigm and there is no way to compare or judge the meaning of facts as described in different paradigms.

This argument fails at the crucial last step, because there is nothing in Kuhn's description of a paradigm or in the argument prior to this step that precludes comparing or judging between paradigms. According to my general description of relativism, the ability to compare between paradigms would not entail relativism, but the further constraint, the inability to judge between paradigms would. At this point in his description of science, Kuhn has simply stated that a paradigm is, in its most basic sense, an exemplar of scientific work, and in a more

30 In Section XI, 'The Invisibility of Revolutions', Kuhn describes the co-evolution of facts and theories during paradigm changes thus: "Those theories [presented in textbooks], of course, do "fit the facts," but only by transforming previously accessible information into facts that, for the proceeding paradigm, had not existed at all. And that means that theories do not evolve piecemeal to fit facts that were there all the time. Rather, they emerge together with the facts they fit from a revolutionary reformulation of the preceding scientific tradition, a tradition within which the knowledge-mediated relationship between the scientist and nature was not quite the same" (1996, p. 141).
sophisticated sense, a disciplinary matrix for understanding the exemplar and working within the tradition that recognises the exemplar.

Of course, Kuhn includes a stipulation restricting or rendering impossible transmission between paradigms by introducing into the description of paradigm function the notion of incommensurability, the lack of a common measure. Kuhn makes this introduction later in his description, where he writes that, "the normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" (1996, p.103). As I have described in Chapter 4, incommensurability as described by Kuhn is a relational property of scientific paradigms. That is to say, a scientific paradigm has a property of having no common measure with another or all other scientific paradigms.

As his later descriptions in SSR demonstrate, Kuhn might have chosen any of a number of different distinctions. Examples of this would be the difficulty or impossibility of communicating across alternative paradigms, the difficulty of translating across rival traditions, the incomparability of traditions from an objective perspective, or the incompatibility of competing normal science world views such that successive traditions cannot accommodate previous ones. Even though Kuhn does not discuss the idea of incommensurability until later in the text, in order to function coherently within his description of science, the concept of the scientific paradigm, which he introduces with the concept of normal science at the very start of the text, requires some mechanism to restrict or render impossible access across paradigms. And it is clear from Kuhn's account that this restriction operates at the level of meaning. For example, in his Postscript - 1969, Kuhn synopsises "Subsection 5 [...] urging in brief [the] conclusion that men who hold incommensurable viewpoints be thought of as members of different language communities and that their communication problems be analysed as problems of translation" (1996, p. 175).

And as I have argued, although Kuhn did not describe a scale of incommensurability, his initial account implies what I have termed strong incommensurability characterises the relationship between alternative scientific paradigms. For example, in his Introduction, Kuhn contrasts normal science and scientific revolutions (1996, p. 5). Looking forward to his detailed descriptions of normal science, he says, "when examining normal science in Sections III, IV, and V, we shall want finally to describe that research as a strenuous and devoted
attempt to force nature into the conceptual boxes supplied by professional education” (1996, p. 5). Whereas, scientific revolutions are "… the tradition-shattering complements to the tradition-bound activity of normal science” (Kuhn, 1996, p. 6). Referring to famous examples from the history of science, Kuhn says that each of them, "necessitated the community's rejection of one time-honored scientific theory in favor of another incompatible with it. Each produced a consequent shift in the problems available for scientific scrutiny and in the standards by which the profession determined what should count as an admissible problem or as a legitimate problem-solution. And each transformed the scientific imagination in ways that we shall ultimately need to describe a transformation of the world within which scientific work was done” (Kuhn, 1996, p. 6). Kuhn will later introduce the term "incommensurability" to characterise the relationship between scientific paradigms (1996, p. 103). I argue that it is clear from his initial descriptions in SSR that Kuhn intends that a strong sense of incommensurability prevails during normal science. Under conditions of strong incommensurability, the constructed argument for alternatives-induced relativism about meaning would succeed.

The failure of the constructed argument shows that for the concept of the scientific paradigm to lead to alternatives-induced relativism, it must include some property that restricts or renders impossible access between paradigms. In Kuhn's account, this property is incommensurability. Therefore, in Kuhn's account, it appears that the concept of paradigm can provide grounds for relativism about meaning because it includes the property of incommensurability between paradigms.

This constructed argument sheds light on two other aspects of the relativism that might be based on Kuhn's account. Firstly, the constructed argument is or can be framed from the third party perspective of a non-adherent to a scientific paradigm. Adherents to a paradigm will be dogmatic about the meanings or knowledge claims of their paradigm and unlikely to allow that other paradigms are equally correct, particularly with incommensurability constraining or strong incommensurability blocking interactions between paradigms. Secondly, in the absence of any insulation between paradigms, before the specification of incommensurability, we can presume there is sufficient common ground, that is, shared meaning, for the members of different schools to disagree, profoundly, intractably, with each other. Therefore, an argument for disagreements-induced relativism could be developed. But such an argument would be framed by a non-scientist, someone outside of the schools, observing the disagreements between scientists from a third perspective. The scientists working within the schools before
the paradigm has formed and before adherence to the paradigm brings about conditions of strong incommensurability, share sufficient meaning to disagree. But they disagree in order to bring about consensus and the dominance of their own views, not to show that several views are correct, each from their own perspectives. And once the scientists have agreed their paradigm, by consensus, under conditions of strong incommensurability they share meanings as defined by the paradigm, and any disagreement expressed using these shared meanings is taken to be part of scientific practice.31

However, under conditions of strong incommensurability, the non-adherent can still frame arguments for disagreements-induced relativism. This is because science involves disagreements, sometimes intractable disagreements. To scientists, disagreements within the paradigm are a part of normal science procedure, and disagreements with those outside of the paradigm are engagements between science and non-science or pseudo-science. But the non-adherent can observe disagreements within the paradigm, where meanings are shared and scientists agree on the meaning of statements but disagree on the truth value ascribed to certain statements, as grounds for relativism. In addition, the non-adherent can incorrectly assume that meanings are similarly shared in disputes between the paradigm adherents and those outside of the paradigm, and so take these disputes as grounds for disagreements-induced relativism.

Overall, under conditions of strong incommensurability, the non-adherent can frame arguments for alternatives-induced relativism based on the perception that there are alternative paradigms that do not share meanings, and disagreements-induced relativism based on their mis-understanding of the role of disagreement in science as Kuhn describes it. This difference indicates that it is not only the lack of shared meaning between paradigms, but the type of judgement exercised by non-adherents that leads to arguments for relativism. Paradigm adherents do not frame disagreements-induced arguments for relativism about science because they view disagreements as part of how science proceeds. Nor will they consider arguments for alternatives-induced arguments for relativism because they are in dogmatic adherence to their paradigm. This difference between the adherent and non-adherent regarding alternatives-induced arguments for relativism indicates that it is not only incommensurability, the lack of shared meaning between paradigms, but the type of

31 Incommensurability can characterise the relationship between successive traditions of normal science, as Kuhn describes (1996, p. 103). And in Chapter 4 I have interpreted this incommensurability as a semantic phenomenon, as a lack of shared meaning between such paradigms. I assume by reciprocity that meaning is shared within a scientific paradigm.
judgement exercised by non-adherents that leads to arguments for relativism. The constructed argument from paradigms to relativism pivots on the relativising step, "and there is no way to compare or judge the meaning of facts as described in different paradigms". The non-adherent feels the constraint to judge between paradigms using some objective standard, but the adherent has selected their paradigm and judges what is "objectively" correct with regard only to the paradigm. I will pursue this distinction between the type of judgement invoked in alternatives-induced arguments for relativism in the remainder of this chapter and in Chapter 6.

5.1.1.2 From paradigms to ontological relativism

Sharrock and Read explicitly address the possibility that Kuhn is subject to a "mad credulousness" they call a "linguistic idealism" form of relativism whereby "things exist in the world if we think they do" (Sharrock and Read, 2002, p. 157). It is not surprising that we could develop an argument for this, what I would call ontological relativism, from semantic relativism or from the same source as semantic relativism, that is, relativism about meaning. I have discussed their detailed refutation of such a position in Chapter 3. My analysis in the following section shows that even to frame an argument for a weak or strong alternatives-induced ontological relativism requires some insulating property, such as incommensurability, restricting or precluding communications across paradigms.

In Chapter 1, I have considered the conditions required for different kinds of ontological relativism. By "ontology" we mean "the categories we use to conceive or interpret or understand that which exists, our conception of that which exists." Then ontological relativism is the position that, for any group or individual within a group, that which exists is relative to the language, concepts, frameworks, paradigms etc. of the individual or group.

Kuhn's description of science as determined by a paradigm suggests the following argument for ontological relativism. Individual scientists operate as a group in a given time and place to agree the synthesis that will become their paradigm. Subsequent generations of scientists consciously or unconsciously assent to their paradigm, their disciplinary matrix. The paradigm defines the accepted theory, legitimate problems, methods, and facts of science, that is, the phenomena or objects in the world and the information about them that is relevant to scientists working within the paradigm. The paradigm determines how the facts about the
objects in the world are to be reconciled with theory. Thus by assenting to a paradigm, a
group of scientists determines, internally to the paradigm, what objects there are in the world,
what facts about these objects they will attend to, and the meaning of the facts they employ in
their work. Therefore, a different group or any different groups of scientists could agree to a
different paradigm and thus to a different set of objects in the world, other facts about these
objects, and other meanings for these or other facts. Therefore, the definition of what are the
phenomena or objects of the world is determined relative to a paradigm (and there is no way
to compare or judge between the objects as described in different paradigms as to which are
the correct ones).

Similar to the previous argument for relativism about meaning, this argument fails at the
crucial last step, because there is nothing in Kuhn's initial description of normal science, at
this point in his account or in the argument prior to this step, that precludes comparing or
judging between paradigms. Once again, we note that later in his text, Kuhn introduces into
the description of the paradigm function, the notion of incommensurability, the lack of a
common measure, which prevents comparisons between paradigms (1996, p. 103). And as I
have argued in Chapter 4 on incommensurability, Kuhn's account implies what I have termed
strong incommensurability characterises the relationship between alternative scientific
paradigms during normal science. Under conditions of strong incommensurability, the
constructed argument for alternatives-induced ontological relativism would succeed. But such
an argument could not be framed by scientists who are in dogmatic adherence to their
paradigm. The alternatives-induced argument for relativism could be framed by non-
adherents, by those external to a scientific paradigm, based on their observation that a lack of
shared meaning prevents science from judging which alternative scientific paradigm is
correct. The adherent judges in accordance with their paradigm as to what is the "objectively"
correct ontology, what are the objects in the world. The non-adherent requires an objective
standard by which to judge between the objects as described in different paradigms as to
which are the correct ones. This difference indicates that it is not only the lack of shared
meaning between paradigms, but the type of judgement exercised by adherents and non-
adherents that leads to arguments for relativism. In addition, non-adherents could also frame
arguments for disagreements-induced relativism based on their perception of disagreements
within a scientific paradigm, where meanings are shared, so scientists agree on the meaning of
statements about the world, but disagree over the truth value of certain statements. In contrast,
paradigm adherents would see such disagreements as part of the process of scientific enquiry
and would not frame disagreements-induced arguments for relativism.
5.1.1.3 From paradigms to conceptual scheme relativism

In Chapter 3, I referred to Sharrock and Read's defence of Kuhn's notion of incommensurability from the charges of impossibility or incoherence levelled against it by Donald Davidson (1974). In addressing the issue, Davidson was also challenging the conceptual scheme relativism that he saw as entailed by the concept of the scientific paradigm in Kuhn's work. In Chapter 7, I will consider Davidson's arguments, and propose that they do not preclude Kuhn's conception of a scientific paradigm.

In what follows here, I will consider a different point, namely, that if we assume the existence of scientific paradigms, then conceptual scheme relativism is easily argued for. Although this may seem obvious, it is useful to derive an argument for conceptual scheme relativism, to examine what it is based on and from perspective it can be framed, and to consider whether intractable disagreements as well as alternative conceptual schemes might give rise to similar arguments for relativism.

In Chapter 1, I have described conceptual relativism as the contention that, because the human mind plays some role in shaping or constructing our perception of what is real, we divide up the world we encounter by applying a different conceptual scheme or framework, or paradigm in the case of Kuhn's account of science, and that there is no means of deciding which frameworks provides the best or correct conception of what is real.

Kuhn's description of science as an activity governed by successive and changing paradigms suggests the following argument for alternatives-induced conceptual relativism. Individual scientists operate as a group in a given time and place to agree the synthesis that will become their paradigm. Subsequent generations of scientists consciously or unconsciously assent to their paradigm, their disciplinary matrix. The agreed paradigm dictates which puzzles the scientists can attempt (what facts in the world are significant), what methods are appropriate, and what solutions are acceptable. Science is defined as that work undertaken within the paradigm, matching facts with theory and articulating the paradigm; thus, science is no more than what it is agreed to be by scientists as a group in a given time and place. But a different group or any different groups of scientists could agree to a different paradigm and thus to other puzzles, facts, methods, and legitimate solutions under other paradigms. Therefore, what
is considered to be science is determined relative to a paradigm and there is no way to compare or judge descriptions of science between paradigms.

Similar to the previous argument for ontological relativism, this argument for alternatives-induced conceptual relativism also fails at the last step, because there is nothing in Kuhn's description of paradigm function, and nothing in the argument up to the last step, that precludes comparing or judging between paradigms. And again, this requirement could be met by including in the description of normal science traditions some property such as incompatibility, incomparability, or incommensurability. Kuhn emphasised that according to his account, normal science traditions are not only incompatible, but often actually incommensurable toward other paradigms (1996, p. 103).

Kuhn includes incommensurability in his description of the function of paradigm for his account to be internally coherent. But this incommensurability ensures that the constructed argument for conceptual relativism can go through. Therefore, Kuhn's account of science requires that the concept of paradigm includes some property that restricts or renders impossible access between paradigms. He includes in the concept of paradigm the property of incommensurability, and the inclusion of this property means that the operation of paradigms entails conceptual relativism.

Given the key function of incommensurability in Kuhn's account and in alternatives-induced arguments for relativism based on his work, whether or not the constructed argument stands up to challenges will depend on the definition of incommensurability we employ and how incommensurability constrains interaction between paradigms. I have argued that Kuhn's account of science implies what I have termed strong incommensurability characterises the relationship between alternative scientific paradigms during normal science. Under conditions of strong incommensurability, the constructed argument for alternatives-induced conceptual relativism would succeed. But it is worth remarking that the alternatives-induced argument for conceptual relativism is framed from a third party perspective, outside of any scientific paradigm. And it also suggests similar arguments for disagreements-induced conceptual relativism.

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32 A possible objection to this argument is that it does not take into account the responsiveness of science to the world that it operates within. That is to say, that scientists working to understand the world under different scientific paradigms would attempt to engage with each other's findings to iteratively improve their understanding of the world and thus reduce the possibility of incommensurability and the relativism it entails. The objection is valid. However, I am not attempting to construct robust arguments for relativism, simply to use reasonably uncontroversial arguments for relativism as a means of determining which aspects of Kuhn's description of science might entail relativism.
relativism based on the paradigm concept. Thus, a third party might argue that there appear to be intractable disagreements within scientific paradigms, where meanings are shared, and between paradigms, between which meanings are not shared, with no means to judge between the disagreement positions. This former type of argument is based on the non-adherent's misunderstanding of how science proceeds, since according to Kuhn's account, disagreements over anomalous phenomena are a part of normal science practice. The latter type of argument is based on the non-adherent's belief that meanings are shared across scientific paradigms, which is incorrect according to Kuhn's account of science, particularly his description of incommensurability between alternative scientific paradigms.

5.1.1.4 Ontological relativism

The previous argument for alternatives-induced conceptual relativism could be extended to yield weak ontological relativism as follows. Assuming all of our experience of the world is mediated by our concepts, given that our concepts are determined by the prevailing paradigm, and given that there is no way to compare across paradigms, then the world we experience is determined by a paradigm that we cannot interrogate with reference to other possible paradigms. Therefore, every group or individual assenting to their paradigm experiences the world relative to the paradigm and not comparable to the world experienced by others assenting to other paradigms. This weak sense of ontological relativism, which can be developed from Kuhn's work, should not be confused with a strong form of ontological relativism in which paradigms not only determine how we experience the world, but also how the world per se is constituted.

5.1.1.5 Epistemic relativism

The previous argument for alternatives-induced conceptual relativism could also be extended to yield epistemic relativism, as follows. Given that all of our experience and knowledge of the world is mediated by our concepts, and given that our concepts are determined by the prevailing paradigm, and given that there is no way to compare across paradigms, then the world we experience and the knowledge we have of it is determined by a paradigm that we cannot interrogate with reference to other possible paradigms. Therefore, every group or individual assenting to their paradigm experiences the world relative to the paradigm and not
comparable to the world experienced by others assenting to other paradigms. Therefore, what is considered to be knowledge can differ between paradigms and is relative to paradigms.

That these arguments can be developed is not surprising, because different manifestations of incommensurability can lead to certain forms of relativism, and certain forms of relativism can lead to other forms of relativism (Chapter 1). For example, semantic incommensurability can lead to semantic relativism, but also to conceptual and ontological relativism. Semantic incommensurability can also lead to conceptual incommensurability and ontological incommensurability, and these can also lead respectively to conceptual and ontological relativism. But semantic relativism can also lead to conceptual relativism and to ontological relativism.

What is notable or surprising in my analysis thus far is that differentiating between the internal, adherent and the external, non-adherent perspective allows us to see that during normal science, the various forms of relativism only beset the non-scientist. During normal science, the scientist is in dogma. For the scientist at the normal science point of a Kuhn cycle, strong incommensurability blocks relativism. As I will discuss in Chapter 6, later in the Kuhn cycle, the scientist will be more willing to interpret other paradigms, under conditions of weak incommensurability, and this will allow adherents to be pluralist about paradigms. However, I will argue that they will not frame arguments for relativism.

In contrast, at any point in the Kuhn cycle, the non-scientist's relativism originates in a different way. They are not committed to a paradigm as the scientist is, so they don't experience any incommensurability, weak or strong. Their relativism does not originate in incommensurability, the lack of common measure, the lack of shared meaning between scientific paradigms. It is grounded, rather, in their lack of a scientific paradigm. The non-adherent can always frame arguments for disagreements-induced and alternatives-induced relativism, whether conditions of strong or weak incommensurability pertain for paradigm adherents.

### 5.1.2 Paradigms and puzzle solving

If an argument for ontological or conceptual relativism based on Kuhn's account of science could be made go through, one might expect that such relativism would be challenged by
science's apparent ability to produce results, both theoretical and practical. For example, by the development of an explanation of the motion of the planets or a new computer or mobile phone technology. Paradoxically, Kuhn contends that according to his description, science is almost assured of its success, because it has set the parameters of the contest. So the success of science does not answer the threat of relativism based on the concept of a scientific paradigm.

Furthermore, Kuhn's description of normal science as puzzle solving itself suggests an argument for conceptual relativism, as follows. Individual scientists operate as a group in a given time and place to agree or assent to their paradigm, their disciplinary matrix. The agreed paradigm dictates which puzzles the scientists can attempt (what phenomena in the world are significant and what facts about them are relevant), what methods are appropriate, and what solutions are acceptable. Scientists working within a paradigm to solve, using approved methods, problems deemed legitimate within the paradigm are guaranteed to succeed. Scientists are not concerned with any puzzles other than those set by the paradigm. Scientists working within different paradigms are addressing different puzzles and developing different solutions. Thus there is no way for scientists within a paradigm to address or solve or compare their work to puzzles outside of the paradigm or in another paradigm. Therefore, paradigms define the scope of puzzle solving, the concepts, theory and facts that the scientists can use and there is no means of comparing or judging concepts, theories, facts etc. or puzzle solutions across paradigms.

Insofar as this argument works within Kuhn's account, it does so because he has expressly specified that scientists within a paradigm are not concerned with any puzzles other than those set by the paradigm. But to completely prevent comparison across paradigms, we would need to interpret this lack of concern as an inability to encounter, engage with, or understand other paradigms. But at this stage in his description of science, Kuhn has not provided the context-specificity, as it were, the impermeability, that an argument for relativism would require. And to deliver conceptual relativism, the argument also needs to assume that there is no means of comparing or judging across these impermeable paradigms from outside of them. Nothing in Kuhn's description thus far has blocked a comparison or judgement across paradigms or from a third perspective. When describing the operation of normal science, scientific paradigms, and normal science as puzzle solving, Kuhn has not described paradigms as impermeable to access outward from within or to access inward from without or un-comparable one to the
other or by a third view outside of all or the relevant paradigms (1996, pp. 10, 36). So the idea that science consists of puzzle solving does not give rise to conceptual relativism.

Later in his text, Kuhn introduces the notion of incommensurability to explain the function of paradigms during normal and extraordinary science (1996, p. 103). But in doing so, he also provides context-specificity that the constructed argument requires. And thus, with the stipulation that paradigms are incommensurable, or strongly incommensurable, the constructed argument from the idea that science consists of puzzle solving to conceptual relativism goes through. In his initial descriptions of normal science as puzzle solving, Kuhn implies that the scientist is not concerned to explore puzzles beyond the scope of their paradigm. But he goes on to describe how exclusive the paradigm is in specifying the puzzles that are legitimate for the scientist. "Other problems, including many that had previously been standard, are rejected as metaphysical, as the concern of another discipline, or sometimes as just too problematic to be worth the time" (Kuhn, 1996, p. 37). And although the exclusivity of the paradigm in this regard is not articulated in terms of shared meaning, it is clearly a result of incommensurability, and what I have termed a strong incommensurability, between paradigms. As Kuhn puts it when describing the rules that constrain puzzle solving, "the existence of this strong network of commitments — conceptual, theoretical, instrumental, and methodological — is a principal source of the metaphor that relates normal science to puzzle-solving" (1996, p. 42).

An argument from puzzle solving to conceptual relativism under conditions of strong incommensurability is as follows. Individual scientists operate as a group in a given time and place to agree or assent to their paradigm, their disciplinary matrix. The agreed paradigm dictates which puzzles the scientists can attempt (what facts in the world are significant), what methods are appropriate, and what solutions are acceptable. Scientists working within a paradigm to solve, using approved methods, problems deemed legitimate within the paradigm are guaranteed to succeed. Scientists are not concerned with any puzzles other than those set by the paradigm, and because of strong incommensurability between paradigms, they do not and cannot engage with such puzzles. Scientists working within different paradigms are addressing different puzzles and developing different solutions. Thus, there is no way for scientists within a paradigm to address or solve or compare or judge their work to puzzles outside of the paradigm or in another paradigm. Therefore, paradigms define the scope of puzzle solving and there is no means of judging puzzle solving across paradigms.
The argument is framed from a non-adherent perspective, external to a scientific paradigm. And it pivots on the final relativising step, that contention that "there is no means of judging puzzle solving across paradigm". In this, the non-adherent is stating their requirement that we should be able to judge by some objective criterion between scientific paradigms. In contrast, the adherent to a scientific paradigm judges according to the standards of the paradigm and would not require such a criterion, and they would not frame an argument for conceptual relativism.

### 5.1.3 Paradigm and rules

In describing further the application of a scientific paradigm through the functioning of rules by different groups, Kuhn seems to leave his conception of science open to the possibility of relativism at the level of meaning or conceptual scheme relativism.

In Chapter 1, I described conceptual relativism as being synonymous with relativism about meaning and with ontological relativism. They are, I believe, different perspectives on the same phenomenon. Conceptual relativism claims that the world is not pre-categorised for us, but rather that we provide the conceptual schemes or frameworks to divide up the world we encounter. These frameworks divide up the world that we encounter, and so our ontology, our beliefs about what objects exist in the world, are relative to our conceptual scheme. In addition, the conceptual schemes determine the meaning we apply to the objects, entities, phenomena that we encounter, and thus our semantic behaviour is relativised to our conceptual scheme.

Before developing an argument for conceptual relativism based on paradigms and rules, I note that Kuhn has not specified at this point in his account that there is any kind of incommensurability between sets of rules (1996, p. 44). Later in his text, Kuhn will specify that incommensurability operates between paradigms, but he does not specify that incommensurability operates between rule sets (1996, p. 103). So any argument for relativism about meaning would need to exploit some other aspect of paradigms and rules.

In fact, the argument developed here exploits the inability of adherents to describe the rules they follow. This is a feature of paradigm operation that is independent of incommensurability between paradigms. So the constructed argument does not fail or succeed because of the
inclusion or exclusion of incommensurability as a property of scientific paradigms. However, the constructed argument does point to the possibility that a non-adherent, someone outside of any scientific paradigm, can frame and argument for semantic relativism based on the difficulty, but not impossibility, of adherents articulating the rules of their discipline.

### 5.1.3.1 From paradigms and rules to conceptual scheme relativism

Kuhn's description of the interaction between a paradigm, and the rules articulated from it, suggests an argument for a semantic perspective on the conceptual relativism that can be developed from his work. For example, sub-groups within the scientific community agree or assent to the paradigm that operates for their field. The sub-groups within the scientific community develop rules, which are the language game members that the sub-group abides by: the "various research problems and techniques that arise within a single normal-science tradition" (Kuhn, 1996, p. 45). Sub-group members can perform research using the rules, but cannot articulate the rules any better than can a lay person, or, we can infer, than a scientist who is not a member of the sub-group. Therefore, neither the members of a scientific sub-group nor scientists in general nor lay persons can articulate the rules of a sub-group. It follows that the rules articulated by different sub-groups might differ. However, we have no easy and reliable way of articulating them for comparison. Therefore, the paradigm may not mean the same thing for scientists working in different sub-groups and so the meaning of the rules and the paradigm are relative to the different sub-groups.

This argument indicates that not only are all scientists working within a shared relativised conceptual schemes or paradigm, but that the different communities and groups of scientists are working within their own versions of this paradigm, and we have no easy and reliable way of adjudicating between these versions.

However, although comparison between paradigms and rule sets may be difficult and unreliable, there is nothing in Kuhn's description that blocks such comparison. Kuhn will later introduce the idea of incommensurability to explain the difficulty, or impossibility of comparison or judgement across paradigms (1996, p. 103). But it is important to note that Kuhn has not specified that there is any kind of incommensurability between sets of rules. His description of the operation of rules concerns the difficulty, but not impossibility, of discovering rules and comparing rules with paradigms. However, Kuhn indicates that to
discover a community's scientific rules, the historian must compare the community's paradigms and the rules that might be abstracted from the more global paradigms. In order to compare paradigms, according to his own conception of science, Kuhn must be describing a situation where the historian is overcoming incommensurability. That is to say, although the historian is not an adherent to any of the scientific paradigms under investigation, they are adherent to their history paradigm. And in order to compare scientific paradigms, the historian must be able to encounter and understand, in some degree, one or more scientific paradigms, all of which are outside the scope of their history paradigm.

In his description of the relationship between paradigms and rules, Kuhn indicates the impact of a person's perspective, internal or external, adherent or non-adherent to a paradigm, on their ability to investigate that paradigm. It may be that the historian, being outside of any scientific paradigm, can overcome incommensurability and encounter various scientific paradigms to discover their rules, whereas the scientists within the various paradigms cannot overcome incommensurability to encounter other scientific paradigms and their rules. That is to say, membership of a scientific paradigm precludes the scientist from overcoming incommensurability regarding other scientific paradigms and other rule sets.

Has the historian, by virtue of their training, their historian's paradigm, special abilities or tools that enables them to compare scientific paradigms? Or is the scientist blocked from accessing a scientific paradigm by membership of a different paradigm, for example, a historian's paradigm? This suggests that incommensurability is not just a relational property of the paradigm, but its effects also depend on who, a scientist or a historian, is examining the paradigm. And from the perspective of my investigation, this seems in concert with the idea I am proposing that framing arguments for relativism depends on the perspective, adherent or non-adherent to a paradigm.

So it seems that Kuhn's description of the operation of rules within paradigms does not exclude the development of alternatives-induced arguments for relativism from a perspective external to the scientific paradigm. This is regardless of any consideration of incommensurability, either strong or weak. But neither do these descriptions exclude the framing of disagreements-induced arguments for relativism. These arguments could, of course, be framed by the knowledgeable non-adherent, such as the historian, viewing a paradigm from outside. For example, they could argue that within a given scientific paradigm, adherents in sub-disciplines hold to different, unarticulated rules. They could thus argue that
there is sufficient common ground between the sub-disciplines, by virtue of being sub-disciplines of a single paradigm, to allow substantive, genuine, intractable disagreement, based perhaps on different interpretations or customisations of the paradigm by different rule sets. Indeed, any paradigm adherent who was willing to admit that rule sets other than their own might also be correct could reasonably frame such an argument. But being adherent to the paradigm, scientists will not make such an admission nor frame such an argument.

5.1.4 Novelty and anomalies, crisis and revolution

Having described the operation of normal science, paradigms, and rules, Kuhn needs to consider some difficulties arising from the all-enveloping nature of the pervasive scientific paradigm. Namely, how can such a description of science allow for novelty — the discovery of new facts and new theories? How can it cope with anomalies, phenomena and discoveries that resist the best puzzle solving efforts of scientists? And how can it allow for change to the paradigm itself, and ultimately, the shift to a new paradigm?

Kuhn considers how scientists respond to anomalies or scientific crisis (1996, p. 81). There are, he says, two universal effects: the first effect is that "all crises begin with the blurring of a paradigm and the consequent loosening of the rules for normal research" (Kuhn, 1996, p. 84) and the second effect is that "all crises close in one of three ways: normal science can accommodate the anomalies, normal science shelves the anomalies for a future research effort, or a new paradigm emerges" (Kuhn, 1996, p. 84).

The resulting transition to a new paradigm is a scientific revolution (Kuhn, 1996, p. 84).

5.1.4.1 From anomaly handling to conceptual relativism

Kuhn's description of how normal science changes to accommodate the anomaly, shelves anomalous phenomena for future research, or changes in response to anomaly suggests another argument for conceptual relativism. Thus, when a normal science paradigm encounters anomaly, it can change to accommodate the anomaly or it can shelve anomalous phenomena for future research or it can continue to confront the anomaly. If a paradigm fails over a period to solve its traditional problems, that is, judged according to its own conceptual framework, it enters a period of crisis and the search for a new paradigm begins, if one is
available. The transition from a paradigm in crisis to a new paradigm, a scientific revolution, is not a cumulative process, but rather it is a reconstruction of the field from new fundamentals. Therefore, the decision to abandon the old paradigm and the decision to adopt the new paradigm are each made relative to their respective paradigms. It follows that these decisions are bounded by the conceptual assumptions of their respective paradigms and the decisions should not be relevant or assumed correct in the other paradigm. Within the individual, the switch to accepting a new paradigm is similar to a Gestalt switch. But for the community overall, the shift to a new paradigm is not a sudden insight, but a gradual shift in the view of the community, so that those who hold the old paradigm are marginalised. In the interim, individuals and groups are working with different concepts, conceiving of the world differently. And because the community cannot compare the concepts they held before with those they hold after the scientific revolution, by definition, there exists conceptual relativism across scientific revolutions.

This argument fails at the final relativising step because nothing in Kuhn's description of how a normal-science paradigm handles anomaly and novelty blocks individuals and the community from encountering, understanding, evaluating, and adopting a competing paradigm. Later in SSR, Kuhn will introduce the idea of incommensurability to describe the difficulty or impossibility of making comparisons between paradigms (1996, p. 103). And ascribing incommensurability to the relationship between competing paradigms during a crisis or revolution would provide the block on comparisons between paradigms that the constructed argument requires in order to entail conceptual relativism.

The constructed argument thus indicates the tension that exists between the anomaly and novelty handling operations of paradigms and the incommensurability that Kuhn says can characterise the relationship between paradigms. It also suggests that any analysis of alternatives-induced relativism that can be attributed to Kuhn's account should take particular care over the precise definition and operation of incommensurability.

This is because incommensurability between paradigms can pose a threat to the internal coherence of Kuhn's description of science. It appears that incommensurability can prevent the transition from a paradigm in crisis to a new, replacement paradigm. Kuhn has described how a paradigm's novelty and anomaly handling strategies can propel the individuals and the community into a state of crisis and revolution, when the search for a new paradigm begins and ends. As recounted in the constructed argument for relativism, the scientific revolution
from a paradigm in crisis to a new paradigm is not a cumulative process, but rather it is a reconstruction of the field from new fundamentals. Therefore, the decision to abandon the old paradigm and the decision to adopt the new paradigm are each made relative to their respective paradigms. And it follows that these decisions are bounded by the conceptual assumptions of their respective paradigms and incommensurability ensures that individuals and the community have no means to adjudicate between the paradigms or the judgements taken within a paradigm about alternative paradigms. As Kuhn says, "the competition between paradigms is not the sort of battle that can be resolved by proofs" (1996, p. 148). If incommensurability blocks all access between paradigms, it follows that the scientists and their community cannot judge between paradigms and so no paradigm shift is possible and no scientific revolution can occur.

However, Kuhn's descriptions of novelty and anomaly handling do not seem to require that incommensurability blocks all access between paradigms. Such incommensurability would be what I have termed strong incommensurability. In fact, according to Kuhn's account, novelty and anomaly handling, scientific crisis, and revolution to a new orthodoxy all involve comparisons between paradigms by individuals and the community between paradigms. These comparisons may be difficult, but if Kuhn's description of science is to be coherent, they must be possible. How could an individual make the decision between paradigms? The old paradigm seems to be at fault by its own standards and the new one seems to be better, but by what standards? Can the new paradigm be judged by the old paradigm's standards or by the standards of the new paradigm, if individuals could provisionally accept them? Could it be that in the inter-regnum between old and new paradigms, a temporary, intermediate system that can bridge the old and new in order to judge their merits with respect to each other, perhaps requiring translation of terms or transmutation of concepts? Or can individuals accept the new paradigm as correct before they can judge by its standards and then accept its own arguments as to why the new paradigm is superior?

Whatever the situation, the shift to a new paradigm requires access between paradigms and Kuhn specified that the relationship between paradigms can be characterised by incommensurability (1996, p. 103). As I have argued in Chapter 4, and as I have shown earlier in the current chapter, although Kuhn did not describe a scale of incommensurability, his account implies what I have termed strong incommensurability characterises the relationship between alternative scientific paradigms during normal science. And as I argue in the next chapter (Chapter 6), Kuhn's account of crisis and extraordinary science and scientific
revolution implies that what I have termed weak incommensurability characterises the relationship between alternative scientific paradigms at other points in the Kuhn cycle.

Before progressing to these issues, it is worth remarking that the constructed argument from novelty and anomaly handling to conceptual relativism is framed from a third perspective. The paradigm adherents would not frame such an argument because of novel or anomalous occurrences, since they are in dogmatic adherence to their paradigm. Even though their paradigm is experiencing difficulties accounting for aspects of the world during periods in advance of extraordinary science and revolution, adherents under conditions of strong incommensurability would not frame such an argument for relativism. Neither would paradigm adherents under conditions of strong incommensurability consider arguments for disagreements-induced relativism. As scientists, they would consider any disagreement within science about a novel discovery or anomalous result as simply another issue to be resolve by science. And they would view any disagreement between the paradigm position on a novelty or anomaly and some position outside of science as a simple case of the other position being wrong. In contrast, to the mind of non-adherents, anomaly handling and novelty generation could provide grounds for both alternatives-induced arguments for relativism such as the one described here and disagreements-induced arguments for relativism. The non-adherent could find grounds for disagreements-induced arguments in their perception that scientists agree on the meaning of statements about the novel or anomalous discoveries, but disagree about the truth value competing groups ascribe to such statements.

5.1.4.2 Addressing some apparent contradictions regarding novelty, anomaly, crisis, and revolution

By working through his text in terms of arguments for relativism, I note that there is no logical necessity to Kuhn's argument for scientific revolutions. Kuhn argument is polemical, persuasive, has the force of analogy, or seems to fit the historical data that he uses as illustration. But there is no logical necessity. Kuhn briefly discusses that there is no logical necessity to verification or falsification (1996, p. 77). But for his own idea, he argues that the history of science shows how things are and that his account of science fits this data (1996, p. 1).
Kuhn's initial description of the role of novelty, anomaly, crisis, and revolution in his description of scientific progress contains several apparent contradictions. In addressing these issues, Kuhn makes an important philosophical commitment to the process of scientific revolution.

It seems contradictory that novelty and anomaly can occur given Kuhn's specification that normal science is tautologously assured that it can solve the problems it sets itself. To meet this challenge, Kuhn asserts that the occurrence of novelty and anomaly is part of the "regular recurring structure" of scientific endeavour. That is to say, he invokes a larger process, the development or progress of science, which consists of periods of normal science, crisis, and revolution.

And it seems contradictory that normal science can both accommodate novelty and also be propelled into crisis by novelty. Rather than relying on a logical principle such as verification or falsification, Kuhn again invokes the process of scientific revolution to explain this difficulty. Novelty and anomaly, he says, can be accommodated by the paradigm (perhaps through ad hoc modifications), or shelved for later attention by the paradigm, or they can precipitate a revolution to a new paradigm.

It seems contradictory that a paradigm that dictates so comprehensively the research environment of scientists can be replaced. How can scientists function in the interim, without a paradigm to guide them? Kuhn again invokes the process of scientific revolution to explain this difficulty: "The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgement leading to that decision involves the comparison of both paradigms with nature and with each other" (1996, p. 77). Later, Kuhn will say that the decision to adopt a new paradigm is made by some, but not all, of the relevant individuals, with those newer to the field and less vested in the old paradigm more likely to adopt the new one. As individuals switch, the community as a whole shifts to the new paradigm, and "the man who continues to resist after his whole profession has been converted has ipso facto ceased to be a scientist" (Kuhn, 1996, p. 159).

These considerations suggest that Kuhn might be open to a charge of circular reasoning. He is describing scientific endeavour using his description of science as a large scale process of cycles of scientific revolution, but then he explains any difficulties that the description encounters by invoking the large scale progress of cycles of scientific revolutions. It seems we
are in similar circumstances to adherents to a scientific paradigm such as Kuhn describes; if we accept Kuhn's description of scientific revolutions, all of the issues raised in the context of that description can be resolved within the description.

Despite this potential circular reasoning, or paradox of analysis, Kuhn has described an account that appears to fit the data of history. In the next chapter, Chapter 6, I will continue to show how distinguishing a scale of strong to weak incommensurability can help to resolve these apparent contradictions.

5.2 Conclusion: Chapter 5

In this chapter, I have constructed and analyzed arguments for relativism based on Kuhn's initial description of the normal science paradigm and related aspects of his account of science: puzzle solving, rules, novelty and anomaly handling. This analysis shows that the paradigm, as Kuhn initially described it, without the specification of incommensurability, does not allow the development of arguments for alternatives-induced relativism. This shows that the possibility of incommensurability is a necessary condition for relativism. However, arguments for disagreements-induced relativism are possible in the absence or under conditions of incommensurability. These arguments can be framed by a third party, a non-adherent to a scientific paradigm.

In SSR, Kuhn introduces the notion of incommensurability as characterizing the relationship between paradigms (Kuhn, 1996, p. 103). And I interpret him as implying that during normal science, paradigms are strongly incommensurable.

Under conditions of strong incommensurability between paradigms, adherents do not allow alternatives-induced relativism, because they are locked in dogma. Under such conditions, non-adherents can frame arguments for alternatives-induced relativism. This difference indicates that it is not only the lack of shared meaning between paradigms, but the type of judgement exercised by adherents and non-adherents that leads to arguments for relativism.

However, by reciprocity, the lack of shared meaning between paradigms entails that there is shared meaning within paradigms. This shared meaning within paradigms provides the conditions for the possibility of disagreements-induced arguments for relativism, but only for
the non-scientist. Under conditions of strong incommensurability between paradigms, adherents consider any disagreement within the scientific paradigm as an issue to be resolved as part of science practice, and any disagreement between the paradigm and some position outside of the paradigm as a simple case of the other position being wrong. Scientists therefore do not make arguments for disagreements-based relativism under conditions of strong incommensurability. However, under such conditions, non-adherents can base arguments for disagreements-induced relativism on the disputes they perceive within a scientific paradigm.

This shows that the possibility of alternatives-induced and disagreements-induced relativism is not dependent on the occurrence of strong incommensurability between paradigms, but on the epistemic position one occupies, internal or external to a scientific paradigm.

In the next chapter, I show how Kuhn's more detailed descriptions of science, after his introduction of the concept of incommensurability in SSR Section IX, imply that a weak sense incommensurability is required during extraordinary science and the revolutionary transition to a new scientific paradigm. I will also examine the impact this weak incommensurability has for the framing of arguments for relativism based on Kuhn's work, making use of the distinction between adherent and non-adherent perspectives and alternatives-induced and disagreements-induced arguments for relativism.
6 Chapter 6: Scientific revolution, incommensurability, and different worlds

6.1 Introduction

In this chapter, I show how Kuhn's more detailed descriptions of science, after his introduction of the concept of incommensurability in SSR Section IX, imply that a weak sense incommensurability is required during extraordinary science and the revolutionary transition to a new scientific paradigm. By weak incommensurability I mean that within a paradigm, adherents can be aware of another paradigm but not share it. They share sufficient meanings to communicate with the alternative paradigm, but do not understand its meanings, methods and standards, or world view as those native to that paradigm do. I also examine the impact this weak incommensurability has for the framing of arguments for relativism based on Kuhn's work, making use of the distinction between adherent and non-adherent perspectives and alternatives-induced and disagreements-induced arguments for relativism.

In the current chapter, I continue to review Kuhn's description of science and present arguments to show how the operation of the components of his account described in Sections IX to XIII, namely, paradigm shift, extraordinary science, and scientific progress, can be interpreted as entailing relativism. My methodology heretofore has been to examine how Kuhn's account of science might give rise to relativism by constructing plausible interpretations of his description, in the absence of a specification that incommensurability characterises the relationship between paradigms, and then in the presence of what I have termed strong incommensurability. This was a reasonable distinction to draw, because in his initial descriptions of science in SSR, Kuhn did not explicitly characterise the relationship between paradigms in terms of incommensurability. Given that Kuhn introduces incommensurability in SSR Section IX, in what follows, I will not consider whether arguments for relativism can be framed in the absence of incommensurability. Instead I examine how plausible arguments for relativism can be framed and whether these interpretations require either a strong or a weak sense of incommensurability. I also examine the effect of weak incommensurability on the framing of arguments for relativism based on Kuhn's account. In this, I make use of the distinctions between adherent and non-adherent perspectives and alternatives-induced and disagreements-induced arguments for relativism.
As in the previous chapter, I am not attempting to construct from Kuhn's description unassailable arguments for relativism. I am merely using the construction of arguments for relativism as an analytical technique for determining what aspects of Kuhn's description of science might lead to relativism.

6.1.1 An argument from incommensurability to several types of relativism

Having relied implicitly on its operation in his initial descriptions of science, in SSR Section IX Kuhn finally introduces the term "incommensurable," to characterise the relationship between paradigms. Kuhn says that the "normal science tradition that emerges from revolution is not only incompatible but often actually incommensurable with that which has gone before" (1996, p. 103). On the basis of this initial descriptions of what we can term meaning incommensurability, methods and standards incommensurability, and world changes incommensurability, the very operation of incommensurability seems to involve relativism about meaning, concepts, knowledge, and ontology. But rather than assuming or taking it on faith that incommensurability leads to relativism about meaning, knowledge, and ontology, as an analytic device, I here develop an argument to explore this idea.

Because incommensurability is a property of paradigms, that is, it characterises the relationship between paradigms, and because it is operational during normal science, crisis, extraordinary science, and scientific revolution, an argument from incommensurability to relativism will naturally involve these aspects of Kuhn's account.

Kuhn's description of incommensurability suggests an argument for relativism about meaning, epistemic relativism (relativism about knowledge, or in terms of SSR, methods and standards), and ontological relativism as follows: Individual scientists operate as a group in a given time and place to agree or assent to their paradigm (understood as a disciplinary matrix) and proceed to work within this normal science tradition. Failure of the paradigm to deal successfully with novelty and anomaly can sometimes lead to crisis, the search for a new paradigm, and revolution, the shift to a new paradigm. The "normal science tradition that emerges from revolution is not only incompatible but often actually incommensurable with that which has gone before" (Kuhn, 1996, p. 103). Incommensurability by definition and use by Kuhn means that there is no common measure between the paradigms, the traditions. So,
by extension, this indicates that there are no common meanings (facts, theories), concepts, or categories between the traditions. Thus, successive scientific revolutions give rise to incommensurable traditions that cannot be adjudicated. Therefore what constitutes science fact, theory, concepts, or categories is relative to a paradigm and cannot be compared across paradigms.

This argument might be better formulated as separate arguments for each of the different forms of relativism, relativism about meaning, epistemic relativism, or ontological relativism. But as it stands, it indicates that it is the description of "incommensurability," meaning "lacking a common measure," that allows relativism to be based on this aspect of Kuhn's description of science. This is logical, since any form of relativism requires not only a variety of different perspectives and either the impossibility of comparing or of judging between the different perspectives.

6.1.2 Scale and perspective

The general paradigm incommensurability that Kuhn describes presents a problem for his account of science. Without being inconsistent, how can general paradigm incommensurability insulate paradigm adherents within the dominant paradigm at one point in the Kuhn cycle, namely during normal science, but allow communications between the dominant paradigm and alternative theories, which are potential alternative paradigms for the discipline, at other points, such as during extraordinary science and scientific revolution? Resorting to different manifestations such as semantic, methods and standards, and ontological incommensurability, or defining epistemic or other forms of incommensurability does not address this issue. In fact, all these manifestations face the same difficulty -- how can any manifestation of incommensurability characterise such different relations between paradigms? I propose that applying a scale of strong to weak incommensurability to Kuhn's account can address this issue. Applying weak incommensurability throughout the account will allow the communication required during extraordinary science and scientific revolution, but it will not insulate the dominant paradigm from alternative scientific theories during normal science. And applying strong incommensurability throughout will insulate the dominant paradigm from alternative paradigms during normal science but will not allow the communication needed for extraordinary research and scientific revolution. Thus, applying a scale of incommensurability whereby strong incommensurability pertains during normal
science and weak incommensurability pertains during extraordinary science and revolution addresses provides a solution to the issue.

Although the notion of a scale of incommensurability can render Kuhn's account consistent on this point, it presents difficulties for any analysis of relativism that might be based on his account. This is because a lack of shared meaning between paradigms as pertains under strong incommensurability would seem to be a prerequisite for framing alternatives-induced arguments for relativism. But under strong incommensurability, as is prevalent during normal science, paradigm adherents are not aware of nor can they interact with alternative paradigms. Thus, they will not or cannot consider alternative paradigms, or consider them to be as likely true as their native paradigm with no means to judge between the alternatives. The adherents cannot frame arguments for alternatives-induced relativism. Any arguments for alternatives-induced relativism can only be framed from a perspective external to the paradigm.

Similarly, the sharing of meanings as pertains under weak incommensurability, for example, during extraordinary science or scientific revolution, seems to be a prerequisite for the intractable disagreement that would engender disagreements-induced arguments for relativism. But under weak incommensurability, for example during extraordinary science, adherents are already doubting their native paradigm's ability to account for anomalies and are unlikely to disagree intractably with what they are coming to view as potential alternative paradigms. The adherents will not frame arguments for disagreements-induced relativism. Any arguments for disagreements-induced relativism will be made from a perspective external to the paradigm.

To address this difficulty, I propose, in addition to applying a scale of strong to weak semantic incommensurability, our analysis should distinguish the perspective from which arguments for relativism might be framed, that of the adherent internal to a paradigm and that of the non-adherent external to the scientific paradigm. We should also consider whether such arguments are alternatives-induced or disagreements-induced arguments for relativism.

6.2 Paradigm shift

Although Kuhn implies the presence of what I have termed strong incommensurability in his initial descriptions of science, in SSR Sections I to VIII, and when he describes
incommensurability itself in Section IX, his detailed considerations of paradigm shifts, extraordinary science, and scientific revolution thereafter require what I have termed weak incommensurability. Examining the following argument from paradigm shifts to epistemic relativism shows how the paradigm shifts that Kuhn has described require a weak sense incommensurability. The occurrence of this weak incommensurability also allows the argument for relativism to succeed.

6.2.1 An argument from paradigm shifts to epistemic relativism

Kuhn's description of how scientific revolution consists of the adoption of an incommensurable paradigm such that scientists encounter a different world suggests the following argument for epistemic relativism, the view that there are no non-perspectival and context-independent claims to (scientific) knowledge. Thus, according to Kuhn's account of science, the entirety of whatever we decide to classify as science consists of repeating cycles of paradigm formation, crisis, extraordinary science (scientific revolution), and normal science. During one of these cycles, a scientific revolution will result in the replacement of one paradigm with an incommensurable paradigm. Any paradigm determines the legitimate problems and methods of that paradigm, and tautologically, the answers to scientific problems that are acceptable within the paradigm. We can consider these the knowledge claims of the paradigm. Therefore during a scientific revolution, one set of knowledge claims is replaced by another, incommensurable, set of knowledge claims, each legitimated by their respective paradigm or perspective. Although we may be able to compare, there is no means of judging between the incommensurable sets of knowledge claims from within the paradigms or from without, from a third perspective. Thus according to Kuhn's description, the entirety of whatever we decide to classify as science consists of repeating cycles of replacement of one set of knowledge claims by another set of knowledge claims, each legitimated by their respective paradigm or perspective. Therefore, according to Kuhn's account of science, there are no non-perspectival claims to scientific knowledge.

This argument seems to indicate that Kuhn's account provides good grounds for epistemic relativism about scientific knowledge. Thus, if we accept that Kuhn's account is an accurate description of science, there are no non-perspectival claims to scientific knowledge. As with all of my previously constructed arguments showing how relativism might plausibly be based on the components of Kuhn's account, this argument pivots on the difficulty or impossibility
of judging, not simply comparing, across incommensurable paradigms. The argument also reveals that the very coherence of Kuhn's account of science is threatened by his definition of incommensurability.

In the constructed argument, using a strong sense of incommensurability, the comparison between paradigms is impossible and the argument for epistemic relativism succeeds. But the revolutionary transition to a new paradigm described in Kuhn's account cannot proceed. Using a weak sense of incommensurability, Kuhn's account is consistent. And the argument for relativism fails. For the purposes of my analysis, it is relevant that even after his introduction and description of incommensurability where he implies a strong incommensurability, in his description of paradigm shifts, Kuhn's use of the term suggests a weak incommensurability.

But in addition to the distinction between strong and weak incommensurability, examining this constructed argument using the distinction between the internal, adherent perspective and the external, non-adherent perspective is instructive. Distinguishing between strong and weak incommensurability throws into contrast the difference in the conditions for the possibility of relativism for scientists and for non-scientists, for those adhering to a scientific paradigm and to non-adherents.

Thus, if we apply strong incommensurability, Kuhn's account does not work because there is no means for scientists to move to a next paradigm. Another result is that under strong incommensurability, all internally generated relativism is blocked because the adherents to a paradigm can only know their own paradigm, and never encounter an alternative. In contrast, weak incommensurability allows Kuhn's account of science to be coherent. And, it also provides the conditions that could lead to internally developed pluralism or relativism. But paradigm adherents, even under weak incommensurability as applies during crisis and extraordinary science, will not develop arguments for relativism. Instead, adherents in crisis assess the different ways of seeing or co-constituting the world presented by alternative paradigms and choose a new paradigm, which is correct by its own standard. That is, the adherents judge by choosing a replacement paradigm. Under weak incommensurability, there is shared meaning and thus it seems that there is the potential for genuine disagreements between alternative paradigms. But scientist don't judge individual disagreement positions, they judge the entire alternative paradigms. And they are not looking to frame disagreements-
induced (or alternatives-induced) arguments for relativism. Instead, they are selecting a new paradigm as a new dogma, their new standard of objectivity.

As Kuhn describes it, during the extraordinary science that precedes a paradigm shift, individuals and groups must encounter competing paradigms (1996, p. 77). Although the decision between competing paradigms will not be made on the basis of relative problem solving ability, Kuhn implies that the debate between paradigms is conducted in these terms. And the individual that adopts a new paradigm in its early days must be able to compare the old with the new in some way so as to motivate their leap of faith. They can only do this if weak incommensurability allows adherents to the paradigm in crisis to be epistemic pluralists. That is, although the adherents know that they should only accept as being true the explanation of novelty and anomaly provided by their current paradigm, they can conceive of a situation where these truths are false under a different paradigm. They know that their own paradigm is failing to make sense of certain knowledge claims that it has been confronted with in the form of novelty or anomaly, and they know that they should not accept the re-interpretation of these contentious knowledge claims offered by a new paradigm, even though they are tempted to do so. But equally, as scientists they will not allow that alternative versions of the world can be correct on their own terms with no means to judge between them. So even under conditions of weak incommensurability, paradigm adherents can be pluralist, but will not frame arguments for relativism, either based on alternatives or on intractable disagreements.

In contrast, under weak incommensurability, a non-adherent, external to the scientific paradigms can frame arguments for alternatives-induced relativism and disagreements-induced relativism. It might seem that under conditions of weak incommensurability, with the allowance of shared meaning across paradigms, alternatives-induced arguments for relativism would be blocked. But this is not the case, because the non-adherent, external to a scientific paradigm, cannot conceive how adherents can judge between apparently equivalent alternative paradigms33. As I have described this, based on Kuhn's account, adherents judge

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33 By "conceive" I mean "conceive as legitimate for themselves." The non-adherent external to the scientific paradigm could imagine, as an intellectual exercise, the type of judgement that the adherent internal to the paradigm exercises. But the non-adherent cannot conceive of this type of judgement as legitimate for themselves. In making this distinction, I follow Sharrock and Read's reading of Kuhn's position such that incommensurability means that we cannot accept the "very-other's point of view" as legitimate for us, although we can appreciate that it was completely convincing for them (Sharrock and Read, 2002, p. 161). This is similar to the distinction that Carol Rovane makes between descriptions of relativism that one can "live" and those that are not a real option for a person (2013, pp. 98, 99). The distinction could also be described in Bernard Williams' terms as the difference between "real" and "notional" encounters between systems of belief (1981).
by choosing a new paradigm. But the opportunity to choose a paradigm that guarantees its own objectivity is not available to those external to all scientific theories. The non-scientist expects that scientists should be constrained to judge which is the objectively correct account of the world by a standard independent of any paradigm, and because this does not occur, according to Kuhn's account, the non-adherent external to a scientific paradigm can frame arguments for relativism about science.

The non-adherent can frame arguments for disagreements-induced relativism because science involves disagreements, sometimes intractable disagreements. To scientists, disagreements within the paradigm are a part of normal science procedure and even intractable disagreements are not grounds for articulating an argument for relativism. But the non-adherent can observe disagreements within the paradigm, where meanings are shared and scientists agree on the meaning of statements but disagree on the truth value ascribed to certain statements, as grounds for disagreement-induced relativism.

In addition, under conditions of weak incommensurability, the non-adherent can frame disagreements-induced arguments for relativism by considering disagreements between scientific paradigms as intractable disagreements. This is possible, because under conditions of weak incommensurability there is shared meaning across paradigms. But such arguments for relativism are based on a misunderstanding of how science operates as described by Kuhn. This is because, according to Kuhn's account, the scientist does not judge disagreement positions between paradigms; they judge by selecting the entire world view. To the scientist, the disagreements between paradigms are not intractable, because the scientist believes there is one correct answer, the one that is coherent with the new paradigm the scientist chooses, and the other disagreement positions (those belonging to the different world views) are incorrect with respect to the newly selected paradigm. Although the non-adherent is not affected by incommensurability, under conditions of weak incommensurability, they might incorrectly perceive that there is common ground or shared meaning between alternative scientific paradigms and even between alternative scientific paradigms and non-science or pseudo-science. From this, they can, erroneously, frame arguments for disagreements-induced relativism. These arguments are ill-founded, yet they can be framed from the external perspective based on the mistaken perception of genuine disagreements under conditions of shared meaning between scientific paradigms and between scientific and non-scientific world views.
6.2.2 An argument from different worlds to ontological relativism

Kuhn's contention that after a scientific revolution, "scientists are responding to a different world" requires that I consider the potential for ontological relativism arising in his work (1996, p. 111).

For example, regarding the Copernican Revolution, Kuhn states that "the very ease and rapidity with which astronomers saw new things when looking at old objects with old instruments may make us wish to say that, after Copernicus, astronomers lived in a different world" (1996, p. 117). And again, "at the very least, as a result of discovering oxygen, Lavoisier saw nature differently. And in the absence of some recourse to that hypothetical fixed nature that he 'saw differently,' the principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world." (1996, p. 118).

At first glance, it does seem that Kuhn is proposing some form of ontological relativism: the position that, for any group or individual, what exists is relative to the language, concepts, frameworks, paradigms etc. of the individual or group. This description suggests the following argument for strong ontological relativism could be drawn from Kuhn's ideas. Thus, in one of his main uses of the term, Kuhn denotes by a paradigm the disciplinary matrix (world view, conceptual framework) that scientists work within. The paradigm determines the meaning of the facts and the theories that constitute the paradigm and therefore that constitute what is defined as scientific. The paradigm, in this usage of the word, thus determines the world that the scientist responds to or encounters. During a scientific revolution, practitioners switch allegiance from one paradigm to a competing paradigm. Thus after a scientific revolution, practitioners are responding to a different world as described by a new set of facts and theories. There is no theory-neutral observation language available to compare the different worlds or the different interpretations of the world, i.e. there exists strong incommensurability between paradigms. Therefore, the world that a scientist encounters or responds to is relative to the paradigm they are working within. Therefore, there are as many incommensurable worlds as there are paradigms.

The implication of this argument for strong ontological relativism is that there are as many incommensurable worlds as there are paradigms. However, the argument is faulty because it, perhaps deliberately, confuses a figurative use of the phrase "determines the world". At issue here is the realist, antirealist, or idealist conception of our relationship with the world, but the
argument takes advantage of the differences in these conceptions for its own purposes. The argument says that the scientific paradigm "determines the world" that the scientist responds to. This means that the paradigm determines the interpretation that the scientist applies to the facts and theories of the world as they encounter it. However, the argument moves to its conclusion by implying that this phrase means that the scientific paradigm determines, constitutively, what exists in the world, rather than what exists for the scientist. The world is extant: its existence is not determined by the paradigm. The paradigm only determines the co-constitution of the world, the perception or interpretation of the noumenal world as the phenomenal world the scientist experiences.

Thus, we should be able to dismiss with this representative argument any charge of extreme ontological relativism against Kuhn's thesis, despite the fact that he states that after a scientific revolution the scientists live in a "different world." Kuhn is speaking figuratively, I contend, as he searches for ways to articulate his ideas about incommensurability. He is not proposing a version of strong ontological relativism and his ideas do not support an argument for such a position.

Kuhn articulates this point himself when discussing the competing paradigms of oxygen and dephlogisticated air:

> After a scientific revolution many old measurements and manipulations become irrelevant and are replaced by others instead. One does not apply all the same tests to oxygen as to dephlogisticated air. But changes of this sort are never total. Whatever he may then see, the scientist after a revolution is still looking at the same world (Kuhn, 1996, p. 129).

But a significant problem remains. It is possible to develop an argument from Kuhn's ideas similar to the one above, but in favour of a weaker ontological relativism, similar to relativism about meaning. The failed argument for strong ontological relativism collapses into an argument for weak ontological relativism, or relativism about meaning, by removal of the assumption that "the paradigm … determines the world that the scientist responds to or encounters", as follows. In one of his main uses of the term, Kuhn denotes by a paradigm the disciplinary matrix (world view, conceptual framework) that scientists work within/adhere to. The paradigm determines the meaning of the facts and the theories that constitute the paradigm and therefore that constitute what is defined as scientific. During a scientific revolution, practitioners switch allegiance from one paradigm to a competing paradigm. Thus after a scientific revolution, practitioners are responding to a different world as described by a new set of facts and theories. There is no theory-neutral observation language available to
compare the different worlds or the different co-constitutions or interpretations of the world. Therefore, the world that a scientist encounters or responds to is relative to the paradigm they are working within.

I note in this regard that some practitioners switch paradigm with their community and others do not and that regardless of making a switch or not, the scientists encounter the same extant world; it is just their interpretation of it that differs, their co-constitution of the phenomenal world they experience through the operation of their paradigm.

Thus, by removing the proposition that the paradigm determines the world for the adherent, we remove the unarticulated proposition that the paradigm constitutively determines the existence of the world for the adherent. What remains is an argument for weak ontological relativism or relativism about meaning.34

The distinctions I have been using thus far to investigate arguments for relativism based on Kuhn's account of science (strong and weak incommensurability, adherent and non-adherent perspectives, alternatives-induced and disagreements-induced arguments) are again useful in examining this argument. Using the proposed scale of incommensurability shows that there is another means of modifying the argument from paradigm shifts and different worlds to weak ontological relativism. As it stands, the argument implies that a strong sense incommensurability is at work so that sharing of meaning does not occur between paradigms. But a weak incommensurability would allow that sharing of meaning does occur across paradigms so that it may be difficult, but not impossible, for adherents to one paradigm to share the perspective of a different paradigm. This weak incommensurability is consistent with Kuhn's account of paradigm shifts. Indeed, a strong incommensurability would prevent the type of transition that Kuhn describes as a paradigm shift. A weak incommensurability also allows for the development of a weak ontological relativism from the idea of paradigm shifts. Thus, before, during, and after a paradigm shift, adherents to the old paradigm can function within their native paradigm's ontology but share meanings, encounter, apprehend, and conceive of the world as describe by one or more competing paradigms. But adherents

34 A more sceptical conclusion is that after successive revolutions, the world has shifted so far from any datum for comparison and the facts and theories about the world have changed to such an extent that we cannot know anything about the world. Kuhn tries to transcend the boundary that relativism about knowledge seems to set for his theory (Kuhn, 1996, p. 170). He does so using an argument for non-goal directed evolution. The problem with evolution, in terms of a search for truth, is that it is not goal directed. Therefore, science might reach its truth, what it considers to be truth under a given paradigm, but science doesn't aim at the Truth, meaning a realist connection with the noumenal world.
will remain pluralist about the alternative paradigms, and as scientists, they will not frame arguments for alternatives-induced relativism. Their pluralism will resolve when the paradigm shift has been completed and the adherents to the new paradigm respond only to the "different world" the new paradigm describes for them. That is, the adherents may consider that the alternative paradigms are equally likely to be correct, but they will not allow that there is no means to judge between them. The paradigms adherents judge by choosing the replacement paradigm and adopt its standard of what is "objectively" correct. In contrast, a non-adherent who is observing from outside of any scientific paradigm can frame arguments for alternatives-induced relativism. They expect that science should be able to judge between the paradigms based on objective criteria and so their judgement is different from the judgement of the adherents.

Because sharing of meaning across paradigms is possible under weak incommensurability, the non-adherents can also frame arguments for disagreements-induced relativism. From their position external to any scientific paradigm, the non-adherent views disagreements between paradigms, for example, about how they carve up the world, as intractable disagreements, made possible under weak incommensurability. But this is a misinterpretation, because a scientist does not judge disagreement positions between paradigms; they judge by selecting the entire world view. To the scientist, the disagreements between paradigms are not intractable, because there is one correct answer, the one that the scientist chooses when they select their replacement paradigm, and the other disagreement positions, those belonging to the different world views, are incorrect with respect to the scientist's newly selected paradigm.

The non-adherent can also frame arguments for disagreements-induced relativism, as it were, independent of the sharing of meaning that occurs under conditions of weak incommensurability. This is because the science conducted within a paradigm can involve disagreements, which can be intractable disagreements. To scientists, disagreements within the paradigm are a part of normal science procedure and are not grounds for articulating an argument for relativism. But the non-adherent can observe disagreements within the paradigm, where meanings are shared and scientists agree on the meaning of statements but disagree on the truth value ascribed to certain statements, as grounds for disagreement-induced relativism.
6.2.3 Non-adherent arguments for relativism

My analysis of the argument from paradigm shifts to epistemic relativism above, and the previous argument from paradigm shifts to ontological relativism, shows that under conditions of weak incommensurability adherents do not frame arguments for relativism about science, but non-adherents to scientific paradigms can do so.

Even under conditions of weak incommensurability, paradigm adherents can be pluralist, that is, they can consider that several alternative paradigms might be correct, but they will not frame arguments for relativism, either based on alternatives or on intractable disagreements. Rather, they will replace their current paradigm, which is in crisis, by choosing a new paradigm, and in doing so, judge which of the alternatives is correct by its own standards. The adherents to the new paradigm can thus resolve any disagreements that seemed to occur between the alternative paradigms in favour of the newly adopted paradigm. Any disagreements that then occur within the new paradigm are seen as part of normal science, as puzzles to be solved.

In contrast, under weak incommensurability, a non-adherent, external to the scientific paradigms can frame arguments for alternatives-induced relativism and disagreements-induced relativism. They do not judge by choosing a new paradigm, as scientists do, and persist in requiring that there should be an objective standard by which to judge between alternative paradigms. The shared meaning that occurs under conditions of weak incommensurability allows non-adherents to perceive that there are genuine disagreements across scientific paradigms and between science and non-science. Based on this, they can frame arguments for disagreements-induced relativism. The former are based on a misunderstanding of how science operates, according to Kuhn’s account, and the latter are based on the mistaken perception of genuine disagreements under conditions of shared meaning between scientific paradigms and between scientific and non-scientific world views. In addition, the non-adherent can also frame arguments for disagreements-induced relativism based on the disagreements that occur within science, independently of the sharing of meaning between scientific paradigms that occurs under conditions of weak incommensurability.
6.3 Extraordinary science and scientific progress

I have argued that Kuhn implies the presence of what I have termed strong incommensurability in his initial descriptions of science, in SSR Sections I to VIII, and when he describes incommensurability itself in Section IX, but his detailed considerations of paradigm shifts, extraordinary science, and scientific revolution thereafter require what I have termed weak incommensurability. Examining the following argument from Kuhn's account of scientific progress to different forms of relativism shows that extraordinary research and scientific progress as he describes it require a weak sense incommensurability. This weak incommensurability allows the argument for epistemic and for ontological relativism to succeed.

6.3.1 An argument from progress through scientific cycles to epistemic or ontological relativism with reference to truth

Kuhn's description of extraordinary research and progress has denied the more usual answer to this question of why we perceive progress in science, namely, verification and falsification. Instead, Kuhn provides an answer by taking an overview of the effects of successive periods of normal science and extraordinary science, both of which, in a tautologous way, guarantee progress. But Kuhn's explanation of why we seem to experience progress, in the sense of increasing puzzle solving ability, through normal science and extraordinary science suggests an argument for several forms of relativism, as follows. Assuming that Kuhn's account of the operation of scientific revolutions is correct, this account explains the apparent progress of science as the overall result of an evolutionary process of improved puzzle solving ability through periods of normal science and extraordinary science. This evolutionary process is not oriented toward any goal, such as the goal of truth. Thus the apparent progress of science may or may not be accidentally moving us toward the truth of our facts, meanings, theories, concepts, and ontologies. And since there is no way of comparing our past, present, future or any other divergent consensus views on scientific truth, we should treat them as true only relative to our current paradigm or be sceptical that any truth can be reached. Therefore, to avoid the sceptical view that any truth is impossible, we might adopt the relativist view that science is paradigm-relative semantically, epistemically, and ontologically.
This argument can go through under conditions of weak incommensurability, which allow some sharing of meaning across paradigms, so that progress across paradigms is apparent. And it is important to note that Kuhn's account of a large scale scientific evolution through relatively smaller scale cycles of scientific revolution cannot function with an exclusively strong sense of incommensurability. His description of science up to his detailed description of extraordinary science in SSR has emphasised how the science of a period is bounded by its paradigm, under conditions that I have termed strong incommensurability. And this insulation within a paradigm is required for normal science to function, on Kuhn's account. But I have argued that for novelty and anomaly handling within normal science to become crisis and extraordinary research, a weak sense of incommensurability is required so that individuals and groups can engage with, understand, compare, and choose between competing paradigms.

Under weak incommensurability, the community should also be able to retain and repurpose and transmute some of the data, facts, theories, etc. of older paradigms for use in the new paradigm. This would allow an evolution across paradigms such as Kuhn describes. However, strong incommensurability would prevent understanding between paradigms or transmutation of resources between them. Each paradigm would constrain its adherents within a paradigm-dependent dogmatism, revolution to a new paradigm would not take place, and Kuhn's large scale scientific progress through successive revolutions could not occur. That is to say, strong incommensurability would lock adherents into dogmatism about their own paradigm.

6.3.2 Applying weak incommensurability to extraordinary science and scientific progress

Although he may not have intended it, specifying a weak sense incommensurability during extraordinary science and scientific revolution is consistent with Kuhn's use of an evolutionary theory of scientific progress, whereas strong sense incommensurability is not. How does this situation arise and what are the implications for Kuhn's theory and any attempt to develop relativism from his description of science?

In the last two pages of his text, Kuhn has introduced the idea of evolution as a concept subtending his explanation of apparent scientific progress, a major explanatory function of his description of science (1996, p. 171).
The Kuhnian account in Darwinian terms might be as follows: a population of paradigms develops, in a place or over time, contextual selection acts on these, and the most successful prevails to become orthodoxy until the inception of a revolutionary cycle that might displace it. But the fit between Kuhn's ideas and Darwin's seems awkward. In biological evolution, the adaptive power of the whole system is largely generated through having huge numbers of individuals and populations, containing mutations that are largely negative for survival, acted upon by selection over time, so that the benefits randomly generated in an individual or population pass into the next generation for further selection. I perceive one advantage that Kuhn's account might usefully adapt from the evolutionary account, the transfer of advantage to the next generation. With a strong sense of incommensurability, paradigms cannot pass on advantage to succeeding paradigms. But with a weak sense of incommensurability, this is possible. I suggest that, although Kuhn may not have intended it, the invocation of an evolutionary account of scientific progress is logical when combined with the operation of a weak sense of incommensurability.

Why would Kuhn specify a non-goal oriented account instead of a goal-oriented account? Assuming that Kuhn would have been aware of the relativist or sceptical potential of a non-goal oriented account of scientific progress, why did he not specify that the evolution of science is goal oriented and that that goal is the truth of scientific facts, theories etc. Perhaps Kuhn believes that he can rescue a telos for science without specifying that it is goal oriented? Maybe it is better, more robust, and more natural, that science approaches truth even though it is not aiming for it? That is to say, perhaps Kuhn believes, as a realist would, that it is inevitable that science will improve the fit between theory and nature.

Whatever Kuhn's reasons for adopting an evolutionary theory, applying a weak sense incommensurability during extraordinary science and scientific revolution is consistent with Kuhn's use of an evolutionary theory of scientific progress, whereas applying a strong sense incommensurability is not. And applying weak sense incommensurability to Kuhn's idea of extraordinary science, revolution, and scientific progress should affect how arguments for relativism could be developed from his account.

Kuhn's account of science specifies incommensurability between scientific paradigms. We can distinguish strong incommensurability and weak incommensurability on the basis of whether or not sharing of meaning across paradigms occurs. The Section I to VIII components of Kuhn's account operate under conditions of strong incommensurability. However, the
Section IX to XIII components require weak incommensurability. Thus it seems that Kuhn's account as a whole requires variation in incommensurability at different points in the cycle of scientific revolution, for the account to be coherent, to function, and to allow the evolution of scientific knowledge.

According to Kuhn's account, under any given scientific paradigm, the paradigm adherents are either engaged in the search for the objective truth of the world, as prescribed by their paradigm, or engaged in the search for a replacement paradigm. According to my reading, the paradigm adherents are dogmatic during normal science, under conditions of strong incommensurability, and pluralist during extraordinary science and scientific revolution, under conditions of weak incommensurability. But adherents will not frame arguments for alternatives-induced or disagreements-induced relativism during either phase of the Kuhnian cycle of scientific revolution. In the case of alternatives-induced relativism, this is because adherents judge between competing alternative accounts by choosing a replacement paradigm and thereby adopting its standard of what is objectively correct. In contrast, non-adherents external to the scientific paradigm can frame alternatives-induced and disagreements-induced arguments for relativism under conditions of strong and conditions of weak incommensurability. This is because they do not judge as adherents do, by choosing a replacement paradigm and thus by choosing the objective standard that they require to judge between paradigms.

According to this reading, adherents are concerned to find the truth of the world, "objectively" correct knowledge claims, categories of being, and networks of meaning relations, according to their paradigm. And scientists who find themselves adhering to successive paradigms, through scientific revolutions, are concerned to find the "objective" truth of the world as prescribed by the successive paradigms. In contrast, the non-adherents who frame arguments for relativism based on the lack of an objective standard that would allow us to judge between the self-prescribed "objective" standards of successive scientific paradigms, are asking that science discover the Truth of the world. They require that science identify knowledge claims, categories of being, and networks of meaning relations that are not dependent on or determined by any scientific paradigm.

In this sense, the non-adherent's arguments for relativism that I have considered preserve a more strict requirement for realism than is supplied by the within-paradigm realism of paradigm adherents. Although arguments for relativism are mostly seen as being detrimental
to knowledge claims, this reminder of a strict realist requirement is, I believe, a positive aspect of such arguments.

The scientists in successive paradigms can consider themselves realist with respect to each paradigm, since they are seeking objective, mind-independent truth using the tools of science (discounting the fact that science itself is mind-dependent, according to Kuhn's account). But the non-adherent views the scientists as changing their description of what is objectively true with each successive paradigm shift, and so they argue that the scientists are antirealist, that they are discounting, but should not discount, the fact that paradigm-dependent science is itself mind-dependent.

6.4 Normativity, realism and antirealism

The position of the non-adherent to a scientific paradigm and the adherent to a scientific paradigm also differs with regard to another judgement: the judgement regarding Kuhn's account itself.

The adherent to a scientific paradigm is working within their paradigm and is realist about the science they conduct under that paradigm. Whether or not they judge Kuhn's account of science to be correct should not affect their within-paradigm realism, which, if they disagree with Kuhn's account, they might consider to be realism. As Kuhn specifies, the adherent is concerned first with learning and then only with working within their paradigm. In crisis and extraordinary research, they are concerned not with theories in the philosophy of science, but with identifying and adopting a new paradigm. Therefore, adherents do not concern themselves with whether or not Kuhn's account is correct, although they may have knowledge of his antirealist ideas about science; they will behave as realists within their paradigm and proceed to be realist with respect to their current paradigm within any succession of paradigms. Subsequent generation of adherents will be untroubled by the history of paradigm shifts, because, as Kuhn specifies, scientific revolutions are rendered almost invisible by the operation of each succeeding paradigm.

In contrast, the non-adherent to a scientific paradigm does not have the guarantee, which is enjoyed by the adherent, that science deals with the real world. If the non-adherent judges that
Kuhn's account of science as paradigm-bound, with its antirealist implications, is correct, then they can construct arguments for relativism based on this account.

The non-adherent arguments for relativism that I have considered can only be made on the assumption that Kuhn's account of science is correct, or at least that his notion that science is paradigm-bound is correct. If the non-adherent makes the judgement that Kuhn's account is not correct, then there are no scientific paradigms, no incommensurability between paradigms, and no alternatives-induced arguments for relativism to be framed. The non-adherent should be able to frame disagreements-induced arguments for relativism, but these could be refuted by arguing that disagreement, even intractable disagreement, is a normal part of scientific proceedings. Thus it appears that the judgement that science is paradigm-bound, that our engagement with the world is mediated by theory, as a more general argument for relativism about science than any of the arguments from paradigm incommensurability to relativism. And this indicates that it is the idea of the paradigm that allows arguments for relativism to be framed from outside of science.

Sharrock and Read are correct in saying that the idea that science is paradigm-bound is the truly radical aspect of Kuhn's account (2002, pp. 99 - 103). And Bird seems to be correct in stating the paradigm is the important source of relativism in Kuhn's account and that incommensurability isn't so important in this respect (2000, p. 188).

As I describe in the next chapter, Chapter 7, Davidson and Putnam, in different ways, have challenged the idea of paradigms and the incommensurability that characterises the relationship between paradigms. Davidson does this by positing that we have unmediated access to the world and Putnam by proposing that science can identify essential properties of objects in the world. In different ways, Davidson and Putnam exemplify the judgement that Kuhn's antirealist account of science is not correct. Rejecting Kuhn's account means that alternatives-induced arguments for relativism based on his description of science cannot be framed. Of course, this still leaves us with the problem of how to account for the events in the history of science that Kuhn describes as revolutions and how to justify a cumulative account of scientific progress.

We can read these philosophers, external to a scientific paradigm, as fallibilist about science because they allow that we need to change the references of terms, adjust meanings, and reset the facts of science occasionally and in a cumulative way. But we can also read Kuhn as a
fallibilist, because he believes that through scientific revolutions we "reconstruct" scientific disciplines "from new fundamentals," ... "a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications" (Kuhn, 1996, p. 84).

6.5 A problem coming into view

I have argued that the idea of a scale does useful work explaining how the same characteristic of paradigms, incommensurability, can insulate them at one point in the Kuhn cycle, during normal science, but allow communications at another point, during extraordinary research.

But I also need to point out a potential problem for the idea of a scale of incommensurability. The problem is that Kuhn refined his conception of incommensurability through his career such that it signifies a semantic notion: local, narrow sense non-translatability of, probably related, key terms in a paradigm. This means that incommensurability is one thing, or different forms or manifestations of incommensurability are reducible to one thing — a semantic notion. It also means, as I interpret Kuhn, that the semantic incommensurability he describes admits of no gradation.

My analysis of Kuhn's account of science describes manifestations of incommensurability rather than different forms of incommensurability. So my investigation is not affected by this aspect of his refinement of incommensurability. However, I interpret Kuhn as intending that the semantic incommensurability he describes admits no graduation, so my idea of a scale of incommensurability faces a challenge.

In the addendum to this thesis, I consider Kuhn's refinement of his notion of incommensurability, and to take account of this refinement, I modify the scale used in my analysis such that it describe effectively strong and effectively weak incommensurability. I propose that although, by definition, incommensurability between paradigms cannot change, the effects of that incommensurability can vary during the Kuhn cycle.

6.6 Conclusion: Chapter 6
In this chapter, I have shown how Kuhn's more detailed descriptions of science, after his introduction of the concept of incommensurability in SSR Section IX, imply that a weak sense incommensurability is required during extraordinary science and the revolutionary transition to a new scientific paradigm. This analysis builds on my analysis in Chapter 5, where I described how Kuhn's initial descriptions of a scientific paradigm, puzzle solving, rules, novelty and anomaly handling imply that what I term strong incommensurability characterises the relationship between paradigms during normal science.

In this chapter, I also examine the impact that specifying weak incommensurability has for the framing of arguments for relativism that might be based on Kuhn's work. In this, I employ the distinctions that I have previously made use of between adherent and non-adherent perspectives and alternatives-induced and disagreements-induced arguments for relativism.

My analysis in this chapter shows that under conditions of weak incommensurability, as I suggest pertains during extraordinary science and scientific revolution, adherents may be pluralist but will not frame alternatives-induced arguments for relativism, whereas non-adherents can frame such arguments, in addition to disagreements-induced arguments. The analysis using arguments for relativism shows that adherents and non-adherents exercise a different form of judgement to each other. Adherents choose a replacement paradigm and judge what is the "objectively" correct account of the world based on this new paradigm, whereas non-adherents judge that scientists should be able to decide between competing paradigms according to some objective criterion that is independent of any scientific paradigm.

When considered together with my arguments from Chapter 5, this shows that the possibility of alternatives-induced and disagreements-induced relativism is not dependent on the occurrence of weak or strong incommensurability between paradigms, but on our epistemic position, internal to or external to a scientific paradigm. This means that the non-adherent to a scientific paradigm can make arguments for both disagreements-induced and alternatives-induced relativism under conditions of both strong and weak incommensurability. However, the adherent to a scientific paradigm will not frame such arguments, regardless of the degree of incommensurability prevailing.
In closing, I indicate how Kuhn's refinement of his conception of incommensurability to mean local, narrow-sense non-translatability of terms might present difficulties for my analysis, given that this refinement precludes a scale of incommensurability.
7 Chapter 7: Challenges to the very idea of incommensurability

7.1 Introduction

In this chapter, I describe how Kuhn's account of science can withstand the charges against it delivered by Donald Davidson in his 'On the Very Idea of a Conceptual Scheme', where Davidson argues that just as we cannot conceive of languages that are not intertranslatable, we cannot conceive of conceptual schemes that are incommensurable (1974). I also consider the challenge to the notion of incommensurability and to Kuhn's account of science presented by the Putnam-Kripke causal theory of reference.

In Chapter 3, I have considered traditional arguments that relativism about scientific knowledge follows from different aspects of Kuhn's account of science as cyclical between periods of paradigm-bound, normal science, and extraordinary research, the search to replace a paradigm that is in crisis. Rather than claiming that Kuhn's ideas give rise to relativism about scientific knowledge, Davidson denies Kuhn the very conditions his account requires: the existence of a separable, conceptual scheme, the existence of scientific paradigms such as Kuhn describes, the existence of paradigm-bound, local holism about meaning.

My analysis shows three things: that Davidson's argument does not rule out the existence of conceptual schemes (only ruling out our ability to access them); that his argument may not apply to the case of scientific paradigms; and that, even if correct, his argument does not preclude Kuhn's idea of a scientific paradigm. I also consider what we can learn from Davidson's arguments about how to reduce arguments for alternatives-based relativism about science.

In this chapter, I also review the contention between Kuhn's notion of incommensurability and Hilary Putnam's conception of meaning and reference in his article "The meaning of "meaning"" (1975). I show that, as with Davidson's argument, the key difference between the Putnam-Kripke causal theory of reference and Kuhn's conception of reference is our ability or inability to access mind-independent reality.
7.2 Davidson's argument

In his famous paper 'On the Very Idea of a Conceptual Scheme', Donald Davidson argues against the existence of what he considers to be the basis of Kuhn's account of science, the paradigm or the conceptual scheme, which he says would lead to conceptual scheme relativism (1974).

Davidson's position is that we share a common co-ordinate system, meaning that our experience consists holistically of the data of the world and the mechanisms by which we process these data (1974, p. 20). This means that there is neither one conceptual scheme, understood as a framework that organises the data of our experience which can be disconnected from that data, nor are there many such schemes. This is because it is not possible to distinguish between a conceptual scheme and empirical content — to claim that this is possible is to accept what Davidson calls the "third dogma" of empiricism (1974, p. 11). Davidson presents a series of inter-related arguments for this position based on his contention that there cannot exist a language that is not intertranslatable to our, or another, language. Davidson says that we can identify conceptual schemes with languages and investigate whether we can say "two people have different conceptual schemes if they speak languages that fail of intertranslatability?" (Davidson, 1974, p. 7). Such failure of translatability could in principle be total or partial, but neither of these is possible. Regarding total failure of translation, the metaphors of a language organising or fitting our experience of the world both, in different ways, involve the notion of translatability. Therefore it does not make sense to talk of total failure to translate a language, given that to be translatable is part of what it is for something to be a language. Regarding partial failure, applying the principal of charity, Davidson says that translation occurs against a background of agreement about what sentences are true, and so partial translation failure cannot occur. Therefore, according to Davidson, as there cannot be languages that are not intertranslatable (if something is a language, it is translatable), there cannot be cognitive schemes that are incommensurable.

I interpret Davidson as extending the idea of holism about meaning within a language to holism about meaning across languages. Davidson's adherence to the idea that the sentences or terms within a language have their meaning in virtue of their relationship to the language as a whole is obvious from the start of the paper. For example, describing examples of conceptual relativism, he says that "sometimes revisions in the list of sentences held true in a discipline are so central that we may feel that the terms involved have changed their
meanings” (Davidson, 1974, p. 5). However, Davidson believes that such changes can be explained "using the equipment of a single language" (Davidson, 1974, p. 6). Davidson underpins his explanation of examples such as this and his extension of holism about meaning within a language to holism about meaning across languages by what he calls our "unmediated touch" with the world, that is, our holistic experience of the world which cannot be differentiated into conceptual scheme and content (Davidson, 1974, p. 20). Reading the arguments against the idea of a conceptual scheme from a Kuhnian perspective, Davidson is describing global as opposed to local holism about meaning, whereas from a Davidsonian perspective, he is describing holism about meaning, which should not be differentiated into "local" and "global."

7.2.1 Setting the context

Davidson begins with some background or introductory remarks on conceptual schemes, conceptual relativism, and examples of this:

The dominant metaphor of conceptual relativism, that of differing points of views, seems to betray an underlying paradox, because differing points of view make sense, but only if there is a common coordinate system on which to plot them; yet the existence of a common system belies the claim of dramatic incomparability (Davidson, 1974, p. 6).

This is Davidson's position, that we have a common coordinate system, and the existence of this would deny that conceptual schemes are sufficiently different that they can be incommensurable i.e. that there would not be a common coordinate system with respect to which they could be compared.

Davidson accepts, as it were for argument sake, "the doctrine that associates having a language with having a conceptual scheme" (1974, p. 6). Thus, Davidson will make his argument in terms of language. The common coordinate system he is arguing for will be language, and his test for the existence of incommensurable conceptual schemes will be the non-intertranslatability of the languages associated with such schemes. Davidson considers two possible cases of failure of translation, total and partial (1974, p. 7).

In what follows I consider two kinds of case that might be expected to arise: complete, and partial, failures of translatability. There would be complete failure if no significant range of sentences in one language could be translated into the other; there would be partial failure if some range could be translated and some range could not (I shall neglect possible asymmetries.) My strategy will be to argue
that we cannot make sense of total failure, and then to examine more briefly cases of partial failure (Davidson, 1974, p. 7).

But it is in his initial consideration of the "purported case of complete failure," that Davidson reveals the thesis underlying his arguments against failure of translation: his rejection of scheme-content dualism, or what he calls the third dogma of empiricism (1974, p. 11). So he urges that the "dualism of scheme and content, of organizing system and something waiting to be organized, cannot be made intelligible or defensible. It is itself a dogma of empiricism, the third dogma" (Davidson, 1974, p. 11).

As characterised by Quine, the first dogma of empiricism, the analytic-synthetic distinction, is the idea that, with respect to all meaningful statements, we can distinguish between statements that are true in virtue of their meaning and those that are true in virtue of both their meanings and some fact or facts about the world. The second dogma, reductionism, is the idea that, any meaningful statement can be recast in the language of pure sensory experience (Quine, 1953). These are "metaphysical articles of faith" according to Quine, and should be rejected; the analytic-synthetic distinction should be rejected because a definition of analyticity cannot be framed that does not itself involve the notion of analyticity or one of its synonyms, and the related dogma of reductionism should be rejected because it has not been shown possible, despite Rudolph Carnap's efforts, to translate statements into a language of pure sensory experience (Quine, 1953).

According to Davidson, giving up these dogma means that we no longer believe we can allocate empirical content sentence by sentence. We have given up on the idea that "we can clearly distinguish between theory and language" (Davidson, 1974, p. 9). The effect is that we now accept that meaning "is contaminated by theory, by what is held to be true" (Davidson, 1974, p. 9). But he says that in conceptual relativism, the first and second dogmas have been replaced by the new, third dogma: the idea of the dualism of conceptual scheme and empirical content (Davidson, 1974, p. 11). Such relativism has moved from the idea that the meaning of our sentences is contaminated by theory to the idea that our experience, the empirical content we experience, is affected by our theoretical framework, our conceptual scheme. The dualism between scheme and content allows that alternative conceptual schemes can exist, and as a result, people can have different experiences of the world. Davidson describes how this can happen through language. He says, the "formula" for generating distinct conceptual schemes, new from old, involves the speakers accepting as true, sentences they previously took to be false. This happens, not because they have come to accept the previous falsehoods as true, but
because a change has come over the meaning of those sentences: because they now belong to a new language (Davidson, 1974, p. 9-10).

Davidson's "formula" for generating distinct conceptual schemes through changes to the meaning of sentences in the languages associated with conceptual schemes suggests a relationship between meaning holism, the idea that the meaning of sentences in a language derives from the meaning of the sentences in the language as a whole, and his idea that we share unmediated access to the world, that we have a holistic experience of the world that cannot be differentiated into scheme and content.

At the end of his paper, contrary to scheme-content dualism, Davidson will give a holistic account of our "unmediated" engagement with the world, an engagement that occurs through language, so that "the truth of sentences remains relative to language" (1974, p. 20). His rejection of scheme-content dualism and his championing of a holistic account of our experiences of the world are touchstones in understanding Davidson's arguments against translation failure and conceptual scheme relativism.

In these arguments, Davidson is targeting the ideas subtending Kuhn's account of science. Contrasting two different metaphors, he says that "(Peter) Strawson invites us to imagine possible non-actual worlds, worlds that might be described using our present language," whereas "Kuhn … wants us to think of different observers of the same world who come to it with incommensurable systems of concepts" (1974, p. 9). Davidson specifies that it is the second metaphor that he wants to work on (1974, p. 9). Whereas Strawson suggests that "using a fixed system of concepts (words with fixed meanings) we describe alternative universes," Kuhn's metaphor suggests quite a different dualism, "a dualism of total scheme (or language) and uninterpreted content" (Davidson, 1974, p. 9).

### 7.2.2 Total failure of translation

In order to test the kind of scheme-content dualism Davidson attributes to Kuhn, he will focus on language and the "failure or difficulty of translation" (Davidson, 1974, p. 13).

According to scheme-content dualism, "something is a language, and associated with a conceptual scheme, whether we can translate it or not, if it stands in a certain relation
(predicting, organizing, facing or fitting) to experience (nature, reality, sensory promptings)."
Although Davidson will disagree with this and present his alternative at the end of the paper,
he sets out to test the idea. As he puts it, "the problem is to say what the relation is, and to be
clearer about the entities related" (Davidson, 1974, p. 13).

The "images and metaphors" used to describe languages or conceptual-schemes of the type
Davidson attributes to Kuhn fall into two main groups specifying that they organize
something or they fit something and that the thing organised is either reality or experience
(Davidson, 1974, p. 14). The notion of organising applies only to pluralities, Davidson says,
but we cannot organise all of nature (Davidson, 1974, p. 14). So organising nature cannot be
used as a criterion of languagehood. Since we cannot organise all of nature, a language or
conceptual scheme must organise experience, the plurality of experience. Although Davidson
does not state it, he then assumes, in keeping with his reading of scheme-content dualism, that
we all have the same experience of the world. Accordingly, we will have to "individuate", that
is, organise, these experiences according to "familiar principles" (Davidson, 1974, p. 14). And
it follows that a language that organises experiences using the familiar principles of our
language "must be a language very like our own" (ibid).

It is important to note that Davidson has not shown that there are no conceptual schemes, but
rather that if there were a language or conceptual scheme that organised the experiences of the
world (which, according to Davidson, we all share) then that scheme or language would be
very much like our own.

But this argument depends on the assumption that we all have the same experience of the
world. And this points to the question of whether this key assumption is something that
Davidson himself believes, or is his reading of scheme-content dualism. That is, whether this
is Davidson's idea of how we experience the world holistically or whether he is interpreting
scheme-content dualism as saying the world is the same for us all. It seems that Davidson is
reading scheme-content dualism as specifying that different schemes are different
perspectives on reality, so that our experience of reality is the same and the purported
conceptual scheme acts upon this experience. For example, Davidson sets up his argument
saying that he wanted to work on Kuhn's metaphor of "different observers of the same world
who come to it with incommensurable systems of concepts" (1974, p. 9). It is true that Kuhn
believes we all engage with the same extant world. But this doesn't mean that Kuhn specifies
that we have the same experience of that world, or that in effect the world we experience is
the same. Whatever Davidson reads scheme-content dualism as implying, Kuhn says that we experience different worlds, that we have different experiences of the world, because of the theory-dependence of observation. The complicating factor is that Davidson also believes that the world is the same for all of us, but he believes this because of his conception that we share unmediated access to the world, not because (as per his reading of scheme-content dualism) we all experience the same world, as content shorn of a conceptual scheme.

Davidson provides additional details on his ideas about our unmediated engagement with the world in 'The Myth of the Subjective' (2001). He begins to describe the emerging "revised view of the relation of mind and the world" by considering what it is we know when we know the meaning of a word or sentence (Davidson, 2001, p. 43). According to the empirical tradition, he says, we learn our first words through "a conditioning of sounds or verbal behaviour to appropriate bits of matter in the public domain" (ibid). So there is a "direct interaction" between "language users and public events and objects" that "largely determines how the learner's words are related to things" (Davidson 2001 p. 44). This means that the correct interpretation of what a speaker means is not determined solely by what is in his head: that is to say, it is not only subjective. And given that "words and sentences derive their meaning from the objects and circumstances in whose presence they were learned", then a word that has been "conditioned by the learning process to be caused to hold true" by the presence of an object will, Davidson says, "(usually) be true" when the object is present. This means that "certain beliefs caused by sensory experience are often veridical, and therefore often provide good reasons for further beliefs" (Davidson, 2001, p. 45). If this reasoning is correct, Davidson says, epistemology has "no basic need for purely private, subjective 'objects of the mind', either as uninterpreted sense data or experience on the one hand, or as fully interpreted propositions on the other (2001, p. 46). And so he advises us, against the tenets of scheme-content dualism or the subject-object dichotomy, that, "content and scheme,..., come as a pair: we can let them go together" (ibid).

In his first argument against total translation failure, Davidson has shown that even according to the organising metaphor that adherents use to describe it, the idea of scheme-content

35 I will return to this issue later in this chapter. Davidson believes we have the same experience of the same world, but Kuhn believes the world we experience depends on our theory. However, our theoretical framework could be applied to the shared experience Davidson proposes. We can make sense of Kuhn's ideas about perception using notions of the noumenal and the phenomenal world. Thus, the world extant is the same for everyone, even without prescribing Davidson's "unmediated" access to the world, but the phenomenal world we experience in a paradigm is different under different paradigms. Then it is possible to allow that we as a species share a holistic experience of the stimuli processed by our minds, underpinning, as it were, the experience we have through theory-dependent observation.
dualism whereby a language stands in an organising relation to our experience does not allow for total failure of translation between languages.

Davidson makes his reliance on our shared experience of the world a little more explicit as he moves on to talk about the fitting metaphor. The general position that he is looking into here "is that sensory experience provides all the evidence for the acceptance of sentences (where sentences may include whole theories)" (Davidson, 1974, p. 15). I take him to mean here that it is not the existence of a thing that makes our sentences true, but rather it is our experience of the thing that makes our sentences about it true (Davidson, 1974, p. 15). And because the evidence we're considering here is all possible evidence, if a theory meets it, then that just means that the theory is true (Davidson, 1974, p. 15). So the fitting metaphor suggests that languages or conceptual schemes fit our experience in that they are true, or largely true. Then according to the fitting metaphor, different, incommensurable conceptual schemes would be "largely true but not translatable" (Davidson, 1974, p. 16). The usefulness of this criterion for distinguishing different schemes depends on how well we understand the notion of truth independent of the notion of translation. And Davidson says, "that we do not understand it independently at all" (Davidson, 1974, p. 16). Tarski's Convention T is not a definition of truth, but it "embodies our best intuition as to how the concept of truth is used" (Davidson, 1974, p. 17). And Convention T succeeds by making essential use of the notion of translation into a language we know. Davidson concludes that there "does not seem to be much hope for a test that a conceptual scheme is radically different from ours if that test depends on the assumption that we can divorce the notion of truth from that of translation" (Davidson, 1974, p. 17).

Davidson concludes that the metaphor of a conceptual scheme fitting reality, that is, being true, cannot be tested independent of the notion that truth involves translating into our native language. He has not shown that there are no conceptual schemes, but rather that we can't make sense of the metaphor of language fitting reality that is used to describe them.

That is to say, no language can fit reality and yet be untranslatable into our language. This is because, if something is a language or a conceptual scheme, it functions by referring to the truth out there in the world, which is the same extant reality for all of us. So nothing could be a language or a conceptual scheme that does not refer to the same true state of affairs as our language, and so no language can be untranslatable because all languages have the truth of the world in common.
There is an interesting duality here. It seems that in his argument Davidson says that according to scheme-content dualism, our experience of the world, as it were, divorced from our conceptual scheme, is the same. So his argument against scheme-content dualism holds on this basis. But Davidson also believes that because we share unmediated access to reality, the world is the same for all of us. So his argument works on his own terms also.

Thus Davidson claims that he has rules out the possibility that we could ever make sense of the idea of an alternative conceptual scheme that is totally incommensurable with our own. But he phrases his conclusion with respect to "the metaphor of a single space within which each scheme has a position and provides a point of view" (Davidson, 1974, p. 17). He says that "neither a fixed stock of meanings, nor a theory-neutral reality, can provide, then, a ground for comparison of conceptual schemes" (ibid). One way to understand him is that he means the notion of a conceptual scheme or language (a fixed stock of meanings) as separable from reality (theory-neutral reality) does not make sense. Our interactions with the world occur within language, and because the world is the same for all of us, our languages deal in the same true propositions, and our different languages will all be intertranslatable. Therefore, Davidson abandons his attempt to "make sense of the metaphor of a single space within which each scheme has a position and provides a point of view" (ibid).

Care and precision is required in the analysis of these arguments, because Davidson is employing ideas he holds, such as Tarski’s description of truth, in working through or arguing against assumptions that he does not adhere to, such as scheme-content dualism and the idea that language stands in some relation to nature. For example, in the argument against the organising metaphor Davidson uses an idea he implies is characteristic of scheme-content dualism: that we have the same experience of the world and that different conceptual schemes can be applied to this. This idea also comes up in his application of Tarski’s Convention T against the fitting metaphor. But this conception of the world providing us with data separated from our mechanism of processing it, is precisely what Davidson believes scheme-content dualism is mistaken about. So it is reasonable to ask whether his conclusion holds, given that it is based on an assumption of scheme-content dualism with which Davidson disagrees.

This indicates that we need to be careful of attributing ideas to Davidson, given that he is arguing as if the assumptions of scheme-content dualism were correct in order to show that these assumptions do not make sense even on their own terms. For example, in his arguments,
Davidson lays out the ideas of scheme-content dualism and tries to show that they do not make sense. But he attributes to scheme-content dualism the idea that the data of the world is the same for everyone. However, the idea of a disjunction between scheme and content does not imply that the content is the same for every scheme. This is, I believe, Davidson's reading of scheme-content dualism, as he might derive from his reading of Kuhn's metaphor of many perspectives on a single reality. This is despite the fact that Davidson is aware that another tenet of conceptual scheme relativism is that theory affects data and so the world is not the same for everyone. In fact, Davidson believes that the world is the same for everyone, but this is because he believes we share unmediated access to the world. So there is potential for confusion between Davidson's reading of scheme-content dualism as specifying the data of the world is the same for everyone and Davidson's own idea that because we share unmediated access to the world, the world is the same for everyone.

A similar difficulty arises with the idea that translatability is a criterion of languagehood. Davidson critiques the scheme-content dualism metaphor of language organising and the metaphor of language fitting our experience of the world and shows that they both imply that for something to be a language just is for it to be translatable. But we can ask, does this very satisfying conclusion hold if we don't accept scheme-content dualism? In the case of the organising metaphor, according to scheme-content dualism as Davidson characterises it, the data of the world separated from the organising scheme is the same for everyone, so an organising scheme other than our own must be similar to our own and thus translatable to our own language or scheme. And in the case of the fitting metaphor, to say that a language or scheme fits the data of the world is to say that it is true, and since the data, separated from any scheme, is the same for everyone, then any scheme or language that fits this data will be translatable to other schemes that fit the data.

In fact, Davidson's adherence to the idea that we all share access to the world that is unmediated by conceptual schemes, argues in a totally different way for the idea that to be a language is to be translatable. Thus, the inherent translatability of language argues against failure of language translation and incommensurability between conceptual schemes. Davidson has used the translatability of language to show that scheme-content dualism does not make sense, but he has his own argument for translatability, an argument that is not dependent on the ideas of scheme-content dualism.
7.2.3 Partial failure of translation

Having argued that total failure of translation does not make sense, Davidson turns to address "the idea of partial rather than total failure of translation" (Davidson, 1974, p. 17).

In the previous sections, Davidson has argued that the metaphors used to describe the role of language and conceptual schemes, the metaphors of organising and fitting experience, do not make sense if we allow the possibility of total failure of translation. This is because the metaphors involve the notion of translation. Now Davidson argues that partial failure of translation does not make sense, because translation (or "interpretation" as he also refers to) occurs against a general background of agreement. To avoid the circularity that his arguments have revealed within the idea of total translation failure, he wants to make the case for translation without using notions associated with translation itself. Thus, Davidson says, "we need a theory of translation or interpretation that makes no assumptions about shared meanings, concepts or beliefs" (Davidson, 1974, p. 17).

Davidson rejects the idea that thought is possible without language and he says that this has serious consequences for translational procedure, as it implies that we cannot attribute mental states to a speaker prior to attributing meanings to his sentences (Davidson, 1974, p. 17). So if we can't translate without knowing what a person believes and we can't know what they believe without translating their sentences, we must have a theory that intermediates between language and concepts but does not take either for granted. This theory is, according to Davidson, that we assume the other holds their sentences to be true and thus largely agrees with us concerning what the relevant facts are. In Davidson's words, "the process is that of constructing a viable theory of belief and meaning from sentences held true" (Davidson, 1974, p. 17). This principle of charity is not an option, but a condition of having a workable theory of interpretation or translation (Davidson, 1974, p. 19). And this theory shows that partial translation failure does not make sense because translation occurs against a background of agreement (Davidson, 1974, p. 20). Davidson concludes that given the methodology of interpretation, that is, translation, "we could not be in a position to judge that others had concepts or beliefs radically different from our own" (1974, p. 20).

Davidson concludes that the attempt to give "solid meaning" to the idea of conceptual relativism and thus to the idea of a conceptual scheme fares no better when based on partial as opposed to total failure of translation. "Given the underlying methodology of interpretation,
we could not be in a position to judge that others had concepts or beliefs radically different from our own" (Davidson, 1974, p. 20). That is, if what Davidson says about interpretation is correct, we cannot judge that someone has a different conceptual scheme to our own, because we can't encounter it. If such a putative scheme existed and were sufficiently different that there is not the shared background that interpretation by his method requires, then we could not encounter it.

Davidson says his investigation shows that the idea that language or conceptual schemes stand in some relation to the world is incorrect. This is Davidson's response to the task he set himself earlier: the task of clarifying what, according to scheme-content dualism, is the relation between language and experience (1974, p. 13). In the last two paragraphs of the paper, Davidson presents his alternative idea, that our experience of the world through language is holistic, not separable into scheme and content (1974, p. 20).

In the second last paragraph of the paper, Davidson summarises his conclusion saying that it would be wrong to announce that communication is possible between schemes and also wrong to say that all speakers of language share a common scheme and ontology. "For if we cannot intelligibly say that schemes are different, neither can we intelligibly say that they are one." (1974, p. 20).

So what is the nature of the common co-ordinate system that Davidson proposes in opposition to the idea of a conceptual scheme? It seems to be the Kantian notion of a species understanding. A close reading of Davidson's conclusion provides evidence that this is the case (1974, p. 20). And I will argue in the next section, that Kuhn's post-Kantian conception of paradigms could be compatible with Davidson's common co-ordinate system.

In the last paragraph of the paper, Davidson describes his conception of our experience of the world, but appears to say some contradictory things. In the first sentence of the last paragraph, he counsels that we should give up what he has called the third dogma of empiricism, in addition, we assume, to giving up the first and second, the analytic/synthetic distinction and the idea of reduction dismissed by Quine. The first dogma says, roughly, that we can distinguish analytic from synthetic statements, the second dogma says that for any, (non-analytic, we assume) statement, we can recast it in terms of sensory experience, and then the third dogma says that within our sensory experience, we can distinguish scheme from content. So together, the rejected dogmas provide a threefold analysis of language in terms of the
analytic/synthetic distinction, experience, and data as separate from conceptual scheme. But Davidson says, in giving up the third dogma (presumably, with the first and second) we have accepted that we do not have access to uninterpreted reality. "In giving up dependence on the concept of an uninterpreted reality, something outside all schemes and science, we do not relinquish the notion of objective truth - quite the contrary" (Davidson, 1974, p. 20).

In the second and third sentences of the last paragraph, Davidson warns that if we accept the idea that whatever does the interpreting can be separated from the data of the world, and (we assume) be substituted by an alternative "scheme", we end up in conceptual scheme relativism. "Given the dogma of a dualism of scheme and reality, we get conceptual relativity, and truth relative to a scheme. Without the dogma, this kind of relativity goes by the board. Of course truth of sentences remains relative to language, but that is as objective as can be" (ibid).

In the fourth sentence of the last paragraph, he says that the truth of a sentence is relative to language, but that is as objective as can be (ibid). I take him to mean that truth or falsity can only be assessed in terms of statements made within a language, as per Tarski, assuming that we can compare the statements for correspondence with reality as we experience it.

In the final sentence of the paper, Davidson says, given that we cannot have uninterpreted access to reality, giving up the idea that we could separate a conceptual scheme from its content (perhaps to characterise a scheme or to derive in this way what the uninterpreted content of stimuli from the world are) does not mean that we give up access to the world. Rather, given that we all have the same interpretive or perceptual mechanism, that we share the same "unmediated touch" with the world, we can judge the truth or falsity of statements in our language against this common co-ordinate system. And given that there is no such thing as an untranslatable language, we can translate from any language into our own to check the truth or falsity of any or all statements. As Davidson puts this, "in giving up the dualism of scheme and world, we do not give up the world, but reestablish unmediated touch with the familiar objects whose antics make our sentences and opinions true or false" (1974, p. 20).

In addition to providing arguments against untranslatability, Davidson's holism about our experience of the world provides an argument for intertranslatability of language. Although there may be different languages used to articulate our experiences of the world, although people may speak different languages and the sentences of the languages take their meaning
from other sentences in the language, the experience of the world articulated in the sentences of those languages is shared and so the sentences of one language can be translated into sentences of another language. That is, because our experience of the world is common, we can use this to translate the meaning of sentences, maintained by meaning holism within our language, into other languages. Thus holism about our experience of the world extends holism about the meaning of sentences in a language so that it applies across all languages. Davidson has therefore argued against the idea of a conceptual scheme, against the notion of failure of language translation, and for the idea that holism about meaning is not localised to languages or conceptual schemes. These arguments present a challenge to Kuhn's account of science, based on the notion of the scientific paradigm, incommensurability between paradigms, and, in his later work, a within-paradigm, or "local," holism about meaning.

7.3 Countering Davidson's argument

I will consider three aspects of Davidson's arguments against untranslatability that might allow Kuhn's account of science to counter the conclusion that the notion of a conceptual scheme or schemes does not make sense. These three aspects are the limitations of conceptual analysis; the sameness or difference of the world, the data, or our experience of the world; and the difference between natural languages and scientific languages. I will show that we should not take Davidson's arguments as ruling out the existence of conceptual schemes; that his arguments do not preclude Kuhn's notion of a scientific paradigm, and that because his arguments concern natural rather than scientific languages, they do not apply to Kuhn's account of science.

7.3.1 The limitations of conceptual analysis

The main work of the Davidson's argument is wrought by his denial of total and of partial translation failure. And these component arguments have a common form or style or motif, namely, that if we cannot conceive of a state of affairs, then that state of affairs cannot be the case. This means that Davidson's arguments against the very idea of a conceptual scheme may be limited by his reliance on our ability to conceive of things as indicative of the state of affairs in the world.
Davidson concludes his argument against the organising metaphor of language according to scheme-content dualism by saying that a language that organises experiences using the familiar principles of our language "must be a language very like our own" (1974, p. 14). He has not shown that untranslatability between languages is impossible, only that, to organise experiences of the world such as we have, we will have to individuate them using the familiar principles of our own language and this will result in a language very like our own. So Davidson's argument depends on everyone having the same experience of the world, and our inability to conceive that such experiences could be categorised differently to how they are organised by our language.

At the end of his argument against the fitting metaphor of language offered by scheme-content dualism, Davidson concludes that there "does not seem to be much hope for a test that a conceptual scheme is radically different from ours if that test depends on the assumption that we can divorce the notion of truth from that of translation" (Davidson, 1974, p. 17). This means that Davidson has not shown there cannot be untranslatable languages, only that we cannot test the notion, because our notion of truth involves the idea of translatability.

And closing off his argument against partial translation failure, Davidson says that given the methodology of interpretation, that is, translation, "we could not be in a positon to judge that others had concepts or beliefs radically different from our own" (1974, p. 20). Thus Davidson has shown, not that alternative conceptual schemes do not exist, but that we are not in a position to judge that they do.

But this form of argument only convinces if we already accept that there can be no alternative conceptual schemes, that is, if we accept that our ability to conceive of how the world is sets the boundaries of what can be the case, of what can exist. In contrast, if we accept that a conceptual scheme mediates our interaction with the world, and that this scheme is potentially replaceable, and separate from the data of the world, then our conception sets no limit on reality. For example, scholars before Copernicus could not genuinely conceive that the earth was in motion. They might be able to conceive of it in the sense of thinking about it as a logical possibility in some thought experiment, but not in the sense that they could own the thought or utter the proposition as their own belief. But the replacement conceptual scheme Copernicus and his followers supplied changed this fundamental aspect of reality as people experienced it. Their ability to conceive of only a static earth was no guarantee that a planetary earth could not be the case. So it seems that Davidson's argument begs the question
against Kuhn, assuming that a separable conceptual scheme cannot exist and arguing, in keeping with this assumption, that we are the arbiters of whether a state of affairs such as the existence of alternative conceptual schemes, can pertain in the world.

So what conclusion can we draw from Davidson's argument without breaching the limits of conceptual analysis? The conclusion seems to be that if alternative conceptual schemes exist, we cannot know about them. But this is a proposition that a proponent of conceptual schemes could agree with. And it indicates that the judgement as to whether or not such schemes exist must be based, not on our experience of alternative schemes, but on some intuition we have about the world. In Davidson's case, it is the intuition that we have unmediated access to the world. Contrary to scheme-content dualism, Davidson believes that we cannot separate language or a conceptual scheme from the data of experience. We cannot, as it were, escape our language or the system that provides our experience of the world to connect with reality separately from our language or that system. This unmediated access guarantees the translatability of language and guarantees that although we cannot access reality directly, we all access reality through the same processing system so that the "objective" reality we share is as objective as we can experience. But against this elegant argument, we must admit that our limitations as a species are not a good guide to reality. Just because we cannot encounter or recognise as a language or culture a very different language or culture, does not mean that it does not exist.

This is what Carol Rovane points out: that Davidson's argument against conceptual schemes, based on the impossibility of an untranslatable language, does not rule out the existence of conceptual schemes, but only shows that if conceptual schemes exist, they are inaccessible to us (Rovane, 2013, p. 179). It is a consequence of the self-affirming nature of Davidson's argument. As I have described, in both his argument against total and his argument against partial untranslatability, Davidson makes us the arbiters of what a language can be, of what is true and of what can conceivably be the case. By his argument, if an alternative conceptual scheme did, in fact, exist, we could neither translate our language to and from its' associated language, nor assent to its view of what is true about the world, nor conceive how it presents the world to those using that alternative conceptual scheme.

Given the limits of conceptual analysis his arguments have revealed and in concession to Davidson, I can allow that our species may experience the world through a single, holistic processing system and that therefore all languages are intertranslatable and effectively
constitute a single network of language. But I will argue in the next section that Kuhn specifies something different, something that can be compatible with this: a local holism about meaning whereby the meaning of terms is agreed by the scientific community through the ostension (pointing out) of similarity relations and co-constitution of the world by the scientific paradigm these relations instantiate (Hoyningen-Huene, 1993, p. 70, 78). What Kuhn describes can occur after the initial stimulus processing: our experience of the world that according to Davidson all humans have in common. My argument that this is the case depends in part on a distinction between our experience of the world as described by Davidson and by Kuhn, which I consider in the next section.36

7.3.2 Our experience of the world

Davidson's characterisation of the scheme-content dualism he associates with Kuhn's account, "a dualism of total scheme (or language) and uninterpreted content" (1974, p. 9), specifies that the data of the world is the same for all of us. But Kuhn clearly states in SSR that "what occurs during a scientific revolution is not fully reducible to a reinterpretation of individual and stable data." (Kuhn, 1996, p. 121). And he describes the reasons for this as being that the data are not unequivocally stable so that after a scientific revolution, the scientist doesn't just interpret the data in isolation from a paradigm, but rather, the data have been transformed, because they have been interpreted under a new paradigm (Kuhn, 1996, p. 122).

With respect to scheme-content dualism, Davidson implies in the arguments against total translation failure, that the data to be organised or fitted by language is the same, is shared by us all, and processed, according to scheme-content dualism, by different schemes or languages. The separability of schemes from content is one aspect of scheme-content dualism, as Davidson characterises it. But this separability of scheme from data, and the replaceability of schemes, does not imply that data remains the same for everyone. The superset of the data

36 Davidson's unmediated access extends his holism about meaning within a language such that the meaning of terms in all languages interrelate and inter-translate. Given that we have the same access to reality, and given his arguments against the failure of language translation based on this access are correct, then the holism of each language extends beyond that language and all languages are in effect a single network of language. There is a difficulty with terminology here. From his position denying the existence of conceptual schemes, Davidson would say there is holism about meaning and we should not or cannot specify holism as being local to a language or a conceptual scheme. But consistent with Kuhn's ideas on paradigms, we can differentiate "local holism about meaning" within conceptual schemes such as scientific paradigms. The contrast term from this perspective might be "global holism about meaning", where the meaning of terms is determined across languages or paradigms. Thus, from a Kuhnian perspective, Davidson is describing global holism about meaning, whereas from a Davidsonian perspective, he is describing holism about meaning, which should not be differentiated into "local" and "global".
provided by the world may be unchanged, but the data attended to by the new scheme may be different and the scheme may process the data differently, so that the experience of the world differs under different schemes.

Davidson has argued that if scheme-content dualism is an intelligible idea then there can be total failure of translation. Against total failure of translation, he has argued that scheme-content dualism describes languages, or schemes, as organising that same data or as fitting the same data, so that failure of translation is not possible. He concludes that the metaphors used to describe scheme-content dualism themselves involve translation, so even to its own description, scheme-content dualism is not intelligible. And Davidson bases a similar argument against partial translation failure on the background of agreement, the sameness of the data presented to us by the world, against which translation always occurs. So again, he concludes that scheme-content dualism does not make sense.

The arguments all depend on the data of the world being the same when it is separated from the scheme that, according to scheme-content dualism as described by Davidson, mediates our engagement with the world. But scheme-content dualism need not include such a constraint. The theory-dependence of observation would suggest that each scheme would affect how the data is perceived by the perceiver. The different schemes may be mediating the same extant world, but the different schemes might attend to different aspects of it or receive different stimuli and process them differently.

Davidson has charged Kuhn with scheme-content dualism, and he reads this as meaning that the data of the world is the same for all of us. But Kuhn's descriptions show that he believes that the data we received from the world is not always the same. Kuhn says that after a scientific revolution, "scientists are responding to a different world" (1996, p. 111) and "the proponents of competing paradigms practice their trades in different worlds" (1996, p. 150). This is despite the fact that the world itself has remained the same and "Whatever he may then see, the scientist after a revolution is still looking at the same world" (1996, p. 129). In SSR, Kuhn is trying to articulate the notion that the paradigm determines, in part, our experience of the world, but that the world extant is also a constraint on our experience. As Kuhn specifies, "though the world does not change with a change of paradigm, the scientist afterward works in a different world (1996, p. 122).
In his final paragraphs of the paper, Davidson urges us to give up the idea that we can have access to reality, unmediated by the mechanisms through which we engage with the world (1974, p. 20). But Davidson implies, that since our species shares the processing mechanisms, and since there is only one extant world for all of us to engage with, we cannot differ so much as to be untranslatable in the meanings we derive from or apply to the world. That is to say, every language that we develop to articulate our conception of the world will be the product of the same mechanisms acting upon the same data and therefore will use the same categories, meanings, etc., even though each language may use different words for these, and so the meanings will be translatable. We can therefore have "objective" access to the world in that we share this common access to the world. Davidson offers this "objectivity" as the best we can do.

From Kuhn's account of science, we could argue that, even if we as a species share access to the world, different communities can agree on different schemas for processing the data received through this access, so that although the extant world is one thing, the world experienced under different conceptual schemes can be different for different communities. According to Hoyningen-Huene's reconstruction of Kuhn's account, the concepts used by a community are acquired by ostension of similarity relations, without or with the help of theories and laws (Hoyningen-Huene, 1993, p. 93). This means that the concepts Kuhn describes as operating within paradigms are agreed by and maintained by the community. They are not concepts that we generate by ourselves from perceptual processing acting on stimuli from the world. So it may be that Davidson's unmediated access relates to these conceptions, the result of stimulation and perceptual processing by the individual. And the concepts Kuhn discusses occur, as it were, at the next level of processing, through consensus generation and learning within a community.

Davidson has said that "in giving up dependence on the concept of an uninterpreted reality, something outside all schemes and science, we do not relinquish the notion of objective truth - quite the contrary" (Davidson, 1974, p. 20). I read Davidson here as arguing that we share, globally as a species, a holism of perception and perceived. We all have the same processing system and the objects of the world are the same for all of us, so we have unmediated, by anything other than our species-wide processing system, access to the world. The perceptions we generate give rise to concepts that we render in language. And so it is always possible to translate between different languages because the concepts are always equivalent, across
languages, because they are generated by the same processing system operating on the same stimuli.

I argue that Kuhn's account of science, which involves local holism about meaning, that is, holism about the meaning of terms within paradigms, is at least compatible with Davidson's arguments. Even if we share a species-wide processing system, that can provide us with perceptions and concepts such as extension, length, circularity etc., this does not prevent a socially maintained processing system from acting on the outputs of such a species-wide processing system. So within a paradigm, adherents generate concepts through object-side and subject-side interactions. For example, object-side perception of lines on a page might be perceived as the construction of a triangle through subject-side processing. Such concepts, when rendered as language, would be particular to the subject-object interaction within the paradigm or conceptual scheme. This implies that the terms for these concepts would not always be translatable into the language associated with other paradigms, because of different subject-object interactions in different paradigms.

There seem to be two different senses of "perception" and our experience of the world or that data of the world operating in Davidson's arguments. Davidson believes that our experience of the world is a holistic experience, the stimuli of the world and the processing we apply to it cannot be separated (1974, p. 20). And in his arguments against conceptual schemes, Davidson says that the data is the same for everyone. Does he forget that in scheme-content dualism, the scheme can affect the data so that the data is not the same for everyone? This is unlikely. It is more likely that this apparent confusion simply shows that Davidson and Kuhn are concerned with different levels of our experience of the world. For Davidson, because of holism about our experience of the world, the data we receive from the world is the same for everyone. Davidson knows that the scheme-content dualists claim that experience is "contaminated" by theory (Davidson, 1974, p. 9). But Davidson is not describing this level of perception. He is describing how the raw stimuli of the world are processed by our perceptual equipment. By applying his sense of "the data" in his arguments, Davidson is insisting that, despite the scheme-content dualists or conceptual scheme relativist idea that theory affects observation, our experience of the world is common to our species. This means, that Davidson's arguments hold good with respect to the initial processing of our perceptions; that we all share a holistic experience of the world through language so that all language are intertranslatable. This is an elegant, Kantian conception of our experience of the world, and it may underpin, or at least not preclude a post-Kantian conception wherein some aspects of our
understanding can differ among members of our species. But even so, Davidson's arguments do not operate at the level of perceptual processing Kuhn is concerned with, at the level of community agreement on a paradigm, where theory affects observation, and the data of the world, our experience of the world, is different for members of our species adhering to different scientific paradigms.

Another way to consider Davidson's dependence on the idea of a common data of experience is in terms of truth. Davidson says the notion of language involves translation, and so it makes no sense to talk about failure of language translation. And all his arguments against failure of translation depend on truth by way of a shared experience of the world. But conceptual scheme relativism, and Kuhn, would dispute that we have this shared experience or common data. For example, Davidson's argument regarding the metaphor of language organising our experience depends on us having the same experience of the world. That is, his argument says that any language will relate to this same experience and so any language must be very much like our own language. And Davidson's argument about the metaphor of language fitting experience depends on Tarski's formal description of how truth operates in language. So Davidson argues that different languages relate to the same world experiences, so if a language is translatable into a set of T sentences, than because different languages relate to the same experiences, then all languages can be translated into T sentences and thence intertranslated. Lastly, Davidson's charity argument regarding partial failure depends on the general background of agreement that he says translation occurs against. That is, Davidson assumes that we each form sentences we take to be true about the world and since the world is the same, we can translate between different languages. But Kuhn would not agree that we have the same experience of the world, even though he believes that the world itself, the world that is available to us, is the same world. For Kuhn, the scientist's experience of the world is mediated by the scientific paradigm, and so "unmediated" access to the world cannot be guarantee that sentences held true in different paradigms relate to the same experience of the world and are translatable.

37 It is possible to quibble over my characterisation of Davidson's position as Kantian, given that Davidson argues against the existence of even one conceptual scheme and as he himself says in 'The Myth of the Subjective,' "Kant thought only one scheme was possible" (2001, p. 40). But my description is useful in distinguishing between the notion that we share a common system of processing the stimuli of the world (and thus a common experience of the world) and the idea that different conceptual frameworks generate for different groups, a different experience of the world.
7.3.3 Natural languages and scientific languages

The concern that Davidson might be misreading Kuhn's account of science as involving "a dualism of total scheme (or language) and uninterpreted content" is related to a worry that Davidson's argument is faulty because of his initial assumption regarding paradigms/conceptual schemes (Davidson, 1974, p. 9). Sharrock and Read believe that Davidson "too readily generalizes" by assuming that whatever holds between a conceptual scheme and a natural language also holds between a paradigm, which is a type of conceptual scheme, and a scientific language. This is because Kuhn is describing schemes/paradigms within and across natural languages (Sharrock and Read, 2002, p. 148).

Davidson assumes that a putative conceptual scheme is equivalent to the language associated with it, whereas Kuhn describes his conception of a scientific paradigm in terms of learned, exemplary problem solutions and a consensually agreed disciplinary matrix. However, we might grant some leeway to Davidson on this point, because Kuhn does come to consider the issue of incommensurability primarily in terms of language and translation or interpretation.

As part of his conclusion, Davidson claims that we have unmediated access to the world, delivered to us as a holistic package of sensory stimuli and the processing of these stimuli. Kuhn's account of scientific paradigms occurs, as it were, at least one level up from Davidson's idea of a holistic process that concatenates sensory stimulation and the processing of these stimuli into perceptions. Kuhn's account concerns how scientists perceive the perceptions, the stimuli with the initial processing of these stimuli, through the operation of the paradigm and how the paradigm thus co-constitutes the phenomenal world of the scientist.

For example, in the constrained fall versus pendulum example, we can understand that the retinas of both the Aristotelean and the Galilean scientists receive similar sense data, and that their physiological systems process the light waves into nervous signals in similar ways (Kuhn, 1996, p. 121). This is in keeping with Davidson's idea of a non-replaceable mechanism we all share and which gives us unmediated access to the world. By "unmediated" I here refer to Davidson's sense of our having "unmediated touch" with the world, a holistic experience of the world that cannot be differentiated into conceptual scheme and content (Davidson, 1974, p. 20). Kuhn's account then describes how one scientist perceives the perceptions as a stone in constrained fall whereas the other perceives them as a pendulum executing harmonic motion.
In the above description, I have used two senses of the word "perception" rather than referring to Davidson's idea as concerning perception and Kuhn's idea as concerning "interpretation." I have used the two senses of "perception" to avoid any suggestion that adherents to different paradigms are merely differently interpreting the same phenomenal world. Hoyningen-Huene is adamant that Kuhn is describing a process of perception and not interpretation (Hoyningen-Huene, 1993, p. 37). By this he means that Kuhn's account specifies that scientists are not seeing something in the world and perceiving it "as" something else, but that the paradigm adherent perceives according to the paradigm. This is because, as Hoyningen-Huene explains, Kuhn is describing a plurality of phenomenal worlds, not a single phenomenal world that we have a shared experience of in virtue of our common perceptual apparatus, nor a single phenomenal world that we interpret differently to our perceptions of (Hoyningen-Huene, 1993, p. 37).

So it is possible that Davidson is arguing against a position Kuhn did not propose, that he has a different idea of a conceptual scheme than what Kuhn means by paradigm, or that Kuhn's ideas are compatible with Davidson's. For example, Davidson seems to argue against what we could call perceptual scheme relativism rather than conceptual scheme relativism. His common co-ordinate system might operate at the level of stimulus and perceptual processing whereas Kuhn is working at the level of the further perceptual processing of perceptual content, stimulus plus the effects of perceptual processing, by scientists according to a paradigm. Davidson seems to be describing how sensation is processed into perception, for example, light stimulus on the eye becomes processed into the perception of a stone in some sort of motion. But Kuhn's explanation comes after or at level above this, in terms of the transmission of stimulus from the world, to our sense modalities, to the brain, and deals with the further perceptual processing of those perceptions, which is theory laden, such that the paradigm adherents perceive either a stone in constrained fall or a pendulum. The confusion is understandable, because Davidson and Kuhn are describing similar concepts with holism as their shared context.

They both allow that the meaning of terms or sentences in a language is determined holistically with respect to other terms or sentences in the language. But in addition to and related to this holism about meaning, Davidson proposes holism about our engagement with the world: the notion that our perceptual process and the stimuli of the world are given to us.
in a holistic experience that can be conceived in thought and articulated in language, but
cannot be separated into scheme and content.

In contrast, Kuhn's theory-laden observation within socially constructed, agreed, learned, and
replaceable scientific paradigms argues for local holism about meaning and reference. But it
is possible that a scientific paradigm as Kuhn describes it is applied to the type of perceptions
that Davidson describes. In the example, both the Aristotelean and the Galilean scientist
receive the same retinal stimuli and process these holistically as determined by their
perceptual modality into the concept of "grey, rock with string attached". Then the
Aristotelean's paradigm further process these data as "grey rock whose fall is constrained by a
string" whereas the Newtonian's paradigm processes them as "grey rock suspended by a
string, executing the harmonic motion of a pendulum".

Thus, it seems that Davidson denies that natural languages constitute separate conceptual
schemes, and he may be right (Sharrock and Read, 2002, p. 148). But Kuhn has described a
paradigm or conceptual scheme as something different than the single processing system that
Davidson believes mediates our interaction with the world. In SSR, Kuhn describes the
features of scientific paradigms, with those who refuse to adopt a paradigm simply being read
out of the profession, and from this we see that he means to describe paradigms as existing
within and across natural languages (1996, p. 18). Thus, Kuhn does not argue that conceptual
schemes are identical with natural languages. And by this reasoning, Davidson's argument
does not apply to Kuhn's account of science.

In summary, Davidson has not simply charged that Kuhn's account of science leads to
conceptual scheme relativism, nor has he simply challenged any conceptual scheme relativism
that might be based on Kuhn's account of science. He has argued that the basis of Kuhn's
account — the paradigm, the conceptual scheme that is separable from the data of the world
— does not exist. I have described how Davidson has not disproved the notion that a
conceptual scheme or schemes could exist, but instead shown that even if such schemes
existed, they would not be accessible to us. I have indicated that Davidson may have been
arguing against a position that Kuhn did not propose, that he assumed too much in his initial
assumption that what holds for natural languages also applies to the language of a scientific
paradigm. And I have argued that, even if Davidson's arguments against the idea of a
conceptual scheme are correct, being based on his idea of unmediated access to reality, they
do not preclude the notion of scientific paradigms, which mediate the scientists' experience of reality, as described by Kuhn.

7.4 Is relativism unavoidable given local holism about meaning?

By examining Davidson's argument, I have distinguished between his holism about our experience of the world and Kuhn's local holism about reference and meaning within paradigms in terms of the levels or stages of our stimulus processing system to which these pertain. And I have suggested that Davidson's argument for intertranslatability, (that is, his argument against the failure of intertranslatability, which is based on holism about our experience of the world) extends holism about the meaning of sentences within a language so that, in effect, all languages constitute a network of intertranslatable meanings. Although Davidson would not allow the distinction, given his stance against the idea of a conceptual scheme, we can characterise the dispute between Davidson and Kuhn as between the possibility of global holism about meaning and local, paradigm-bound holism about meaning. But as I have shown, the former does not have to preclude the latter, so that Kuhn's ideas can be compatible with Davidson's.

But addressing the challenges posed by Davidson's arguments also reveals how local holism about reference and meaning presents a danger for Kuhn. Although Kuhn does not argue for lack of scientific progress, underdetermination, indeterminacy of translation, as per Quine, he does argue for incommensurability and he bases his arguments for this on historical evidence and, after developing it, a theory of meaning/reference that is locally holistic. Because Kuhn's account requires local holism, the other arguments for relativism, those based on underdetermination, indeterminacy, and incommensurability based on these, could be based on Kuhn's ideas through local holism about meaning rather than through his substantive arguments in SSR. The key to preventing this might be to show how Kuhn refined incommensurability, and to give details on his theory of meaning and reference.

It seems that Davidson's fears were correct: once we allow the paradigm account of science, which is a fundamental break with the idea of cumulative scientific progress, given that paradigms are locally holistic determinants of meaning and reference, then relativism cannot be avoided.
However, I propose that the relativist conclusions can be drawn from local holism only if we assume or imply that the holism is static, not open to translation or interpretation. As I will describe later, Kuhn's description includes the provision that paradigms are, at times, open to translation and interpretation. In fact, a great deal of background in one paradigm is taken and reapplied by a successive one. So paradigms share a lot of meanings and background. But key concepts in successive paradigms are incommensurable, and so it is important to explain how the incommensurability that insulates paradigms from each other at certain points in the Kuhn cycle, such as during normal science periods, can allow interpretation across paradigms as required at other points, such as during extraordinary science.

This means that Kuhn needs to describe how incommensurability can work so as to insulate at one point in the cycle and allow communications at another. And so he needs to describe or subscribe to a theory of meaning that will allow paradigms and incommensurability to work in this way. That is, within a paradigm, meaning is generated and maintained through a network of relations so that adherents can develop and learn and the incommensurability between paradigms can insulate and also allow communications across alternative scientific theories when required. That is, Kuhn needs a non-rigid local holism so that learning can happen within and even across paradigms, and some translation and then interpretation of the incommensurable terms can occur when required, such as during extraordinary science episodes.

By this mechanism, Kuhn allows that the local holism that applies during normal science can allow interaction, translation, interpretation, engagement, and learning from other paradigms when required. If the local holism is not closed, static, absolute, then the relativist arguments based on underdetermination do not hold. And this permeability or flexibility or non-rigidity of local holism might allow us to defend Kuhn's description of progress against the relativist argument from a rigid local holism to lack of progress in science. However, disagreements-based arguments for relativism might still be framed, even from within competing paradigms, and third party alternatives-based and disagreements-based arguments could also be made.

This means that the issue of conceptual scheme relativism that can follow from Kuhn's ideas might be resolved by specifying how incommensurability can be circumvented in the context of local holism about meaning. So either Davidson was correct about the issues underpinning this debate, global versus local holism about meaning, or his contribution sent the debate in the direction he indicated.
In this chapter thus far, I have considered Donald Davidson's challenge to the very idea of incommensurability. Another challenge to the notion of incommensurability and to Kuhn's account of science comes in the form of the Putnam-Kripke causal theory of reference.

In the following section, I will review the contention between these positions and show that, as with Davidson's argument, the key difference between the Putnam-Kripke causal theory of reference and Kuhn's conception of reference is our ability or inability to access mind-independent reality.

Reviewing the issues in this debate also provides an opportunity to consider how Kuhn's local holism about meaning was subtended by his developing ideas about reference. In the addendum to this thesis, I will argue that although Kuhn developed these ideas through his career, they are consistent with and can be applied to his account of science in SSR.

In his article 'The Meaning of 'Meaning'', Hilary Putnam argues against the theory that "words have 'intentions', which are something like concepts associated with the world by speakers" and that "intension determines extension," that is, the meaning of the words for the speaker (1975, p. 234). Instead, Putnam argues, that the extension a word has for a particular speaker depends in some way on facts about their environment. And, agreeing with Kripke, he argues that the extension a word has for a speaker partly depends on causal relationships between the speaker and their environment. The word "water" as used in Putnam's now famous Twin Earth thought experiment, is indexical or a rigid designator, as Kripke would say (see below). And this is where the Putnam-Kripke causal theory of reference challenges Kuhn's notion of incommensurability, because such indexicals or rigid designators pick out essential properties of natural kinds, and so the extension of these words will not change across time or space, as in Putnam's Twin Earth experiment, or, we assume, across scientific revolutions (Sharrock and Read, 2002 p. 152).

Putnam sets out to argue his claim that "extension is not determined by psychological state" (1975, p. 222). This traditional theory of meaning, he says, rests on two unchallenged assumptions: (1) that "knowing the meaning of a term is just a matter of being in a certain
psychological state…" and (2) "that the meaning of a term (in the sense of "intension") determines its extension …" (Putnam, 1975, p. 219). By "extension" Putnam means "the set of things the term is true of" (1975, p. 216), and by "intension" he means "the 'concept' associated with the term" (1975, p. 217). At the end of his paper, Putnam says that he wants to retain the second assumption, that "meaning determines extension" but wants to give up the first assumption so that "the psychological state of the individual speaker does not determine 'what he means'" (1975, p. 270).

To make his case, Putnam wants to show that two speakers can have the same intention when using a term, but the term they use can have different extensions (1975, p. 219). As he puts it, "it is possible for two speakers to be in exactly the same psychological state (in the narrow sense), even though the extension of the term A in the idiolect of the one is different from the extension of the term A in the idiolect of the other" (Putnam, 1975, p. 222). To begin making his case, Putnam introduces his "science-fiction examples", the first of which involves Earth and Twin Earth (1975, p. 223). Although this example is complicated by travel by Earthians to Twin Earth, and vice versa, Putnam's main point is clear. On Earth there is a liquid called "water", and on Twin Earth there is also a liquid called "water." Thus, when an Earthian uses the term "water" they have the same intension as when a Twin Earthian uses the term "water". But according to Putnam's setup, a peculiarity of Twin Earth is that "the liquid called 'water' is not H2O but a different liquid" whose chemical formula is very long and complicated and which he abbreviates to XYZ (1975, p. 223). This means that, although the Earthian and the Twin Earthian have the same intension when they use the term "water", the term picks out a different extension on Earth (where it is the set of all molecules of H2O) and on Twin Earth (where it picks out XYZ) (1975, p. 224). On visiting Twin Earth, the supposition by Earthians that "'water' has the same meaning on Earth and on Twin Earth" will be corrected "when it is discovered that 'water' on Twin Earth is XYZ" (Putnam, 1975, p. 223).

It is important to note in this example that Putnam moves immediately to the chemical composition (or formula) as a means of determining the extension of "water." Putnam has said that, other than the differences he will specify in his story, Twin Earth "is exactly like Earth" (1975, p. 223). But he has also specified that on Earth there is a liquid called "water" which falls from the sky as rain, gathers in lakes and oceans, and quenches thirst, and on Twin Earth there is also a liquid called "water" which falls from the sky as rain, gathers in lakes and oceans, and quenches thirst. Ostension and description of such features of water, as Putnam describes in his next version of the Twin Earth example when he rolls back time to "about
1750," should be the means by which Earthians and Twin Earthians, before the development of modern science, characterise the extension of a natural kind term such as "water" (1975, pp. 224, 229). Putnam maintains that the typical Earthian English speaker Oscar1 and their counterpart on Twin Earth Oscar2 "understood the term 'water' differently in 1750 although they were in the same psychological state, and although…it would have taken their scientific communities about fifty years to discover that they understood the term 'water' differently" (1975, p. 224). This is because, "the extension of the term 'water' was just as much H2O on Earth in 1750 as in 1950; and the extension of the term 'water' was just as much XYZ on Twin Earth in 1750 as in 1950" (ibid).

It seems, although Putnam has not stated it, that however natural kind terms are generated in our language, on Earth or on Twin Earth, they somehow pick out the chemical structure of water, even before the science of the time posits such structure, and tracks this essential property across space and across time.

Putnam's example of aluminium pots on Earth and molybdenum pots, which are referred to as aluminium pots on Twin Earth, reinforces his point about intension not determining extension (1975, p. 226). But it also reinforces the idea that it is a chemical or metallurgical feature of the substance called "aluminium" on Earth and "aluminium" on Twin Earth (which Earthians call "molybdenum") that determines the extension of the term "aluminium."

This means that Putnam is proposing that our current science knows the essential property of water. So in 1750, the extension of the term "water" was the liquid that fell as rain, gathered in lakes, quenched thirst etc., and we can now look back and say that people of the time meant by their intension "water" all that stuff that we now know is H2O. Thus, their intention had the extension H2O even though they didn't know it at the time. That is, the essential property of water is, we are certain, H2O and this does not change with time. And this is why, according to Putnam, the Earthian travellers across space to Twin Earth, on discovering the chemical composition of the substance that falls as rain, gathers in lakes and oceans, and quenches thirst on Twin Earth, will report something like "On Twin Earth the word 'water' means XYZ." In this, according to Putnam, they would be correcting their supposition about the extension of the word "water", which refers to a different set of molecules on Earth than on Twin Earth (1975, pp. 223 - 224).
Putnam expands on this idea with a more mundane example. He contends that even though he cannot "tell an elm from a beech tree," the extension of the term "elm" in his idiolect, that is, the set of all elm trees, is nonetheless different than the extension of the term "beech" in his idiolect, the set of all beech trees (Putnam, 1975, p. 226). His conception or intention when he uses the term "elm" or "beech" when he identifies a tree, correctly or incorrectly, does not alter the extension of the term "elm" or "beech," that is, the set of all elm trees and the set of all beech trees, respectively. And even if the extension of these terms was switched on Twin Earth, Putnam and his Twin Earth Doppelganger would be in the same psychological state, that is, would have the same intension, when they use either of these terms, but they would be identifying a different extension, a different set of objects (1975, p. 227).

Putnam says that the extension of terms is not determined by the speaker's psychological state (or intension) because we normally rely on experts to determine the extension of terms such as "water", "aluminium", and "elm", and because terms such as these have an "unnoticed indexical component" so that "water" is stuff that bears a certain similarity relation to the water "around here" (1975, p. 234). Such a term, Kripke calls a rigid designator because in any given sentence it "refers to the same individual in every possible world in which the designator designates" (Putnam, 1975, p. 231). As his examples of gold and jadeite/nephrite show, our reliance on experts and the indexicality or rigidity of terms can occur because a hidden structure determines what it is to be a member of a natural kind, unless the substance has many hidden structures in which case "superficial characteristic become the decisive ones" (Putnam, 1975, p. 241).

Putnam summarises his ideas about meaning:

the extension of a term is not fixed by a concept that the individual speaker has in his head, and this is true both because extension is, in general, determined socially - there is a division of linguistic labor as much as of 'real' labor - and because extension is, in part, determined indexically. The extension of our terms depends upon the actual nature of the particular things that serve as paradigms, and this actual nature is not, in general, fully known to the speaker (Putnam, 1975, p. 245).

There are many points in Putnam's paper with which Kuhn could agree. Given his account of science in SSR and his developing theory of meaning, which I will consider shortly, Kuhn could, for example, agree with Putnam's hypothesis that there is linguistic division of labour and with the idea that ostension and description are important in determining what belongs to the extension set of a term.
And Kuhn could agree, in a qualified way to Putnam's "semantic externalism" in the sense that the features of the world or properties of objects contribute to the meanings of our terms, so that that "meanings' just ain't in the head" (Putnam, 1975, p. 227). But Kuhn would not agree with essentialism, if that means that these features are invariant across paradigms, or over space and time as in Putnam's examples. For Kuhn, the features that we identify in objects and attribute to natural kinds are paradigm co-constituted and so change with paradigms. The terms of our language do not pick out invariant essential properties of objects or kinds.

That is to say, Kuhn could agree that the extension of terms in a language, the set of objects in the world that the terms refer to, depends in some way on the environment the speakers of that language inhabit and a dubbing of features of the environment with the term by the language users at some time. But for Kuhn, this dependency only holds good within the scientific paradigm of those language users. Just as Kuhn believes scientists can determine the truth of the world as prescribed by their paradigm, but not the truth of the world independent of any paradigm, so also, the meaning of our natural kind terms are determined by causal relationships to objects in the world that are grouped as prescribed by the paradigm. Thus, under a different scientific paradigm, as we assume pertains in a very different epoch or on a different planet, the meaning of the natural kind terms can be incommensurable.

Kuhn addresses the challenge of Putnam's thought experiments in his 'Dubbing and Redubbing: The Vulnerability of Rigid Designation' (1990). When introducing Putnam's ideas, Kuhn describes the nature of this challenge. In his account of science as paradigm-determined, Kuhn specifies that the relationship between successive paradigms can be characterised by incommensurability (1996, p. 103). He acknowledges that the change of lexicon and change to the meaning of "some group or groups of interrelated terms" can lead to "problems about the possibility of truth-preserving translations" (Kuhn, 1990, p. 308). And he implies that the initial attempts to address this problem focussed on how language terms mean (Kuhn, 1990, p. 309). Perhaps here Kuhn is thinking of approaches to meaning and truth that use traditional theories such as descriptivism or meaning in use. But Kuhn says, more recently efforts to avoid the problems about truth-preserving translations, or we might say, arguments against incommensurability, have focussed on the reference function of language, on the notion that, whatever changes in meanings occur, the reference of terms does not change so that reference is an indication of truth. The causal theory of reference is the most influential of
these efforts, Kuhn says, and so he will examine two well-known examples in which Putnam applies this theory (1990, p. 309).

This is not immediately obvious, because Kuhn sets his paper up as addressing the difficulty a historian faces trying to understand "some body of past scientific belief" (1990, p. 298). But he takes some pains to set the context of the problem in terms of translatability across lexicons; dubbing, redubbing and rigid designation (1990, p. 298); incommensurability, understanding, and language learning (1990, p. 299); the "sameness-of-kind" relation (1990, p. 311) and his "developing theory of meaning" (1990, p. 301). Kuhn will address two aspects of this theory: holism about meaning and incommensurability or the impossibility of translation across lexicons (1990, p. 301, 308).

According to Kuhn, "knowing what a word means is knowing how to use it for communication with other members of the language community within which it is current (1990, p. 301). But this ability to use a word "does not imply that one knows something that attaches to the word by itself" (ibid). Rather, Kuhn believes, "With occasional exceptions, words do not have meanings individually, but only through their associations with other words within a semantic field" (ibid).

In a retelling of his SSR account of novice induction into the scientific community through language learning, and of how scientific anomalies threaten both the discipline's vocabulary and the theory it relates to, Kuhn describes in terms of lexicons and possible worlds, how incommensurability comes about (1990, pp. 301, 308).

But if change of lexicon results in changes to the meaning of inter-related terms, how could we effect "truth preserving translations"? Attempts to avoid this difficulty, says Kuhn, have emphasized that truth values depend only on reference, rather than on the meaning or mode of use of terms. And one such attempt, the causal theory of reference, "which invokes an original act of baptism or dubbing as an essential determinant of reference," as represented by Putnam's examples of "gold" and "water", is Kuhn's target (Kuhn, 1990, p. 309).

According to Kuhn, travellers through space to the possible world, Twin Earth, made actual in Putnam's example, would not report back about language, about the meaning of term "water," but about chemistry. Their report would be something like, "back to the drawing board! Something is badly wrong with chemical theory." (Kuhn, 1990, p. 310). This is because the
terms "XYZ" and "H2O" belong to the lexicon of modern chemical theory, and the discovery of XYZ, a substance with properties very nearly the same as water but a very different, unabbreviated, chemical formula would "demonstrate the presence of fundamental errors in the chemical theory that gives meanings to compound names like 'H2O' and the unabbreviated form of 'XYZ'" (Kuhn, 1990, p. 310). In this rebuttal, Kuhn is not simply refusing to buy into Putnam's possible world scenario by resorting to the technicalities of modern chemical theory. He is explaining that the term H2O does not pick out some essential property of water or identify some set of objects, such as the set of all H2O molecules, that can be discerned independent of modern chemical theory. Kuhn is rejecting Putnam's essentialism, which seems to discount the revolutionary impact on chemical theory of the discovery of XYZ on Twin Earth. As Sharrock and Read put it, "Putnam's essentialism begs the question against Kuhn by ignoring the knock-on consequences of change in taxonomy, of change in the world-as-understood-by-science" (Sharrock and Read, 2002, p. 4).

To pursue his argument, Kuhn shows the difficulties that arise for essentialism in travels through time, as in Putnam's example, which suggests, "it is chemical formula, not superficial qualities, that determines whether a given substance is water" (1990, p. 311). In his example, Putnam proposes that the correct extension of the term "water," is given by the chemical formula "H2O," now and at a time in the past such as 1750, when people referenced the substance water using accidental properties rather than this essential property. But according to Kuhn, Putnam's use of the "developed scientific vocabulary" of modern chemistry does not help resolve the problem of deciding which properties of water are essential and which are accidental, "which properties belong to a kind by definition, which are only continent?" (1990, p. 312). The problem seems to be an empty one, because as Kuhn says, "theoretical" properties "come no closer to being essential or necessary properties than the superficial ones they appear to supplant" (ibid). And worse, the "so-called superficial properties" are no less necessary than their apparent essential successors" (1990, pp. 312, 313). That is to say, although it seems that theoretical properties are those that define the nature of a substance, any substance cannot have those theoretical properties without necessarily exhibiting certain superficial properties as determined by the theoretical properties. Essentialism would claim that "gold" identifies the extension set of all atoms with atomic number 79. And all atoms with atomic number 79 appear to us as gold in colour. As Kuhn puts it, "that color is a superficial property does not make it a contingent one" (1990, p. 313).
In his summing up, Kuhn sets the idea of dubbing in the context of his account of science as paradigm determined, and in doing so, he argues for the possibility that some terms are non-translatability across paradigms, what he has referred to as "incommensurability" (1990, p. 315). Kuhn wants to say that the dubbing of terms can occur, whether using theoretic, what Putnam would view as "essential" properties, or superficial properties, but that these terms only function correctly between re-dubbing episodes. "Scientific development...has from time to time involved sets of scientific terms in systematically interrelated acts of redubbing. Only for the periods between those acts...does dubbing result in rigid designation" (Kuhn, 1990, p. 298). This sets the idea of dubbing in the context of Kuhn's account of science. But if the acts of dubbing and redubbing involved the same essential properties of objects across different paradigms, there would be no possibility that some terms would be untranslatable across paradigms. This is not the case, according to Kuhn. Dubbing does not simply place a dubbed object within a taxonomic category, "but within a taxonomic system (Kuhn, 1990, p. 314, 315). In places, an old and a new lexicon can "embody differently structured, nonhomologous taxonomies" and so statements "from the regions where the two differ are (were) not translatable between them" (Kuhn, 1990, p. 315).

What is at issue here is a difference of intuitions about the world, as Putnam anticipated in his paper: the difference between a realist and an antirealist intuition (1975, p. 236). For the strong antirealist, Putnam says, it does not make sense to say that the extension of the term used by Archimedes to refer to gold should be determined using our modern theory of what it is for something to be gold. This is because "... the antirealist does not see our theory and Archimedes' theory as two approximately correct descriptions of some fixed realm of theory-independent entities, and he tends to be sceptical about the idea of 'convergence' in science he does not think our theory is a better description of the same entities that Archimedes was describing" (ibid). In this, Putnam has linked the issues of progress in science, truth, and realism. The antirealist, he says, "does not have the notions of truth and reference available extra-theoretically. But extension is tied to the notion of truth. The extension of a term is just what the term is true of" (Putnam, 1975, p. 236).

Kuhn does not address the issue of our intuitions about the world in this paper. But he does show that his notion of incommensurability, the occurrence of non-translatable terms, can see off the challenges presented by essentialism and Putnam's application of the causal theory of reference in his Twin Earth examples. We cannot, as essentialism would require, use scientific terms to pick out properties of objects independently of the theory within which the
terms are developed and we cannot tell which properties of objects are essential and which are accidental. In fact, what essentialism labels as "accidental" properties are just as necessary as what it labels "essential."

Putnam believes that our science can discover the essential properties of objects, such as the correct extension of the terms "water," which people in 1750 only approximated using superficial properties. But Kuhn says both the theoretical and superficial properties of objects or kinds are theory-laden and therefore when theory changes, the properties will change and the terms in one theory will be untranslatable into the terms of a successor theory.

Thus, Putnam and Kuhn are not disagreeing over whether reference isn't only in the head (isn't only determined by psychological states) or that meaning is partly socially determined. Kuhn could agree with these ideas and with the idea that the terms used by experts pick out the essential properties of natural kinds and the general population use the terms for these kinds in a division of linguistic labour. But Kuhn would dispute the objectivity of the essential properties. He would say that they are socially determined or agreed within the paradigm, that they are therefore paradigm-bound and will change with a change of paradigm, that the meaning of the terms does not persist through paradigm change, that the terms do not provide a realist link to the world.

7.6 Conclusion: Chapter 7

In this chapter, I have described how Kuhn's account of science can withstand the charges against it delivered by Davidson in his 'On the Very Idea of a Conceptual Scheme' (Kuhn, 1996, Davidson, 1974). I have examined Davidson arguments to the effect that just as we cannot conceive of languages that are not intertranslatable, we cannot conceive of conceptual schemes that are incommensurable (1974). Davidson's arguments against total and against partial failure of translation are similar attacks on scheme-content dualism and depend on his reading of scheme-content dualism as specifying that the data of experience purportedly separable from the organising scheme is the same for everyone. Davidson opposes this view with his own conception of our engagement with the world, a global holism about experience. However, Davidson's arguments only apply to what we can conceive, rather than what might be the case. They may not go through if the data of the world is not the same for all of us, if our observation is theory laden. And they may only apply to natural, rather than scientific,
languages. For these reasons, I have argued that the local holism about meaning in Kuhn's account of science is at least compatible with the global holism about our experience of the world described by Davidson in his 'On the Very Idea of a Conceptual Scheme' and with the global holism about meaning that results (1974). Davidson's arguments are useful to students of Kuhn's work because in attacking the very idea of a conceptual scheme, Davidson draws attention not only to aspects of Kuhn's description of science, such as paradigm, incommensurability, and different worlds, but to the underpinning Kuhn requires for these to function: a theory of meaning, a holism about meaning that is local to paradigms, a holism that Davidson denies can exist.

In this chapter, I have also considered the challenge to the notion incommensurability posed by the Putnam-Kripke causal theory of reference as deployed by Hilary Putnam. The exchanges between Kuhn and Putnam on this issue point to the semantic nature of incommensurability. Kuhn's responses to the challenges presented by Davidson and by Putnam indicate how he was developing his conception of incommensurability and refining it to a semantic notion based on a theory of meaning and a theory of reference. In an addendum to this thesis, I indicate how Kuhn's refinement of his conception of incommensurability to mean local, narrow-sense non-translatability of terms might present difficulties for my analysis, given that this refinement seems to preclude a scale of incommensurability. And I indicate how this can be avoided by modifying my scale slightly.
7.7 General conclusion

This thesis shows that the possibility of alternatives-induced and disagreements-induced relativism is not dependent on the occurrence of weak or strong incommensurability between paradigms, but on the epistemic position one occupies. That is to say, the non-adherent to a scientific paradigm can make arguments for both disagreements-induced and alternatives-induced relativism under conditions of both strong and weak incommensurability. In contrast, the adherent to a scientific paradigm will not frame such arguments, regardless of the degree of incommensurability prevailing.

The main conclusion of this thesis can also be phrased in terms of judgement. Thus, we can say that it is not only the lack of shared meaning between paradigms that allows arguments for alternatives-induced relativism to be grounded in Kuhn's account of science in SSR, but the type of judgement available to non-adherents external to a scientific paradigm compared to the type of judgement available to adherents internal to a paradigm. And the difference in the type of judgement, internal to and external to a paradigm, also allow non-adherents to frame arguments for disagreements-induced relativism, although sometimes this is due to misunderstanding how science works according to Kuhn's account. Adherents will not, and during normal science cannot, frame arguments for relativism, whether disagreement-induced or alternatives-induced. Non-adherents can always frame both disagreement-induced and alternatives-induced arguments for relativism based on Kuhn's account of science.

More generally, we can say that a non-scientist observing from outside of a scientific paradigm, lacking objective criteria to assess the meaning of terms in scientific language; the methods and standards, including knowledge claims, of the paradigm; and the ontological commitments of the paradigm, can articulate arguments for relativism at any point in the Kuhnian cycle of scientific revolution. In contrast, scientists working within a scientific paradigm adhere to the semantic, methods and standards, and ontological criteria of the paradigm, accept these standards as objectively correct, and so they do not frame arguments for relativism about science at any point in the Kuhnian cycle.

At the start of this thesis, I drew together a number of distinctions to use in my investigation into the relativism that might be grounded in Kuhn's account of science. I described relativism
and pluralism as responses to uncertainty about our knowledge of the world and our inability to judge between competing accounts of the world, differing in terms of a constraint to judge that is felt by the relativist but not by the pluralist. I described different forms of relativism in different domains, considered the inter-relatedness between them, and adapted a general description of relativism based on the constraint to judge. I reviewed Carol Rovane's distinction between disagreements-induced and alternatives-induced arguments for relativism, and I used this to sketch the distinction between perspectives on relativism from within and from without of a paradigm.

But these distinctions were not the only ones that I invoked to investigate Kuhn's account of science in SSR, and indeed, that account itself suggested other distinctions. These include the different descriptions of incommensurability, different forms or manifestations of incommensurability, possible scales of incommensurability, Kuhn's refinement of his conception of incommensurability, and his awareness of the difference between the adherent and the non-adherent perspective.

The traditional charges of relativism against Kuhn focus on the notion of the scientific paradigm and the property of incommensurability between paradigms and Kuhn's conception of within-paradigm truth. In describing these charges, I have shown how incommensurability is based on holism about meaning. That is, the arguments about incommensurability are in essence about holism about meaning. And local as opposed to global holism about meaning is an important distinction in allowing the possibility of incommensurability, as denied by Donald Davidson. But the traditional arguments fail to mention the possibility of disagreements-induced relativism and the effect of the adherent or non-adherent perspective on arguments for relativism. And they do not make clear the effect of forms or manifestations of incommensurability or a scale in the severity of incommensurability.

To investigate the traditional and other possible charges of relativism that might be grounded in Kuhn's account of science, I constructed arguments for different types of relativism and examined them using the various distinctions drawn from the literature: relativism versus pluralism, disagreements versus alternatives, internal versus external perspective, forms of incommensurability versus manifestations of incommensurability, strong incommensurability versus weak incommensurability, and local versus global holism about meaning. This examination shows that what I term strong incommensurability is required during normal
science, but weak incommensurability is required during extraordinary research and for paradigm shifts to occur in the Kuhn cycle. Under conditions of strong incommensurability, arguments for relativism can be framed, but from an external perspective only. So it is not only the lack of shared meaning between paradigms, but the kind of judgement, adherent or non-adherent, internal or external, that determines whether arguments for relativism can be made. Shared or not shared meaning, that is, incommensurability, is not the deciding factor in relativism, because there can be disagreement-induced relativism under conditions of shared meaning as well as alternatives-induced arguments under conditions of strong incommensurability. My investigation also shows that what I term weak incommensurability is required to allow transitions from one paradigm to another within the Kuhn cycle. Under conditions of weak incommensurability, the adherent, internal to a paradigm could, but would not, frame arguments for relativism. In contrast, the non-adherent, external to the paradigm can frame such arguments.

I conclude that, contrary to claims by many influential philosophers, the occurrence of incommensurability (the lack of shared meaning between paradigms) alone cannot lead to arguments for relativism, but that arguments for relativism can be framed through an exercise of judgement by non-adherents external to a scientific paradigm.
8 Addendum: Kuhn's refinement of incommensurability

8.1 Introduction

In this addendum, I describe how Kuhn refined his conception of incommensurability throughout his career such that it was a semantic phenomenon, and I argue that we can apply this conception of incommensurability as semantic incommensurability retrospectively to Kuhn's account of science in SSR. The idea of a scale of incommensurability that I use in this thesis is challenged by Kuhn's refinement of his conception of incommensurability to mean semantic incommensurability, which I interpret as allowing no graduation. Rather than argue that Kuhn's later, refined conception of incommensurability is not applicable to his earlier account of science in SSR, I show that it is applicable. I then describe how the scale of incommensurability can be modified such that it meets this challenge and continues to provide insight into Kuhn's account of science.

In the first two sections of this addendum, I examine Kuhn's later refinement of the concept of incommensurability through Hoyningen-Huene's reconstruction of Kuhn's account of science. I then briefly consider Kuhn's original articulations in SSR, where he seems to describe incommensurability as a complex of three forms of incommensurability: semantic, methods and standards, and different worlds (perceptual, or experiential, or ontological incommensurability depending on how we read him). And I argue that Kuhn can be interpreted as describing these as manifestations of semantic incommensurability in SSR.

Drawing again on Hoyningen-Huene's reconstruction, I describe how Kuhn explains how scientists learn to co-constitute their phenomenal world through language during their education into paradigm adherence. And I consider what Kuhn would need to supply in order to subtend his ideas about incommensurability: a theory of knowledge, ontology, meaning and reference that makes sense of saying that a scientist's use of language in some way generates the world they encounter.
8.2 Kuhn's refinement of "incommensurability"

There is broad agreement that Kuhn changed his description of incommensurability throughout his career, but it seems that the later, refined versions were all compatible with the key ideas he was articulating in SSR. According to Howard Sankey, in his survey of the current state of play regarding incommensurability, "Kuhn originally used the term to describe methodological, semantic and perceptual differences which impede communication between the advocates of rival paradigms ... In subsequent work, Kuhn restricted incommensurability to semantic relations between theories, though his use of the term continued to evolve" (Sankey, 1997, p. 426). And Sankey continues, "his final position was that natural kind terms from the taxonomic structure of one theory may not be introduced into the taxonomic structure of another, because of a relation of non-overlap between the extensions of natural kind terms. (Sankey, 1997, p. 427).

According to Sankey, the basic idea of Kuhn's later conception of incommensurability is that the content of theories cannot to be compared due to translation failure arising from the meaning variance of the vocabulary the different theories employ. This means that if Kuhn had included a theory of meaning and accounted for meaning variance between paradigms, he could have showed in SSR (as he later came to believe) that incommensurability is a semantic issue although it seems to be manifest in various guises.

Sharrock and Read also describe a progression from Kuhn's initial descriptions of "world change" incommensurability in SSR, to his move away from descriptions in terms of vision and his use of the Gestalt analogy, to his "taxonomic turn", and an attempt around 1990 at a Darwinian account of phenomenal worlds as evolutionary niches (2002 pp. 177, 181, 189).

Hoyningen-Huene agrees that Kuhn moved from a perceptual to a linguistic understanding of incommensurability, but he provides a more nuanced description of this semantic incommensurability in terms of the impossibility of translation and the possibility of interpretation (1993, pp. 60, 61). In his interpretation, Hoyningen-Huene shows that through his career, Kuhn refines the concept of incommensurability to semantic incommensurability as local, narrow sense non-translatability of key terms (1993, p. 216).

Hoyningen-Huene interprets Kuhn's work hermeneutically and tries to provide a systematic philosophical underpinning for the ideas it contains. Hoyningen-Huene's reconstruction of
Kuhn's ideas about science yields descriptions of Kuhn's original articulation of incommensurability in SSR and two subsequent refinements of the concept of incommensurability in science. But these three variant descriptions of incommensurability cannot be understood without reference to their context, Hoyningen-Huene's reconstruction of Kuhn's philosophy, which I now consider briefly.

Reconstructing Kuhn's work in terms of a post-Kantian idealism, as Hoyningen-Huene does, is not a misreading of Kuhn's ideas in SSR or his career as a whole. Indeed, in *The Road Since Structure*, Kuhn says that he is "a post-Darwinian Kantian with moveable categories" (2000 pp. 104, 264). And the hermeneutic method Hoyningen-Huene employs allows him to apply concepts from Kuhn's later work, such as co-constitution of the phenomenal world, similarity relations, and meaning as use, to flesh out ideas that may only have been incipient or inferred in SSR.

Hoyningen-Huene begins his reconstruction by stating clearly that Kuhn is examining science and the epistemic dimension of how it investigates its object: the natural world. Thus, he says, "the object domain of Kuhn's philosophy of science is composed of the total domain of the basic sciences, taken in its epistemic aspect" (Hoyningen-Huene, 1993, p. 28). And "the object of scientific knowledge is nature, or the world ... The epistemically operant world concept in Kuhn's work is the notion of a 'phenomenal world,' of a world constituted by the activities of knowing subjects" (Hoyningen-Huene, 1993, p. 29).

There is also another use of "world" or "nature" in Kuhn's work. This usage refers "to something which itself remains untouched and uninfluenced by revolutionary change in science" (Hoyningen-Huene, 1993, p. 33). This usage, Hoyningen-Huene refers to as the "world-in-itself," due to "an obvious parallel to the thing-in-itself of Kant's critical philosophy" (Hoyningen-Huene, 1993, p. 35). Both Kant's thing-in-itself and Kuhn's sense of world-in-itself are pure object-sided and thus unknowable.

Although the distinction has been made between the world-in-itself and a single phenomenal world of appearance, Kuhn is "primarily concerned with the difference between distinct phenomenal worlds, the assumption of which he holds as necessary if we are to understand the structure of scientific development in a historically adequate way" (Hoyningen-Huene, 1993, p. 36). And it is important to note that Kuhn is describing a plurality of phenomenal worlds, breaking with the tradition since Descartes, and persisting to today, that envisages a
single phenomenal world that we experience in virtue of our common perceptual apparatus (Hoyningen-Huene, 1993, p. 37). Neither is Kuhn proposing that we differently interpret our perceptions of a single phenomenal world, but rather, that there are a plurality of possible phenomenal worlds (Hoyningen-Huene, 1993, p. 37).

But how do scientists come to constitute phenomenal worlds? Hoyningen-Huene reconstructs from Kuhn's writings a general analysis of the process of constituting phenomenal worlds. It is, he says, a learning process, in which "by means of ostension, a certain type of similarity relation, which members of a given social community have already mastered, is learned. These similarity relations are codeterminants for perception and for the formation of empirical concepts. Concepts introduced by means of the similarity relation cannot be precisely explicated, and they contain knowledge of nature" (Hoyningen-Huene, 1993, p. 70).

Through the process of ostension, the instructor shows the pupil different members of a similarity class, already established for the instructor, so that the pupil can learn to distinguish the class. The objects and problems that the instructor ostends are paradigms, in the sense of exemplars, which "somehow constitute the fixed points in the net of similarity and difference relations at the heart of world constitution" (Hoyningen-Huene, 1993, p. 78).

Kuhn is most interested in immediate similarity relations, so named because the "similarity involved isn't derived from defining characteristics of the relata" (Hoyningen-Huene, 1993, pp. 72, 73). In such relations, "the elements of a similarity class are tied to one another by 'family resemblances,' in the late Wittgensteinian sense," and "such similarity classes turn out to be sets with fuzzy boundaries" (Hoyningen-Huene, 1993, p. 74).

For Kuhn, the scientific community is the agent of scientific activity. As Hoyningen-Huene puts it, "to belong to a given community means, among other things, to have mastered the same similarity relations as other members of the community" (Hoyningen-Huene, 1993 p. 82). But the community does not determine the similarity relations such that they are static. For Kuhn's account of science, it is important that the coconstitution of phenomenal worlds can be revised. Hoyningen-Huene notes that "access to the phenomenal world of a given (scientific) community may be gained by way of an at least partially reversible learning process" (Hoyningen-Huene, 1993, p. 70).
So for Kuhn, scientists co-constitute the phenomenal world experienced by their community by learning the empirical concepts of the community through learning ostended similarity relations. But for this to happen, the community must attribute meaning to the empirical concepts. And to allow the conceptual changes that Kuhn says occur during scientific revolution, these meanings must be attributed in a process that is revisable.

According to Hoyningen-Huene, Kuhn's ideas about the learning of empirical concepts is unintelligible without understanding his view of meaning. Hoyningen-Huene describes how in his 1962 SSR, Kuhn uses "meaning" colloquially, in the traditional sense where the meaning of a concept is specified by a definition. But Hoyningen-Huene says that even at this time, his writing shows that he is beginning to depart from the idea that the meaning of concepts is given by definition. According to Hoyningen-Huene, Kuhn believes that the unequivocal use of concepts is guaranteed by their relation to other concepts (Hoyningen-Huene, 1993, p. 91).

Kuhn's views on learning empirical concepts initially occurred without any reflection on the concept of meaning. Therefore Hoyningen-Huene traces this development temporally (Hoyningen-Huene, 1993, p. 92). In addition, while developing these ideas, Kuhn was also moving from a more perceptually oriented conception of the phenomenal world to a more linguistically oriented conception. (Hoyningen-Huene, 1993, p. 93). Therefore, Hoyningen-Huene considers the learning of concepts without the use of laws and theories, under the perceptual and then the linguistic outlook, and then learning with the help of laws and theories from the linguistic perspective of Kuhn's later thought (Hoyningen-Huene, 1993, p. 94).

Hoyningen-Huene explains why he uses the distinction between learning concepts with and without the help of laws and theories (Hoyningen-Huene, 1993, p. 93). It is because we can't distinguish cogently between the notion of theoretical and observational concepts, even though the distinction between them is useful.

In the perceptually oriented account of the phenomenal world, described in Kuhn's work up to 1969, concept learning without the use of laws or theories is simply a consequence of Kuhn's theory of perception. So "learning those immediate similarity relations that are coconstitutive of perception leads directly to learning certain empirical concepts" (Hoyningen-Huene, 1993, p. 94). And thus the meanings of the concepts are located, under this theory, "at least preliminarily, in similarity relations, not in definitions" (Hoyningen-Huene, 1993, p. 94).
However, by 1969, Kuhn recognised that he must address the concept of meaning for empirical concepts to give a more positive account, rather than leaving it as residing in similarity relations and perception. This is because Kuhn felt that the conceptual changes that he proposed occur during scientific revolution could not be conceived merely as consisting of additions or subtractions of elements to the extension of a class generated by a similarity relation (Hoyningen-Huene, 1993, p. 97).

But Kuhn faced the problem that the traditional theory of meaning (which included the provision that the meaning of a concept provides a set of necessary and sufficient conditions for the concept's application) did not work. He doesn't attempt to provide a full understanding of meaning, and instead focusses on one aspect of meaning: the reference function of empirical concepts, that is, how concepts pick out their objects in the world.

He asks how can the immediate similarity relations relevant to the identification of an empirical concept's referents and nonreferents be learned by ostension? He answers that it occurs in "a 'metaphor-like process' in which exemplar elements of the extension of the concept to be learned are juxtaposed" (Hoyningen-Huene, 1993, p. 98.)

The difference between Kuhn's pre-1969 and post-1969 conception is that the former involves changes to the learner's perception, whereas the latter involves the learner discovering features of objects relevant to concept identification. (Hoyningen-Huene, 1993, p. 100). As Hoyningen-Huene puts it "in the first case, it is perception that grounds the connection with the world; to encounter the world is to see it...In the second case, by contrast, the connection with the world is a product of language; to encounter the world is to capture it linguistically" (Hoyningen-Huene, 1993, p. 101).

For Kuhn, scientists learn concepts using laws and theories by applying the laws and theories to problem situations. (Hoyningen-Huene, 1993, p. 102). In this concept learning and in the application of the empirical concepts to new, analogical problem situations, the immediate similarity relations between the problem situations have an important role. (Hoyningen-Huene, 1993, p. 104) Although scientists within a community can learn and apply empirical concepts, implicitly knowing to that they refer, they cannot explicitly define such concepts (Hoyningen-Huene, 1993, p. 105). They cannot, as Kuhn understands the classical concept of definition, "provide necessary and sufficient criteria for the concept's unequivocal application in all conceivable situations" (Hoyningen-Huene, 1993, p. 107).
This is a precise articulation of Kuhn's local holism about meaning, which I contrasted with Davidson's global holism about meaning in Chapter 7. Within a scientific paradigm, learned similarity relations allow terms to perform their referencing function, picking out kinds and objects in the world. But this referencing is itself a function of the co-constitution of the phenomenal world by the paradigm, so that outside of the paradigm, terms can fail to refer. Terms from different paradigms refer to kinds and objects in differently co-constituted phenomenal worlds and so can be semantically incommensurable.

Hoyningen-Huene summarises Kuhn's position on similarity relations: they are "coconstitutive of perception and the formation of empirical concepts" (Hoyningen-Huene, 1993, pp. 111, 112). And beyond this, Kuhn claims, similarity relations or the concepts they introduce contain what he refers to as "knowledge of nature" or of the "world" (Hoyningen-Huene, 1993, p. 112). This knowledge has two components, what Hoyningen-Huene refers to as "quasi-ontological knowledge," so called because it "concerns a phenomenal world with no claim to exclusive reality," and "knowledge or regularities," that is, knowledge of how the world behaves (Hoyningen-Huene, 1993, p. 112, 113). The quasi-ontological knowledge and knowledge of regularities acquired through immediate similarity relations is teachable, learnable, and it can be overlearned (Hoyningen-Huene, 1993, p. 118).

8.2.1 Two refinements of "incommensurability"

Having constructed or reconstructed an underpinning for Kuhn's ideas with this theory of epistemology or ontology through similarity relations and the phenomenal world, Hoyningen-Huene can reprise Kuhn's argument in SSR. He describes how the components of Kuhn's account of science, paradigm, rules, novelty and anomaly handling, and the dynamic of scientific revolutions, functions in this context, that is, in the context of the fully articulated epistemology and ontology.

This is of interest in my researches because Hoyningen-Huene's reprisal of Kuhn's account describes the various meanings Kuhn developed during this refinement of the concept of incommensurability.
Hoyningen-Huene explicates three senses of incommensurability articulated by Kuhn over his career (1993, p. 212):

1. incommensurability between paradigms in their problems and solutions, the meaning of concepts, and the phenomenal world. We might call these forms methodological, semantic, and conceptual / ontological incommensurability.

2. incommensurability, as incommensurability of meaning, affecting only some, but not all concepts within successive paradigms (local incommensurability, affecting only a small group of terms) such that the empirical consequences of successive theories can not be translated without loss or change. We might call this local incommensurability, meaning local, or semantic incommensurability.

3. incommensurability such that theories are incommensurable just in case they are formulated in languages not translatable in the narrow, technical sense of translation. We might refer to this as semantic incommensurability in the narrow sense, or taxonomic incommensurability.

I note here that according to Hoyningen-Huene, Kuhn refined, but did not re-cast the concept of incommensurability (1993, p. 212). Thus, in its second refinement, the concept still includes world change between incommensurable theories (paradigms, disciplinary matrices). This is because the failure of translation in the "narrow, technical sense" for certain concepts in the first paradigm involves a change in the empirical concepts of the second paradigm and thus a change in that conception of the phenomenal world that these concepts are co-constitutive of. This means that by definition, for Kuhn, narrow sense incommensurability only occurs if the structures of the world, as mediated by the lexicon, change (Hoyningen-Huene, 1993, p. 218).

These descriptions of incommensurability are explicated in terms of the specific vocabulary of words and concepts that Hoyningen-Huene uses to reconstruct Kuhn's philosophy of science. As a result, the full meaning of the three articulations of incommensurability only become apparent when they are considered with respect to their context, Kuhn's philosophy of science as reconstructed by Hoyningen-Huene.
The question now arises of whether or not it is appropriate to apply Kuhn's later, refined semantic conception of incommensurability when investigating his seminal SSR, where incommensurability is described in terms of semantics, but also methods and standards, perception and world change.

There is broad agreement that Kuhn refined his notion of incommensurability throughout his career. It is likely that Kuhn did this, with reference to his work, and in response to criticism and debate. Therefore, it is likely that the refined conception of incommensurability is consistent with Kuhn's early work in SSR, and that applying this refined conception will help resolve some of the difficulties he admitted to having in describing concepts such as the "different worlds" effect of scientific revolutions.

8.3 Applying Kuhn's refined notion of incommensurability

Although Kuhn and Feyerabend introduced the term "incommensurability" to debates in the philosophy of science at the same time, they used it to describe different ideas.

According to Sankey:

Kuhn originally used the term to describe methodological, semantic, and perceptual differences which impede communication between the advocates of rival paradigms. By contrast, Feyerabend introduced the term in the context of an attack on the empiricist model of reduction, specifically to express the point that reduction of one theory to another by deductive means may fail due to meaning variance of the terms used by theories (Sankey, 1997, p. 2).

Through his career, Feyerabend did not change the meaning he ascribed to the term "incommensurability," although he did apply the concept to an ever wider set of phenomena, from protocol or observation statements within science, to scientific theories, to scientific paradigms, and to societies (Oberheim and Hoyningen-Huene 2013). But Kuhn continued to refine the term and its application throughout this career, so that we can identify an original sense of it and at least two refinements consistent with that original articulation (Hoyningen-Huene, 1993, p. 208).

I argue that the refined conception of incommensurability can be consistently applied to Kuhn's writings in SSR. The refinement indicates that Kuhn's original articulations of "incommensurability" should be interpreted as intending that, however it is manifested, as for
example, methods and standards incommensurability or world change incommensurability, incommensurability between paradigms is a semantic phenomenon.

To begin arguing this point, it is sufficient to briefly reconsider Kuhn's original descriptions of incommensurability in SSR. Kuhn introduces the concept of incommensurability in describing the relationship between paradigms: "the normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before" (1996, p. 103). He then provides illustrations of what we can call this general, paradigm incommensurability, in terms of scientists "responding to a different world," in terms of a Gestalt-type shift in perception, and in terms of the lack of a neutral observation language (Kuhn, 1996, pp. 111, 112, 125). One way to interpret Kuhn's figurative descriptions of incommensurability is to expand the general, paradigm incommensurability such that it includes within it semantic, epistemic, and ontological incommensurability. Or the illustrations of Kuhn's general, paradigm incommensurability could be understood as different kinds of incommensurability, such as paradigm incommensurability itself, ontological or conceptual incommensurability, perceptual or experiential incommensurability, and semantic incommensurability. But they could also be understood as different aspects or manifestations of a fundamental form of incommensurability, such as semantic incommensurability, which can give rise to epistemic, conceptual, ontological and other manifestations of incommensurability.

As I have argued in Chapter 4, this latter is the correct interpretation. The figurative descriptions of incommensurability may be an aid to our initial understanding of the concept, but thereafter, the terms do not help explain the situation they describe. To say that a paradigm is incommensurable with another at the level of methods and standards is to explain no more than it states. The explanation we seek occurs at the level of meaning, and the source of the various manifestations of incommensurability is semantic incommensurability.

**8.3.1.1 Education and semantic practices**

If incommensurability is a semantic phenomenon, as I have argued Kuhn's writing in SSR show it to be, how then can semantic incommensurability lead to the manifestations he describes: incommensurability of problems and standards, incommensurability between different worlds? And how could it lead to manifestations that Kuhn does not describe, such
as epistemic incommensurability, if we wanted to differentiate it? This question shows why Kuhn's account of scientific revolutions requires the underpinning of a theory of knowledge and a theory of reference. He needs to show, or we need to show using his ideas, how semantics (meaning and reference) determines not just semantic relationships, but also methods and standards, experience, knowledge, and world views for the different paradigms. We can sketch briefly Kuhn's development of such theories by examining his conception of novice education into a paradigm.

If incommensurability can exist between alternative scientific paradigms, then the means by which a novice scientist acquires their disciplinary matrix and the means by which those inducted into the discipline maintain their paradigm is relevant to the question of the source of incommensurability. Through their training, the novice scientist acquires a set of beliefs through "the educational initiation that prepares and licenses the student for professional practice" (Kuhn, 1996, p. 5). The student becomes familiar with the discipline's paradigms, in the sense of exemplar problems and solutions. This must occur through language, whether a spoken or written natural language, the formal language of mathematics, or the symbolic language of graphs, curves, diagrams etc. used in the natural sciences. In contrast, the professional scientist is often guided in their research by tacit knowledge. The student learns the discipline's vocabulary, the terms it uses to describe the world and the referents of these terms, through familiarity with the exemplars, through using them to solve problems. They are guided in this by their teachers and accept the authority of teachers and texts because "The applications given in texts are not there as evidence but because learning them is part of learning the paradigm at the base of current practice" (Kuhn, 1996, p. 80). In time the student will become a professional scientist and understand implicitly the rules of their paradigm, their disciplinary matrix, although they likely will not be able to articulate these rules (Kuhn, 1996, p. 47).

The scientist during and after a scientific revolution faces the same challenge as any novice scientist: they must learn their newly adopted paradigm. Unless learning is a purely perceptual process, we assume there is language and meaning and understanding involved in learning to be a scientist in the first instance, becoming inducted into a paradigm, and in being inducted into a new, replacement paradigm. Therefore, when professional scientists acquire a new, replacement paradigm, during a scientific revolution, they learn the meaning of terms and the population of the world through a similar process of learning the meanings of terms in the world as would be undertaken by a novice being inducted to the paradigm. Any
incommensurability between the paradigms, although perceptual or ontological, will thus originate as semantic incommensurability.

8.3.1.2 Meaning and reference

Kuhn acknowledges in SSR that at the time of writing he could not supply or point toward a theory of knowledge to explain the historiography of science he was describing. The explanation that scientists across paradigms "see different things when looking at the same sort of objects" or "pursued their research in different worlds" because they "differed in their interpretation of what they had both seen" (Kuhn, 1996, pp. 120 - 121) is neither "all wrong nor a mere mistake" (1996, pp. 120 - 121). Kuhn can say this because he is applying his conception of paradigms to the discipline of philosophy, and by extension, his conception of incommensurability to competing philosophical paradigms.38 When Kuhn says that the "very usual view of what occurs when scientists change their minds about fundamental matters can be neither all wrong nor a mere mistake," I interpret him as meaning that the "very usual view" belongs to the contemporary philosophical paradigm and cannot, or should not, be judged as wrong from the perspective of a replacement philosophical paradigm. Neither is it merely a mistake, from the perspective of the developing, replacement philosophical paradigm, rather, it is an indication that the old paradigm is failing (Kuhn, 1996, p. 121).

We can use a distinction that Kuhn did not explicitly use in SSR to draw apart three different senses of an articulation such as "the proponents of competing paradigms practice their trades in different worlds" (Kuhn, 1996, p. 150). The realist disposition towards the world allows us to distinguish between perception of the world and experience or understanding of the world, because according to this disposition, reality is independent of the mind.

It follows that the scientists under alternative paradigms may be perceiving or experiencing different things when encountering one and the same physical world. This experiential difference is likely what Kuhn had in mind when he used the Gestalt switch as an illustration of the incommensurability between paradigms that occurs during a scientific revolution. Kuhn did indicate that such experiential or perceptual incommensurability is a component of paradigm incommensurability or a manifestation of semantic incommensurability. But Kuhn

38 Kuhn believes that the traditional view is part of what he calls "a philosophical paradigm initiated by Descartes" (Kuhn, 1996, p. 121).
admitted in *The Road Since Structure* that the Gestalt allusion is somewhat misleading because it uses a term from the psychology of the individual to describe episodes in the experience of a group, and throughout his career, he moved from a perceptual or visual explanation of incommensurability to an explanation in terms of language, the terminology of science and the function of semantics, of meaning and reference (2000, p. 242).

Another possibility is that the scientists working within alternative paradigms might also understand the same extant world differently not simply because they have different experience of it, but because they carve up, classify, or categorise that same physical world differently. This antirealist position involves co-constitution of the phenomenal world the scientists experience through the action of their respective paradigms on the extant world. This co-constitution of the world can be explained in terms of the language the scientists under different paradigms use to classify the population of objects in the world. This is a type of antirealism, one which allows that the world exists, but denies that the phenomenal world that we co-constitute and experience is independent of the mind. According to this position, where scientists under different paradigms co-constitute different phenomenal reality, the semantic incommensurability that exists between the alternative gives rise to a weak form of ontological incommensurability.

A third logical possibility is that the scientists under different paradigms encounter different worlds because they generate, existentially, these worlds. It is unlikely that Kuhn, as a trained physicist, would embrace this idea and the strong ontological incommensurability it would give rise to.

We should also perhaps note here Kuhn's reticence or discomfort at the ontological reading of incommensurability. Initially he seems to be excited by the prospect, that after showing how changes in methods and standards can transform a science, he will go on to "even suggest a sense in which they transform the world" (Kuhn, 1996, p. 106). But then he draws back from the "different world" effect of revolution or its implications. Examining his subject, "the historian of science may be tempted to exclaim that when paradigms change, the world itself changes with them" (1996, p. 111). But although Kuhn may be tempted, he has reservations about this effect. He says that "we may want to say" that it occurs and "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, 1996, p. 111). Or we may "wish to say" that it occurs or seems to occur. "The very ease and rapidity with which
astronomers saw new things when looking at old objects with old instruments may make us wish to say that, after Copernicus, astronomers lived in a different world. In any case, their research responded as though that were the case" (Kuhn, 1996, p. 117).

Kuhn is aware of the difficulty presented by the idea that when Aristotle and Galileo looked at swinging stones, "the first saw constrained fall, the second a pendulum" (1996, 121). And by the idea that although "the world does not change with a change of paradigm, the scientist afterward works in a different world (Kuhn, 1996, 121). In trying to make sense of these ideas, rather than pursuing the concept of different worlds, Kuhn describes how the competing schools are "always slightly at cross purposes" (1996, p. 112). And he hints that the different world effect might be a manifestation of a lack of shared meanings between paradigms so that "the proponents of competing paradigms fail to make complete contact with each other's viewpoints" (Kuhn, 1996, p. 147) and the proponents of competing paradigms are "always slightly at cross-purposes" (Kuhn, 1996, p. 148).

Although Kuhn is not satisfied with his articulation of the idea, and does not seem enthusiastic about its consequences, he admits that, "in a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds" (1996, p. 150).

Despite struggling with the issue of "different worlds", Kuhn cannot supply an explanation, in terms of a new epistemology, for the changes brought about by paradigm shifts. Neither did Kuhn provide or refer to a theory of meaning and reference that might underpin his ideas. For Kuhn in SSR, the scientist engaged with the world through perception, especially through vision. And Kuhn's descriptions and explanations of induction into a paradigm, maintenance of a paradigm, and the incommensurability that he posited between paradigms is largely in terms of perception.

Subsequently Kuhn addressed this deficiency, as described by Hoyningen-Huene, moving from a perceptual link to a linguistic link to the world (1993, pp. 60, 61). Kuhn develops his conception of local holism about meaning, where meanings of terms are maintained within a

39 As I have mentioned earlier in this chapter, Kuhn did state his belief at the time that research "in parts of philosophy, psychology, linguistics, and even art, all converge to suggest that the traditional paradigm is somehow askew" (1996, p. 121). Whatever the new epistemological paradigm does, it must help us, Kuhn says, to make sense of statements such as "though the world does not change with a change of paradigm, the scientist afterward works in a different world" (1996, p. 121).
paradigm's language by a network of meanings. And this is underpinned by Kuhn's theory of reference, whereby similarity relations enable the terms of a language to refer to kinds of objects in the world, as experienced by the paradigm adherents.

I have addressed the question of whether or not it is appropriate to apply Kuhn's later, refined, semantic conception of incommensurability when investigating his early, seminal SSR, where incommensurability is described in terms of semantics, but also methods and standards, perception and world change. I propose that it is correct to do so, because Kuhn's later conception is consistent with his earlier ideas.

In summary, in the first two sections of this addendum, I have argued, in line with the consensus view, that Kuhn refined his conception of incommensurability throughout his career such that it was a semantic phenomenon. I have examined Kuhn's later refinement of the concept of incommensurability through Hoyningen-Huene's reconstruction of Kuhn's account of science. And I then considered Kuhn's original articulations in SSR, where he seems to describe incommensurability as a complex of three forms of incommensurability: semantic, methods and standards, and different worlds (perceptual, or experiential, or ontological incommensurability depending on how we read him). I have argued that we can read these articulations as describing a general paradigm incommensurability consisting of semantic, methods and standards, and different worlds incommensurability. And I show that Kuhn can be interpreted as describing these as manifestations of semantic incommensurability in SSR.

The notion that incommensurability is semantic incommensurability, which I interpret as admitting no graduation, could present a challenge to my analysis in Chapters 5 and 6, which employs a scale of incommensurability. I address this challenge in the next sections of the addendum.

8.4 Effectively strong and weak incommensurability

I argue here that we can usefully apply a scale, from effectively strong to effectively weak semantic incommensurability when interpreting Kuhn's account of science in SSR. I use Hoyningen-Huene's interpretation of Kuhn's refined conception of incommensurability: local, narrow sense non-translatability of, probably related, key terms in a paradigm. And I use
Hoyningen-Huene's description of how for Kuhn translation has two essential components: word-for-word translation and interpretation.

Using these descriptions, I explore what happens when we apply the refined version of incommensurability and the distinction between the components of translation to Kuhn's account of science in SSR. I consider, given that these two distinctions allow that adherents can circumvent, but by definition not overcome, incommensurability, why would a community of scientists want to circumvent incommensurability? The answer, I suggest, is that during crisis and extraordinary science, scientists are motivated to engage beyond their native paradigm in the search for an alternative world view. By "motivated," I intend to refer to epistemic rather than psychological motivation. I am not suggesting that adherents feel they need to engage with other paradigms for psychological reasons, rather that they do so in order to behave coherently, rationally, as scientists.

My analysis using a scale of effectively strong to effectively weak incommensurability shows that Kuhn's refinement of incommensurability doesn't affect the grounds for relativism that can be found in his account of science.

8.5 Modifying the scale of strong to weak incommensurability

Hoyningen-Huene's reconstruction of Kuhn's philosophy of science provides detailed background that I can use to explore and modify the idea of a scale of incommensurability such that it meets this challenge and continues to provide insight into Kuhn's account of science.

8.5.1 Incommensurability through the Kuhn cycle

According to Hoyningen-Huene, Kuhn refined his conception of incommensurability between paradigms/theories such that it is a semantic notion signifying local, narrow technical word-for-word non-translatability of, probably related, terms (Hoyningen-Huene, 1993, p. 212). This second refinement of the notion, which includes Kuhn's first refinement that restricts incommensurability to local incommensurability, is developed from and should be consistent
with Kuhn's first articulations of the concept of incommensurability in SSR. But is it consistent with the rest of Kuhn's description of science in SSR?

We need an account of how, given local, semantic narrow sense non-translatability of terms, there can at times be interaction between paradigms and a switch between paradigms, but at other times, no such engagement. Also, we need an account of how knowledge might be preserved across paradigm shifts to allow for progress in Kuhn's sense.

The problem is, if there is only one manifestation of incommensurability, as narrow technical untranslatability of a subgroup of terms, how can adherents engage with alternative paradigms, how can there be scientific revolution, and how can there be progress across revolutions? The incommensurable terms are likely to be the central terms and concepts of the alternative paradigm. If they are unavailable, how would the Kuhn cycle proceed?

In analysing this problem, Hoyningen-Huene's treatment of the significant misunderstandings of incommensurability is informative. Hoyningen-Huene describes three common misunderstandings of Kuhn's conception of incommensurability: the idea that all concepts change, the idea of incomparability, and the idea of non-continuity.

The first misunderstanding of Kuhn's position, whereby he is interpreted as claiming that "all of the concepts employed in both theories (pre- and postrevolution) change meaning in the transition to a new theory," occurs if we don't take into account Kuhn's narrowing of the concept of incommensurability so that it applies to only some terms in a lexicon (Hoyningen-Huene, 1993, p. 218). Hoyningen-Huene says that Kuhn's first refinement of incommensurability is a substantial narrowing of the concept, from including three aspects (problems/solutions, the meaning of concepts, and phenomenal world change) to involving only meaning change (Hoyningen-Huene, 1993, p. 213). And Kuhn narrows the concept further by stating that he always intended that incommensurability, as incommensurability of meaning, affects only some, but not all concepts within successive paradigms, what he describes as "'local incommensurability'" (Hoyningen-Huene, 1993, p. 213).

The second misunderstanding, to the effect that paradigms are not comparable, occurs if we fail to understand that incommensurable theories may be comparable because, unlike incomparable theories, they target approximately the same object domain in terms of the world-in-itself (Hoyningen-Huene, 1993, p. 219). The different theories produce different
incommensurable (untranslatable in the narrow sense of translation) lexica. But this incommensurability is local, not global, because it relates to a subgroup of terms in the lexica, rather than all of the terms.

Another misunderstanding of Kuhn's conception of incommensurability, that denies all continuity between incommensurable theories, is related to the previous one in that it is derived from the idea that successive theories are incomparable. However, even in SSR, Kuhn explicitly stated that at least part of the achievement of normal science survives revolution (proves to be permanent) (Hoyningen-Huene, 1993, p. 222). And as Hoyningen-Huene quotes Kuhn as saying, it is a condition of acceptability of any candidate replacement theory (paradigm), that it promise to retain "a relatively large part of the problem-solving ability that has accrued to science through its predecessors" (ibid).

Two of the three misunderstandings, non-comparability and non-continuity, involve a total block on communication and understanding between alternative paradigms. These related misunderstandings indicate that although incommensurability is by definition local, narrow technical non-translatability of terms, it is not a total block on communication or understanding between paradigms. This indicates that there must be some means of communicating across paradigms, despite incommensurability. It suggests that although adherents cannot overcome the incipient incommensurability that exists, according to Kuhn, they can find means of circumventing it.

How might this occur? One answer might be that we can compare paradigms and translate word-for-word the non-central terms, those not affected by the local, narrow sense incommensurability. This sounds a reasonable, approach. But those terms affected by the local, narrow sense incommensurability are likely to be the key terms, concepts, and ontological distinctions of the alternative paradigm. It should not be possible to switch to an alternative paradigm without some conception of its key terms and ideas. And if it were possible to make such a paradigm shift, we would be moving to an alternative paradigm by leaving out its central terms, concepts, and ontological implications. Thus we would perhaps surrender the key concepts of an old paradigm, because they find no equivalent in the new paradigm, during the shift to a superficial understanding of a new paradigm. This seems unlikely to succeed. But even if it were possible, it would prevent the kind of evolutionary progress that Kuhn envisages for science.
A more promising solution is that although the local, narrow sense semantic incommensurability persists, it can be observed, or expressed, or manifested differently. I suggest that this is what occurs, that the expression of the incipient incommensurability can vary and be modified through the Kuhn cycle of scientific revolution. This is made possible by the different moments (or indispensable components) of translation.

8.5.2 Circumventing, but not overcoming, incommensurability

In considering the refinements of incommensurability, Hoyningen-Huene describes Kuhn's conception of translation (Hoyningen-Huene, 1993, p. 216). For Kuhn, there are two heterogeneous moments, that is, essential components, to translation, namely, narrow sense, technical, systematic word-for-word translation and also translation as interpretation (ibid).

Incommensurability by definition means terms are non-translatable in the technical word-for-word sense. For Kuhn, this incommensurability is due to the co-constitution of the phenomenal world by the paradigm, that is, the co-constitution of the world through interactions between the paradigm adherent and the paradigm. Thus, incommensurability relates to narrow sense technical translation. This usually affects a "local" group of, probably related, terms that play a key role in the paradigm's description of the world. However, other peripheral terms may not be affected by this untranslatability in the narrow sense. And interpretations might be generated for both the local and the peripheral terms.

This means that through narrow sense translation of some, non-central terms we can engage with an alternative paradigm to translate some, accessible and therefore not incommensurable terms. And then by comparison and interpretation of incommensurable terms, we can modify our native lexical structure and world view to include the interpretation of what the concept might be. We don't have an exact word-for-word translation, which is impossible because the

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40 According to Hoyningen-Huene, in his papers circa the 1970s, Kuhn used an everyday sense of "translation," to convey the sense of the, often difficult, process of rendering a theory from one language into another. However, in the 1982, Kuhn claims that this translation consists in "two heterogeneous moments," meaning two indispensable components (Hoyningen-Huene, 1993, p. 216). These are translation in the narrow, technical sense, and also a moment of interpretation, which requires the interpreter to, as it were, think in the foreign language. This means that the moment of interpretation involves changes to the target language (the interpreter's language) and familiarity with some assumptions operational in the world from which the language originates. The formerly unintelligible may be rendered intelligible by the interpretive moment. But it may still not be translatable in the narrow technical sense of single words or word groups in a source text language being systematically replaced by single words or word groups in the target language. "Two theories are now called incommensurable just in case they are formulated in languages not translatable in the narrow sense" (Hoyningen-Huene, 1993, p. 216).
phenomenal world of the different paradigms is differently co-constituted, that is, incommensurable, by definition, but we have a modification of our view to contain a version of the word or concept.

Thus, when necessary, both narrow sense translation, but especially translation as interpretation, provides a means of circumventing the incommensurability between paradigms.

8.5.3 Why circumvent incommensurability?

Despite the possibility of circumventing incommensurability through narrow sense translation of non-central terms and interpretation of these and other incommensurable terms, there remains the question of why a community would do this. According to Kuhn's account of science in SSR, the community needs to explore alternative paradigms during extraordinary research (Kuhn, 1996, p. 91).

The problem could be stated thus. How can the same incommensurability stabilize a paradigm and insulate it from outside influence at one point in a Kuhn cycle of scientific revolution, but de-stabilise it and leave it open to replacement at another point in the cycle? Another way of looking at this problem is in terms of differences in how incommensurability affect the behaviour of the paradigm adherents at different points in a Kuhn cycle. By definition, incommensurability cannot be overcome, but for revolutions to occur, adherents to a paradigm must be motivated and able to circumvent incommensurability. They must be motivated and able to engage with other paradigms and when a new paradigm has been chosen, they need to lose this motivation in order to adhere to their newly adopted paradigm. So although the incipient incommensurability between paradigm pairs cannot, by definition, be overcome, the effective incommensurability seems to vary through the Kuhn cycle.

I propose that although the incipient incommensurability between any paradigm pair does not, and cannot, by definition, change, the effective incommensurability between paradigms varies from effectively strong to effectively weak during a Kuhn cycle. According to this proposal, the variation is due to the motivation of adherents working through a Kuhn cycle.

41 The word "motivated" is here intended to refer to epistemic rather than psychological motivation. It is not that adherents feel they need to engage with other paradigms, but that they do so in order to behave coherently, rationally, as scientists.
It is as if the adherents take the incommensurability and apply it strongly so that no narrow sense translation of any terms and no interpretation occurs. Or they might choose to circumvent the incommensurability and try to translate and interpret as far as possible between paradigms.

To re-state the problem, Hoyningen-Huene's reconstruction of Kuhn's refinements of incommensurability show that it is unequivocally semantic, local, narrow sense non-translatability of probably related terms. This notion is consistent with Kuhn's articulations of incommensurability in SSR, in that it can be used to give an account of changes to the phenomenal world, problems and solutions, concepts and procedures. But for the Kuhn cycle to proceed, incommensurability must be circumvented in some way. It cannot, by definition, be overcome. So how can paradigm adherents engage with alternative paradigms sufficiently to evaluate them and shift allegiance? And if this were possible, how could they then disengage from other alternative paradigms and abide within their selected theory without being open to other theories? The solution to these problems is, I believe, changes in the effective incommensurability that we can describe on a scale from strong to weak.

### 8.5.4 Effectively strong and effectively weak incommensurability

To clarify these ideas, I describe here the operation of a scale of effectively strong and effectively weak incommensurability.

In an initial engagement between two paradigms, those terms that are not incommensurable could be compared and translated in the narrow, technical word-for-word sense. Those words that are incommensurable, could then be translated in the interpretative sense, such that the adherents adapt their own lexicon to include an interpretation of the word or concept. The incipient incommensurability might differ in extent and difficulty between paradigm pairs, but not in interesting ways. For example, the extent of incommensurability might vary depending on the number of non-shared terms, on the difference in these concepts, and the difference in co-constitution of the phenomenal worlds.

But the effective strength of weakness of the incommensurability depends on the efforts of adherents to compare, translate, and interpret; it does not depend on the number of terms
involved. If no effort is made, the central incommensurable terms of an alternative paradigm remain untranslated, either technically or interpretively. In addition, no efforts are made to translate or interpret the non-incommensurable terms, and the paradigm is effectively strongly incommensurable. If efforts are made, although the central terms of an alternative paradigm remain incommensurable, some other terms are word-for-word translated and incommensurable terms are translated in the interpretive sense. Thus, fewer words and concepts and ontological distinctions are unfamiliar and the paradigm becomes effectively weakly incommensurable.

A more detailed description of the distinction I have drawn between effectively strong and effectively weak incommensurability can be made by applying the scale of incommensurability to the Kuhnian cycle of scientific revolution.

Under conditions of effectively strong incommensurability, the adherents may experience narrow technical untranslatability of incommensurable terms and assume that no meaningful encounter or understanding of an alternative paradigm is possible. I describe this as effectively strong incommensurability because although other means of engagement are possible, namely technical translation of non-incommensurable terms and interpretive translation of non-incommensurable terms, there is an effective block on all translation, both narrow and interpretive, of all terms, local and peripheral.

Under effectively strong incommensurability, the incipient, local, narrow technical sense non-translatability of the paradigm / theory pair, the competing phenomenal worlds or concepts of the native and the alternative world view, is not challenged by either translation or interpretation efforts and so adherents in the native paradigm do not and cannot encounter an alternative paradigm in a meaningful way in that they cannot understand it, semantically and therefore conceptually. The adherents cannot encounter the alternative paradigm other than to perceive it as nonsensical, or ignore it as incorrect or fail entirely to understand it or perceive it as an alternative view of the world.

This failure to encounter an alternative paradigm is not simply a consequence of the incipient incommensurability between the paradigm pair. Adherents cannot encounter in any meaningful way another paradigm, because they are not motivated to try. The fact that narrow technical translation is impossible for a group of local terms is taken to infer that all translation, communication, understanding between paradigms is similarly impossible. It is as
if the narrow technical untranslatability is allowed to set the tone of the native paradigm and
disallow all forms of translation or interpretation of possible alternative paradigms.

As a consequence, the adherents to a paradigm are locked in dogmatic adherence and cannot
frame arguments for relativism, since no alternative paradigms are accessible to them. In
contrast, non-adherents can view different paradigms as alternatives or as positions locked in
intractable disagreement and accordingly frame alternatives-induced and disagreements-
induced arguments for relativism.

Under conditions of effectively weak incommensurability, the reverse applies. The
incommensurability between paradigms does not change, in an absolute sense, but the
expression of this or how it is manifest does change through a Kuhn cycle. That is to say,
according to Hoyningen-Huene's description of Kuhn's final refinement, incommensurability
is the local narrow sense word-for-word untranslatability of terms that are probably related.
The number of words, concepts, and ontological categories for which there is no one-to-one
systematic translation between paradigms at the start of an effort to interpret between them
does not change. The translation and then the interpretation effort modifies the target
language, the target paradigm's co-constitution of the phenomenal world, to include translated
and interpreted versions of the words, concepts, and ways of seeing the world as if in the
alternative paradigm. These are additions to the target paradigm. This process does not change
the fact that the two paradigms originally different regarding these words, concepts, and
ontological categories. Although the target paradigm has additional words and concepts and
versions of the co-constituted world, there is still no one-to-one match between its words and
those of the alternative paradigm.

In this sense, the incommensurability persists. But as a block to communications, the effective
incommensurability is weakened through narrow sense translation of non-incommensurable
terms and interpretation of both non-incommensurability and commensurable terms. Under
effectively weak incommensurability, the incipient local, narrow technical sense non-
translatability word-for-word of alternative paradigms is challenged by, at first translation of
non-incommensurable terms, and then interpretation efforts.

Whatever the number of problematic terms or the disjunction between terms or the dis-
similarity of co-constituted phenomenal worlds, adherents to the native paradigm try to first
translate and then interpret the alternative paradigm by modifying the native paradigm with respect to its words, concepts, and ontology.

The implications for arguments for relativism are similar to those I describe in Chapter 6, although in that chapter I consider conditions of weak incommensurability, rather than effectively weak incommensurability.

The incommensurability between the paradigms does not change from the beginning to the end of this process. This is because this incipient incommensurability is defined as word-for-word untranslatability, and this word-for-word untranslatability is not changed by the process of interpretation, that is the process of modifying the native paradigm to accept versions of the untranslatable terms. Adherents do not translate the untranslatable terms. Rather, they modify their language, concepts, and ontology to adapt or generate terms for their interpretation of the untranslatable terms and ideas.

But the practical consequences are that fewer terms and less of the world view is foreign because the native paradigm changes to contain versions / interpretations of the new words and ideas.

I call it effectively weak because the incipient incommensurability between paradigms remains the same, but the adherents' response to it is different. They work to, at first translate, where possible, the translatable terms and then to interpret the untranslatable terms.

Even if adherents in the alternative paradigm work to first translate and then interpret the other paradigm, they will create a modified version of their paradigm and will not alter the original incommensurability, as defined as word-for-word untranslatability between two paradigms. They will, however, understand the other paradigm better by the inclusion of versions of its words, concepts, and ontological categories in their own theoretical system.

8.5.5 Some examples from the Kuhn cycle

Using Hoyningen-Huene's reconstruction of Kuhn's ideas, I have shown that although incipient incommensurability between paradigms does not change, the expression of this incommensurability as effectively strong or effectively weak incommensurability alters
depending on adherents disposition at different points in the Kuhn cycle of scientific revolution. So adherent disposition or motivation is affected by the position the community of researchers finds themselves in within the Kuhn cycle i.e. whether they are in normal science or in extraordinary science.

In considering the misunderstandings of Kuhn's ideas, Hoyningen-Huene describes how comparing paradigms is possible (1993, p. 221). This shows the operation of narrow, technical word-for-word translation and of interpretation when adherents engage with an incommensurable paradigm.

For paradigm adherents in a period of normal science, everything about an alternative paradigm is unfamiliar. This is because of the co-constitution of the world, which is different under different paradigms. Although incommensurability is a semantic notion, the co-constitution means that in addition to the meaning of terms, the concepts and ontology are also different under a different paradigm. Furthermore, adherents are not disposed to investigate alternative paradigms. Thus, whatever the incipient incommensurability between alternative paradigms, it is expressed as strong incommensurability. For paradigm adherents in normal science, anything sufficiently different to be an alternative paradigm is effectively strongly incommensurable with their native paradigm.

But in a time of crisis, adherents are motivated to investigate alternatives, and so they begin to compare, as Hoyningen-Huene describes it, and where possible to translate, in the narrow sense of word-for-word translate, but not interpret, between paradigms. This is likely to begin with the meaning of empirical words, concepts, and categories, which although not shared, will be closely matched between the two paradigms because the paradigms address the same object-side world. That is to say, these words are not affected by the local incommensurability that affects the key terms of the alternative paradigm.

At some point, adherents encounter the key concepts of the alternative paradigm, the key words, concepts, and ontological categories of the alternative way of co-constituting the phenomenal world. There are no narrow sense, technical, word-for-word translations for these terms. Adherents to the native paradigm can interpret meanings for these key terms by changing their native lexicon's structure. This means that although the incommensurability persists between the two paradigms so that there is still no word-for-word translation for those same words, concepts, and ontological categories, the adherents make efforts to translate and
then to interpret a different paradigm. This results in modification of the native paradigm lexicon to include interpretations of the problematic terms. These are versions of the meanings of these terms as understood in terms of the translating/interpreting paradigm. This has changed the native paradigm without altering the incommensurability that exists between the previous version of this paradigm and the alternative paradigm. Kuhn's account of science in SSR also provides examples of how adherent motivation to circumvent incommensurability changes at different points in the cycle of scientific revolution.

When Kuhn introduces "incommensurability" in SSR Section IX, it is in the context of a recent scientific revolution to a new paradigm. At this point in the Kuhn cycle, adherents are working under what I have called effectively weak incommensurability. The incipient incommensurability between the old and the new paradigm has not changed, nor will it. But individuals have just been through a process of evaluating and choosing a new paradigm. So they will be able to translate and interpret a great deal of terminology between the old and the new theories. But as Kuhn remarks, they will not be able to switch back to the old theories in the way we can switch between Gestalt perceptions of an object (Kuhn, 1996, p. 84).

Then after the scientific revolution, the group or society, which is the real agent of science, works to establish the new paradigm, to bed it in, to professionalise the discipline etc. In a strange reversal, the old paradigm is now perceived as including unfamiliar terms and ideas. The incipient incommensurability between the old and the new paradigm has not changed, but it is now effectively strong incommensurability because of the disposition of adherents. That is to say, the core incommensurability, the non-translatability word-for-word of key terms between the paradigms has not changed. The scientists have used translation and interpretation to master the new paradigm and include either translations or interpretations of key terms into what has become their new paradigm. And now they are not disposed to engage with the old paradigm or any alternative paradigm. Because of this disposition, all paradigms are effectively strongly incommensurable with the newly adopted paradigm. The adherents are no longer looking outwards to translate or interpret other paradigms, but inward, to articulate, stabilise, and professionalise their discipline, to solve its puzzles, and write its textbooks.

Thus it seems that in some way, the effective incommensurability needs to vary through the Kuhn cycle. The community is motivated because of crisis to begin interpreting, and so it is motivated to switch from strong observance of the incipient incommensurability to weak observance. This seems to be the mechanism that allows the Kuhn cycle to proceed.
I have proposed modifying a scale of incommensurability such that it registers effectively strong to effectively weak incommensurability. This is consistent with Kuhn's description whereby the incipient incommensurability between paradigms does not, and cannot by definition, change. Other scales of incommensurability, such as those I considered in Chapter 4, are likely incorrect because they suggest that the incommensurability between paradigms can change. It might be possible to rehabilitate these other scales by modifying them so that they talk about "effectively" total or partial, strong and weak etc. incommensurability.

But according to Kuhn, the incommensurability between paradigms is because of co-constitution, so we cannot grade it in terms of a paradigm being more or less semantically untranslatable. If a thing is different enough to be a paradigm and not just a modification of a concept extension within a paradigm then it will by definition differ with respect to words and co-constitution of the phenomenal world to a greater or lesser degree. But this difference is not about more or less semantic translatability, it is non-translatability of terms. And terms either are translatable or non-translatable. They are not more untranslatable or less untranslatable.

A different but related matter is how different the paradigm is or how different its words are from another alternative paradigm. We can circumvent this difference by interpretative translation. But we cannot carry out a one-to-one translation of un-translatable terms. So it may be that the other scales I considered are measures of the ease or difficulty of interpretation, which has to do with a different aspect of translation and should not be confused with the non-translatability, word-for-word, of incommensurable terms.

And the other proposed scales might be describing types of incommensurability found outside of Kuhn's philosophy of science, in other fields etc. So they may be legitimate for that purpose. But for Kuhn, incommensurability is only one thing: local, narrow technical untranslatability, and this does not admit of graduation.
8.5.7 Other "forms" of incommensurability

According to Hoyningen-Huene, Kuhn intended that incommensurability should be a semantic notion, signifying local, narrow technical word-for-word untranslatability of some terms between paradigms or theories that cannot be overcome but which can be circumvented by interpretive translation.

I have proposed that at some points in a Kuhn cycle, this incipient semantic incommensurability can be generalised so that paradigm adherents do not attempt to narrow-sense translate non-incommensurable terms or to interpret incommensurable terms between paradigms leading to what I have called effectively strong incommensurability. At other points in the Kuhn cycle, although the incipient semantic incommensurability remains, if paradigm adherents try to translate and interpret both non-incommensurable and incommensurable terms, effectively weak incommensurability results.

It is also conceivable that the incipient semantic incommensurability between paradigms could be used to describe other forms of incommensurability. For example, if incommensurability means technical non-translatability of some terms between paradigms, and some of these terms are concepts, then semantic incommensurability leads to conceptual incommensurability. Similarly, if some of the concepts are regarding ontological categories, then semantic incommensurability and the conceptual incommensurability that can be developed from it can give rise to ontological incommensurability.

However, it is also possible to generalise these forms of incommensurability in a way analogous to how I have proposed adherents generalise semantic incommensurability to either effectively strong or effectively weak incommensurability. Strictly, the conceptual incommensurability relates only to the terms that are semantically incommensurable, that is, technically non-translatable, between the paradigms. However, adherents could conceivably interpret this as a general block on communicating concepts between the paradigms. That is to say, if adherents are not motivated to circumvent the conceptual incommensurability they encounter, it can become effectively applied to all the concepts that differ between the paradigms. In fact, the conceptual incommensurability is restricted to the semantically incommensurability terms, and even this incommensurability could be circumvented by interpretive translation.
Interestingly, Hoyningen-Huene's reconstruction of Kuhn's account of the co-constitution of the phenomenal world would allow for the development of conceptual and ontological incommensurability directly, independent of a route from semantic incommensurability. Briefly, paradigm adherents in a co-constituted phenomenal world might encounter concepts or groups of related concepts in an alternative paradigm for which they cannot provide a narrow sense technical concept for concept translation. It is however important to note that the conceptual and ontological forms of incommensurability originate in the impossibility of technical translation. So these forms of incommensurability are reducible to semantic incommensurability as described by Kuhn, even though they can be developed from his ideas on the co-constitution of the phenomenal world.

Concepts and ontological categories may have some existence beyond the reach of language and thought. But the notion of incommensurability relates to translation, and the lack of a common measure for technical, narrow sense, word-for-word, translation. Thus conceptual incommensurability and ontological incommensurability must relate to those aspects of concepts and ontological categories that are conceivable in thought and expressible in language.

Further, although we might encounter in the literature various putative forms of incommensurability — paradigm, conceptual, ontological, methodological, taxonomic etc. — any legitimate forms should be explicable in terms of Kuhn's description and refinement of the concept of incommensurability. For Kuhn, incommensurability is a semantic notion signifying the impossibility of narrow sense technical translation of some terms between paradigms, which is circumventable by interpretive translation.

8.6 Conclusion

In this addendum, I have argued, in line with the consensus view, that Kuhn refined his conception of incommensurability throughout his career such that it was a semantic phenomenon. In the first two sections of the addendum, I have examined Kuhn's later refinement of the concept of incommensurability through Hoyningen-Huene's reconstruction of Kuhn's account of science. And I have considered Kuhn's original articulations in SSR, where he seems to describe incommensurability as a complex of three forms of incommensurability: semantic, methods and standards, and different worlds (perceptual, or
experiential, or ontological incommensurability depending on how we read him). I have argued that we can read these articulations as describing a general paradigm incommensurability consisting of semantic, methods and standards, and different worlds incommensurability. And I have argued that Kuhn can be interpreted as describing these as manifestations of semantic incommensurability in SSR.

In the third and fourth sections of this addendum, I suggest that we can usefully apply a scale, from effectively strong to effectively weak semantic incommensurability, when interpreting Kuhn's account of science in SSR. This scale is a modification of the scale of strong to weak incommensurability that I used in Chapters 5 and 6 to investigate the grounds for relativism that might be found in Kuhn's account of science. In arguing for this scale of effectively strong to effectively weak incommensurability, I have used Hoyningen-Huene's interpretation of Kuhn's refined conception of incommensurability: local, narrow sense non-translatability of, probably related, key terms in a paradigm. And I have used Hoyningen-Huene's findings that Kuhn believed translation has two essential components: word-for-word translation and interpretation.

I have explored what happens when we apply the refined version of incommensurability, that is semantic incommensurability, and the distinction between the components of translation to Kuhn's account of science in SSR. Given that these two distinctions allow that adherents can circumvent, but by definition not overcome, incommensurability, why would a community of scientists want to circumvent incommensurability? The answer, I suggest, is that during crisis and extraordinary science, scientists are motivated to engage beyond their native paradigm in the search for an alternative world view.

Based on this investigation, I suggest that effective incommensurability varies at different points during the Kuhn cycle from effectively strong to effectively weak. I propose that we can describe effectively strong and effectively weak incommensurability depending on whether or not efforts are made at different stages in the Kuhn cycle to circumvent the unchanging, incipient incommensurability that exists between paradigms.

This is not an empirical argument, nor is it found explicitly in Kuhn's empirical description of science. It is a logical argument, inferring motivational change among paradigm adherents during the Kuhn cycle. The argument makes sense of Kuhn's account, it provides or suggests an answer to the question "if incommensurability is one thing, semantic incommensurability,
how can semantic incommensurability insulate paradigm adherents at one point in the Kuhn cycle but allow them to communicate beyond their paradigm at other points in the cycle? The answer is that, by definition, the semantic incommensurability between paradigms does not change. Instead, adherents generalise this semantic incommensurability during normal science, under what I have called effectively strong incommensurability, so that no effort is made to communicate beyond their paradigm. In contrast, during crisis and extraordinary science, adherents attempt to translate and interpret beyond their own paradigm and generalise these communication attempts under what I have termed effectively weak incommensurability.

Using a scale of effectively strong to effectively weak incommensurability shows that Kuhn's refinement of incommensurability doesn't affect the grounds for relativism that can be found in his account of science. Arguments for relativism, both disagreements-induced and alternatives-induced arguments, can always be framed by the non-adherent external to a scientific paradigm under conditions of effectively strong or effectively weak incommensurability, because non-adherents exercise a different type of judgement than do adherents. The adherents to a scientific paradigm cannot frame arguments for alternatives-induced relativism during normal science under conditions of effectively strong incommensurability and can, but are unlikely to, frame such arguments during extraordinary science under conditions of effectively weak incommensurability. Adherents can but are unlikely to frame disagreements-induced arguments for relativism at any point in the Kuhn cycle, as they consider disagreements within their paradigm to be part of the scientific enterprise and disagreements between their paradigm and views external to it to be irrelevant, misunderstandings of science, non-science, or pseudo-science.

I conclude that Kuhn's refinement of incommensurability does not affect the grounds for relativism that can be found in his account of science.
Bibliography


