

CHAPTER 1: INTRODUCTION

1.1 Background: The Problem of Theory Choice

It is generally acknowledged that the supreme aim of science is to achieve continuous progress. Philosophers may interpret the notion of scientific progress differently. It means progression towards truth or approximate truth to scientific realists; however, the very same notion may appear to mean practicality to anti-realists; relativists may interpret the notion of scientific progress as the liberation of ideas. Importantly, the diverse understanding of the meaning of scientific progress leads to the varied formulations of scientific methodologies and criteria of theory choice among philosophers of science. These methodologies and criteria are formulated to promote the aim of science, that is, scientific progress. Because scientific progress has been recognized, by virtually all philosophers from various schools, as a rational aim of science, philosophers must strive to demonstrate that their proposed scientific methodologies and criteria of theory choice are indeed rational. A philosopher's accounts on science would be untenable should he fail to demonstrate the rationality of his arguments on scientific methodologies and criteria of theory choice.

Unfortunately, the notion of rationality is a debatable notion which has not settled in consensus among philosophers. It is common to see that philosophers accusing their opponents being irrational on the theses on science, while claiming that their notion of rationality is justified. Scientific realists, for example, accuse relativism as an irrational tenet that would impede scientific progress, in the way that true theory will not be

favored by the relative criteria of theory choice. On the contrary, relativists rebut that they are rational in their proposed criteria of theory choice and the view of scientific knowledge. Take Kuhn, a reputable icon of relativist, for an example. He claims that his philosophy is rational by saying that “incommensurability is far from being the threat to rational evaluation of truth claims that it has frequently seemed.” (Kuhn 1990, 3) Despite the disagreement on the notion of rationality, there is something which all philosophers share: the means (scientific methodologies and criteria of theory choice) that facilitate scientific progress can be deemed rational. Hence, the disagreement between philosophers from different camps on the issue of rationality can be characterized as the disagreement on what means (a specific scientific methodologies and criteria of theory choice) can be legitimately recognized as effective in promoting scientific progress. This causal connection, in interpreting the notion of rationality, between means and ends (i.e. scientific progress) requires the methodologies and criteria of theory choice that fit the scientific progress. As mentioned above that philosophers diverge on the notion of scientific progress, there is no surprise to see that they would not agree on the issue of the rationality of scientific methodologies and criteria of theory choice.

Such disagreement can be found in literatures. Van Fraassen, a prominent anti-realist, who regards empirical adequacy as the aim of science favors the empirically well-supported theory as the rational criterion of theory choice. For him, other criteria of theory choice (e.g. scientific realists’ principle of Inference to the Best Explanation) which would not promote scientific progress in the form of achieving greater degree of empirical adequacy of theory are not rational. Similar case can be found among

relativists. Feyerabend, for example, views that proliferation of theories and methodologies is the only way to promote scientific progress. Thus, he claims that any scientific methodology and criterion of theory choice are rational so long as scientific progress can be realized.

In view of the fact that philosophers from different camps possess distinct notion of rationality, and of the fact that there is no way to convincingly and independently define the meaning of rationality, it is premature to conclude that a particular criterion of theory choice (whether it is of scientific realist, anti-realist or relativist flavor) should be favored.

Apart from the issue of the rationality of the criteria for theory choice, the causal effectiveness of the criteria is another problem. Criteria of theory choice, which serve as a guide for scientists, do not necessarily bring out the desired chosen theory. That is, the criteria may serve merely as a guide with no determining force to compel scientists to make a corresponding choice. This issue is often seen in the philosophers who claim that there are no objective criteria of theory choice. Admitting the roles of subjectivity and intersubjectivity in theory choice, relativists always find themselves being accused of tolerating irrationality in science. Critics argue that subjective elements that are advanced by relativists, such as cultural background and personal taste, could as well be the deciding factors in theory choice despite the scientists may claim that they are adhering to a set of rational criteria of theory choice. Kuhn, for example, denies that two scientists who adopt the same criteria of theory choice (e.g. coherence of theory) are always yielding the same decision on the choice. Although he claims that his criteria of

theory choice are rational, he also grants the flexibility in applying those criteria. For Kuhn, though the criteria of theory choice are instrumental in facilitating theory evaluation, they are subject to the interpretation of scientists. Scientists may appeal to the same criterion yet arriving at different choice of theories. Therefore, Kuhn's self-claimed rationality of criteria is always deemed irrational, or at best viewed as a notion of weak rationality, as suggested by Šešelja and Straßer (2009).

...the rationality of the standard list of criteria for evaluating scientific belief is obvious. Accuracy, precision, scope, simplicity, fruitfulness, consistency, and so on, simply *are* the criteria which puzzle solvers must weigh in deciding whether or not a given puzzle about the match between phenomena and belief has been solved..... As the developmental process continues, the examples from which practitioners learn to recognize accuracy, scope, simplicity, and so on, change both within and between fields. But the criteria that these examples illustrate are themselves necessarily permanent...

(Kuhn 2000, 251-252)

Another long-standing and disputable topic in philosophy of science, which is the thesis of underdetermination of theory by evidence, is also closely related to the rationality of science and theory choice. The underdetermination thesis has been raised by anti-realist to against the realist enterprise. This thesis is related to the issue of theory choice in this way: if it is prevalent that scientific theories are underdetermined by evidences, scientists would face a dilemma in arbitrating between two rival theories. For there would be no rational (empirical) grounds for one to justify his choice of one theory over another. Further, if rival theories could be well-confirmed by all possible evidences, the dilemma of theory choice will not be dismissed naturally through the progress of science. Indeed, the progress of science itself may become an issue given that rational theory choice is implausible. Because philosophers of science concur that scientific progress is the aim to

strive for, they have to evade from getting into the dilemma of theory choice. Therefore, the thesis of theory choice appears as a major issue for virtually all philosophers of science. Whether he is a realist, anti-realist, or relativist, a philosopher has to defend his position by demonstrating that his account of theory choice is plausible for, or at least would not hinder, the progress of science.

1.2 Objectives and Scope

- (1) This study aims to investigate the philosophical problem of theory choice in science, with special interest in analyzing its implications in the context of scientific realism, anti-realism and relativism.
- (2) To discuss the rationality of the criteria for theory choice in the context of scientific realism, anti-realism and relativism.
- (3) To examine the connection between theory choice and scientific progress in relation to each of the philosophical context.

This study does not attempt to tackle the issue of theory choice in an all-round fashion. Hence, only the representative characters of each philosophical school will be discussed. The discussion presented in this study will pave the way for a better understanding of the issue of theory choice in the context of scientific realism, anti-realism and relativism.

1.3 Methodology

The methodology of study is based on library research involving an extensive literature review on the issue of theory choice. The search for the literature is delimited to the problem of theory choice in the context of scientific realism, anti-realism and relativism. The university's digital library was used to search for the journal publication. Major journals in philosophy of science, such as *Biology and Philosophy*, *British Journal for the Philosophy of Science*, *Philosophy of Science*, *International Studies in the Philosophy of Science*, and *Studies in History and Philosophy of Science*, among others, were searched. Journal search was also extended to journals in the area of epistemology, such as *Erkenntnis*, *Synthese*, *Analysis*, and *Philosophical Studies*, among others. Besides, search was carried out by exploring the philosophers' official website for their latest manuscripts or unpublished works. The university's library was used as the main source for the book reference.

1.4 Overview of Major Literature on Theory Choice

1.4.1 Scientific Realism and Theory Choice

Although theory choice is an important issue in the philosophy of science, it is surprising to find that, to my best knowledge, there is no single book that dwells specifically on this issue. In most of the major philosophical books, the thesis of theory choice is treated as a side issue of some other major philosophical theses. The situation is not optimistic in journal publication. Only a handful of journal papers published in the major philosophical journal were explicitly dwelling on the thesis of theory choice (e.g., Chang

and Leonelli (2005); Ivanova (2010); Hempel (1983); Barnes (2002); Lugg (1980); Okasha (2011); McAllister (1993); Roorda (1997); Rueger (1996); Kuhn (1983)).

Despite being treated as a side issue, the thesis of theory choice is a long-standing issue in the philosophy of science. Its modern origin can be traced back as far as in Duhem's conception of good sense as a guide to theory choice (Ivanova 2010; Stump 2007) and Whewell's preference of successful to true theories (Butts 1970, cited in Wilson 1973). In the mid-twentieth century, falsifiabilists and falsificationists discuss the issue of theory choice, in an indirect way, in a form of refutability or falsifiability of a theory as a criterion of rational theory choice. Popper (1992), for example, argues that scientist should choose the highly refutable theory which could survive rigorous tests. The reason behind this preference is, according to falsifiabilists and falsificationists, that a refutable theory is more scientific because its assertions are testable. The motivation for the falsifiabilist program is the verisimilitude of theory, i.e., the progress of science towards truth. Using falsifiability as a criterion of rational theory choice, critical rationalists argue that only the theory which has greater verisimilitude (truthlikeness) should be chosen over its rivals. However, although falsifiabilists are realists, falsifiability as a criterion of rational theory choice is by no means a predecessor criterion for scientific realist correspondence criterion of theory choice. It is so because what have falsifiabilists offered are "conjectured theories which represent better or worse approximations to the truth." (Tichý 1978, 175) Falsifiabilist program, contra to scientific realism, does not claim that correspondence truth is a necessary virtue of theory, because, according to falsifiabilists, "the scientist is not someone who knows the truth" (Tichý 1978, 175). It is

in this sense that falsifiabilists are more modest than scientific realists in their claims of truth. Thus, for falsifiabilists, the superiority of one theory to another does not mean a final truth judgment; because “more likely than not, the superior theory will also be false.” (Tichý 1978, 175) Hence, the falsifiabilist criterion of theory choice is an attitude rather than a hard-and-fast rule that guides scientists in theory choice. It is a criterion that warrants the scientificity of a chosen theory, that is to say, no pseudo-scientific theory (e.g., Marxist economics, according to Popper) will ever be chosen using the falsifiabilist criterion of theory choice. Although falsifiabilist criterion of theory choice can safeguard the scientificity of candidate theories, it falls short to provide a working criterion of theory choice per se which could serve as a benchmark in theory evaluation in the face of two rival theories which are on a par in terms of falsifiability.

Scientific realist criterion of theory choice is an optimistic approach towards the rationality of scientific methodology. It is a philosophical attitude that reflects the success of physical sciences. As Putnam (1984) has proposed, and developed by Boyd (1984) in defense of scientific realism, realism is the only philosophical doctrine that can account for the success in sciences, without which this success is a miracle. The success of science in predicting phenomena entails the existence of a mind-independent reality, without which the theory would be making no sense. However, it can hardly see that the success in prediction could provide conclusive evidence for the truth of the predicting theory, a point which has been famously made by the argument of pessimistic induction. The truth of a theory that is explained in terms of its empirical success can gain no solid

grounds in support of scientific realism, for Laudan has pointed out that a successful theory could eventually turn out to be false (Laudan 2002).

Because the epistemic status of a scientific theory, according to scientific realist, is warranted by its success in the prediction, it is natural for a scientific realist to choose the theory which is capable of making more accurate prediction. This accuracy, as a realist criterion of theory choice, is the degree of truth that could be manifested by scientific theories. A theory is said to be more accurate if it has a greater degree of correspondence to the phenomena. Such a correspondence relation between theory and reality is always regarded as an isomorphic relation. For a committed scientific realist, there exists only a single correspondence relation between theory and reality. Holding such an ontological view allows a realist to be consistent with her semantic account of correspondence truth. The possibility of two distinct theories which could correspond to a particular phenomenon has been totally precluded. For scientific realists, there is only one account of truth. Truth is singular, not plural. This commitment to truth is supported by realist ontological belief that the underlying physical entities are unique (e.g., electron has unique ontological characteristics that make it different from proton). Entity realist, such as Ian Hacking, holds that the existence of a theoretical entity or process is vindicated not by the inference to the best explanation, but by the manipulability of this entity to create new phenomenon. The manipulability of the theoretical entities also presupposes the uniqueness of these entities, that is, truth about the entities can only be singular. Hacking has set this out clearly: “We are convinced about the structures we seem to see because we can interfere with them.... Instruments using entirely different physical principles

lead us to observe pretty much the *same structures* in the same specimen.” (Hacking 1985, 152; my emphasis)

However, it is hard to see how the singular physical entities, if it is so, could lend support to realist singular truth, and thus to singular scientific theory. Granted that any physical entity is singular, still, there is no reason to bar one to reasonably assume that at least some physical entities can be accounted by more than one true theory. The blind spot that prevents scientific realists to see this line of reasoning is that they have implicitly, and subconsciously, taken scientific theories to be a product of nature (as opposed to the view that theories are artifacts), a product of discovery. In line with realist assumption that physical entity (nature) is singular, theory, as construed as a discovered product of nature, has taken to be singular. But even if it is so, scientific realist still owe an explanation on why a one-to-one correspondence relation must hold between theory and reality. Apparently, the recourse to the ‘no miracle’ argument is unpromising. By further extending Laudan’s argument of pessimistic induction, it is conceivable that even if there is a one-to-one correspondence between a theory and the predicted phenomenon, there were cases in history of science that such correspondence (the success of a theory in prediction) was brought out by a false theory. Hence, the correspondence theory of truth is not firmly established as it initially seems to be.

The realist conception of correspondence truth has received severe challenges from the underdetermination thesis, which claims that scientific theory is underdetermined by evidence. In addition to the recognition that realization and interpretation of experiments

imply “adherence to a whole set of theoretical propositions” (Duhem 1976, 21), crucial experiment has been thought to lose its force because evidence entails auxiliaries and hypotheses of theory, which makes impossible the falsification of theory. Such entailment does not reveal which hypothesis in the holistic part of a theory is problematic. Due to this holistic nature of theory, experiment is not a means that could effectively pick out *one* theory among an array of rivals; especially the chosen theory must, according to realists, be the only one that truly depicts the reality. The thesis of underdetermination has presented a threat to rational theory choice. For scientific realists, this threat is more severe because their principle of correspondence truth allows only one theory to be chosen, that is, the only theory which is corresponding to the physical phenomenon. In the presence of empirically equivalent theories, the realist picture of one-to-one correspondence between theory and reality has changed to a multiple correspondence relation between theory and reality. In the face of empirically equivalent theories, scientist is asked to decide between rival theories which entail the same body of observational data. Apparently, empirical evidence cannot be used to justify a theory choice. Scientific realist has to recourse to non-empirical criteria, such as simplicity and aesthetic factor, in his justification of a theory choice. According to anti-realists, non-empirical criteria are detrimental to scientific realism because they do not warrant the rationality of theory choice.

The arguments from the underdetermination thesis and empirical equivalence thesis have put scientific realists in a defensive state for the rationality of theory choice. One of the easiest realist responses to these arguments is the suspension of judgment. Suspension of

judgment implies that one does not make a concrete decision and disposition on scientific issues in her daily research activities. Ladyman argues that in a situation where evidences are underdetermining the theories, judgment should be suspended and all we have to do is to wait for the precise evidence to emerge in future (Ladyman 2002). Being optimistic, Ladyman hopes that the dilemma of underdetermination of theory by evidence would dismiss naturally as science progresses. However, such hope is dependent on a dogmatic assumption that the available evidence will be more precise in future, that is, the evidence one obtains will converge to truth as time goes by. Besides, suspension of judgment is not a practical strategy in daily scientific practice. Scientist always needs to perform theory evaluation and theory choice, either explicitly or implicitly, in virtually all of his research activities. He has to evaluate and decide which (theory-laden) protocol to use in his experimental setup; he has to choose the right equipments and materials, which are rooted in and stipulated by theories; he has to decide what to observe and what to ignore in his experiment, which is a decision that is based on his hypotheses. All these scientific activities inevitably require a scientist to evaluate and choose between theories. Thus, it is not practical for a scientist to suspend his judgment on theory in his daily works. Further, suspension of judgment about theory would counter the claim of scientific realism that science tends to increase the stock of knowledge in the long run. If a scientist has to suspend his judgment on theory in his daily practice, it would be unlikely for him to make progress. Apparently, most of the scientists do not suspend their judgment on theory, at least this fact could not be denied by scientific realists who are subscribing to the 'no miracle' argument. Thus, there is a tension between the 'no miracle' argument and Ladymanian suspension of theory judgment which was proposed

as a solution to the problem of theory choice. If scientists practice judgment suspension on theory until more precise evidences to emerge, then, the success of science would become a real miracle because it is unconceivable how progress could be achieved without choice being made among rival theories.

Other realists argue, using a different strategy, that the underdetermination thesis and the empirical equivalence thesis are too trivial to be real in the actual scientific practice. Despite admitting the serious threat posed by these theses to scientific realism, scientific realists always claim that these theses are “puzzlingly at odds with the actual history of science, in which empirically adequate theories are thin on the ground.” (Day and Botterill 2008, 249). Okasha (2000), on the other hand, has distinguished between trivial and substantive underdetermination thesis. Ian Hacking asserts that “Duhem’s thesis has long been decked out in Quinery and hence been largely irrelevant to real science.” (Hacking 1988, 150)

Typically, scientific realists hold that scientists are not troubled by the dilemma of theory choice in the face of empirical evidences. They thus conclude that evidences do not underdetermine theories, and that there exist no genuine empirically equivalent theories. This line of arguments assumes that the issues of underdetermination and empirical equivalence do not arise if scientists are able to carry out their daily research, without deterred by the problem of theory choice. It further presupposes that the sustainability of the research activities implies that there is no such a problem of theory choice in the actual science. However, granted with realists that scientists do not *consciously*

encounter the dilemma of theory choice, it does not preclude the possibility that they may *subconsciously* perceive the dilemma of theory choice and solve it *subconsciously* using a non-rational criterion (e.g., personal preference, breadth of theory, or aesthetic preference). It is important to bear in mind that the rationality of a scientist's theory choice is dependent on the justification of her belief in theory virtue. It is impossible that a scientist, in this subconscious state, could choose among rival theories using a rational criterion, for applying a rational criterion requires the scientist to be in a conscious state, and that would imply that he is consciously facing with the problem of theory choice, which is running against realist claim that the problem of theory choice does not arise because the theses of underdetermination and empirical equivalence are trivial and do not occur in science. However, if one admits that a scientist, in a subconscious state, cannot rationally evaluate and choose among rival theories, it follows that this scientist *must* use non-rational criteria, subconsciously, in theory evaluation and theory choice. Therefore, scientific realist must admit that the use of non-rational criteria for theory choice by scientists cannot warrant the truth of the chosen theory, which opposes the core doctrine of scientific realism.

Further, it should be noted that the theses of underdetermination and empirical equivalence do not assert that theory choice is completely impossible, nor do they claim that scientific research will be impeded. These theses merely stress that *rational* theory choice is impossible, and a theory choice is inevitably made based on non-empirical criteria. Hence, the realist's arguments on the triviality of the underdetermination thesis and the empirical equivalence thesis do not dampen the force of these theses.

1.4.2 Anti-realism and Theory Choice

Anti-realism, stands opposite to scientific realism, does not claim that the theoretical entities postulated by true theories *must* exist. A typical anti-realist may grant that the postulated theoretical entities *may* exist if the theory is true, but he will not share with realist's commitment that the existence of an entity is necessarily and sufficiently warranted by a true theory. Anti-realists are "not saying theoretical entities don't exist or that talk about them is meaningless....[their] point is simply that there's no evidence that makes it irrational to withhold judgment about their existence." (Gutting 1985, 119)

Antirealists are agnostic on the issue of the existence of theoretical entities, for they claim that these entities are merely postulated in scientific theory without observable evidence. They also hold that inference to the best explanation, which was maintained by scientific realists (e.g., Lipton 1991 and Psillos 1999), falls short to vindicate the existence of theoretical entities. Although an antirealist may legitimately suspect the existence of theoretical entities which are postulated by a theory, he is obliged to believe the existence of the observable entities depicted in a theory.

... if the constructive empiricist believes his theory T to be empirically adequate, he can be agnostic about any consequence about unobservables, but he must believe any consequence about observables.

(Dicken and Lipton 2006, 229-230)

Although it is a common practice to equate antirealists with instrumentalists (Rosenberg 2005), we should categorize pragmatists as anti-realists too. It is because both pragmatists and instrumentalists do not commit to the correspondence theory of truth. A

typical instrumentalist or pragmatist would, as made clear by van Fraassen (1980), distinguish theory acceptance from the belief in truth. For a pragmatist, it is unnecessary to commit to the truth of a scientific theory when accepting it. When an antirealist subscribes to a theory, he treats the theory as a tool/means rather than as a true piece of knowledge. Thus, to choose among rival theories, an antirealist needs not to ask which theory is truer than its rivals. Rather, he may favor the pragmatic criteria such as the breadth of application of a theory, when come to choose among rival theories.

Van Fraassen holds that what is central to science is not the correspondence truth. He has distinguished between observable and unobservable (van Fraassen 1980), claiming that scientific theories should save only the phenomena. Science is not an enterprise that seeks for true theories, but for empirically adequate ones. Acceptance of an empirically adequate theory does not imply that one has to believe that this theory is true. This has become van Fraassen's famous slogan: "acceptance is not belief" (van Fraassen 1980; van Fraassen 1985). According to van Fraassen, theory acceptance requires one to believe only the empirical adequacy of a theory, that is, the observable entities. It does not compel one to believe the unobservable entities postulated by this theory. Given a theory *T* which has true description of the observables yet false description of the unobservables, van Fraassen would think that it is rational to accept *T*. Van Fraassen thinks that what is knowable is the observable. The unobservables are inaccessible to our mind, so one would not be able to know whether the description of unobservables by a theory is true. Although van Fraassen does not deny that a theory can provide true account of the reality, he insists that theories "need not be true to be good" (van Fraassen

1980, 10). What is of most essential virtue for a theory is its pragmatic value. To accept a theory, according to van Fraassen, requires a practical commitment on its use.

... to accept a theory is to believe that it is empirically adequate, while also taking on certain practical commitments concerning its use and authority in further theorizing and application. I contrast this with belief that the theory is true.

(van Fraassen 2003a, 482)

By distinguishing acceptance from belief, van Fraassen has rejected realist commitment toward correspondence truth. Although he stresses on the pragmatic use of theories, he is by no means a relativist, for he has imposed the empirical adequacy as an objective criterion for theory choice.

The problem of theory choice requires constructive empiricists to justify that the selected theory is more empirically adequate than any other rivals. To do so, constructive empiricists are expected to spell out clearly the boundary of observables. However, van Fraassen's notion of empirical adequacy, especially the distinction between observable and unobservable, has received criticisms. Musgrave (1985) has argued that such distinction is incoherent, for to demarcate between observable and unobservable requires one to observe what is unobservable, but to claim that one has "*observed* that something is unobservable contradicts himself." (Musgrave 1985, 208). A theory which delineates the observables, Musgrave (1982) argues, would be inconsistent because it would have to say something about what is unobservable, which is apparently violating the empirical adequacy that van Fraassen maintains. Foss (1984) argues that the notion of observability is vague and the distinction between acceptance and belief has rendered van Fraassen in a state of methodological inconsistency. If these criticisms have teeth,

constructive empiricism would be at risk and the empirical adequacy as a criterion of theory choice would be shaky. However, van Fraassen (1980) does not think that it is necessary to make a sharp distinction between observable and unobservable as long as clear cases and counter cases can be yielded. He further claims that one needs not to observe the unobservable in her effort to distinguish the observable from the unobservable (van Fraassen 1985), for the unobservable does not have a corresponding model in the empirical substructures of a theory that entails the claim that it is unobservable (van Fraassen 1985, 256). For van Fraassen, there is no issue of justification concerning the demarcation of observable/unobservable, which he thinks that it is the usual attitude adopted by statisticians too. It seems that the demarcation could be drawn in a pragmatic manner.

For a statistician... nor would there be any question as to what that evidence E is; he is employed to accept certain data as input for his calculations.

(van Fraassen 1980a, 168)

....there is no justification for why E [evidence] was accepted.

(van Fraassen 1980a, 169)

Although Nancy Cartwright is recognized as an entity realist, I discuss her philosophy under the chapter of anti-realism because she holds an antirealist position about scientific laws and theories. Cartwright against the idea that there are fundamental laws and theories in science. According to her, the so-called “fundamental laws of physics” do not represent the facts in our dappled world (Cartwright 1983 & 2005). It is so because the nature is too complex to be encompassed by a single fundamental law. The laws of physics, Cartwright claims, are not universal because they “apply only where [their] models fit, and that, apparently, includes only a very limited range of circumstances”

(Cartwright 2005, 4). Indeed, Cartwright asserts that the complexity of nature requires one to seek for phenomenological laws (instead of fundamental laws) which are capable of explaining the causes of phenomena. It is the phenomenological law, not the fundamental law, that can provide us a true claim about the theoretical entities. Hence, the problem of theory choice appears as a choice between phenomenological laws/theories. A successful phenomenological law is characterized by successful causal explanations (Cartwright 1983, 8). In Cartwright's account, causal explanation plays an important role in determining a winning theory among its rivals.

Putnam's famous argument of internal realism, and his rejection of metaphysical realism, has rendered him an anti-realist. However, he is not an anti-realist in all respects. It was recognized that Putnam is a realist about truth, while being an anti-realist about metaphysics and semantics (Folina 1995). Some have argued that Putnam's anti-realism is an enterprise seeking a middle path between metaphysical realism (scientific realism) and irrealism (anti-realism) (Cox 2003; Haldane 2005; Szubka 2005; Gupta 1993). In his rejection of metaphysical realism, Putnam turns to the realism of Dewey, William James and Wittgenstein in his search for an account of the objectivity of the world, without resorting to the traditional mind-independent realism (Putnam 1990; Putnam 1996). Using Putnam's words, he endeavors to "find a picture that enables us to make sense of the phenomena from within our world and our practice, rather than to seek a God's-Eye View". (Putnam 1996, 109). Notably, Putnam stresses that objective truth of science has its human perspective, implying that observers' role is a necessary factor in constructing

scientific theory (Putnam 1990, 7). He even goes further to claim that both *a priori* and empirical truth are contextual.

My account does not deny—indeed it affirms—that there is a distinction between truths which are *a priori* relative to a particular body of knowledge and truths which are empirically relative to a particular body of knowledge.

(Putnam 1975, x)

According to Putnam, human perspectives or contexts are indispensable in science because they are a part of the reality. Although this perspectivist account of objectivity has rendered Putnam to be regarded as an inconsistent relativist-cum-realist (Throop and Doran 1991), and sometimes as a full-fledged relativist (Devitt 1984), he firmly denies these accusations.

But I do not conclude... that “the propositions which are true given our current choice of conceptual schemes might not be true given some other choice”

(Putnam 1991, 404)

Putnam’s perspectivism is blended with pragmatism. When scientists are presented with conflicting theories, Putnam advises them to decide in a pragmatic way. Notably, Putnam’s assertion that theories could be rejected on non-observational (i.e. pragmatic) grounds, which is deemed rational by him, can hardly to be qualified as an objective and rational criterion for theory choice according to many traditional rationalists.

When a theory conflicts with what has previously been supposed to be fact, we sometimes give up the theory and we sometimes give up the supposed fact... the decision is a matter of trade-offs that are “where rational, pragmatic”—and that means... a matter of informal judgments of coherence, plausibility, simplicity, and the like... Indeed, a great number of theories *must* be rejected on non-observational grounds...

(Putnam 2003, 141-142)

The main reason of Putnam's endorsing pragmatic attitude in theory choice is that, according to his pragmatism, metaphysical realist and scientific realist claim of the correspondence theory of truth is a false tenet. The greatest mistake of this tenet, Putnam maintains, is its assertion that only one way of correspondence exists between reality and theory. This realist picture of the reality which is claimed to be a complete theory does not leave room for Putnam's so-called human perspective of science, for the realist position rejects the notion of the universality of the fallibility of theory. In other words, realist tenet is too good to be true.

... the traditional picture of a reality that dictates the totality of possible descriptions once and for all preserves *those* insights at the cost of losing the *real* insight in James's pragmatism, the insight that "description" is never a mere copying and that we constantly add to the ways in which language can be responsible to reality.

(Putnam 1994, 452)

That [metaphysical] fantasy goes with the equally fantastic idea that there must be just one *way* in which a knowledge claim can be responsible to reality—by "corresponding" to it, where "correspondence" is thought of as a mysterious relation that somehow underwrites the very possibility of there being knowledge claims.

(Putnam 1994, 514)

In Putnam's opinion, the fallibility of theory is applicable universally in science. Besides, Putnam holds that there is no absolutely reliable fundamental theory for one to choose as a background framework for the comparison between rival theories. Such absolute reliability of theory is non-existent because all theories are fallible. Putnam's thesis of theory choice has a "human face" as he holds fast to pragmatism and the fallibility of theory.

Since human aspect is vital in theory appraisal, Putnam's thesis of theory choice has a social and relativistic dimension, although he does not spell out explicitly. In general, Putnam abolishes all kind of dualism such as fact/value, mind/body, observation/theory, truth/convention, and mind/world dichotomy (Ben-Menahem 2005, 13; Putnam 2003). So, we may as well assume that he will not object the abolishment of the social-dimension/theoretical-dimension and objective/subjective dichotomy in theory choice. If it is so, Putnam's thesis of theory choice which has a "human face" (Putnam 1990) might as well have a "relativistic face" and an "irrational face".

Larry Laudan's philosophy is discussed in the chapter on anti-realism along with the above-mentioned anti-realists. As an antirealist, Laudan does not repudiate the view that scientific theories could be true or approximately true. He claims that the search for truth is a desired goal, though he remains prudent with regard to the kind of truth that is virtuous for a scientific theory. Notably, Laudan rejects the idea that the notion of truth that is embraced by realist is plausible. Indeed, he is skeptical about the human's ability in knowing the status of truth of scientific theories (Laudan 1977). He has criticized the scientific realists' associating truth of a theory with its empirical success. For Laudan, the empirical success of a scientific theory in the past does not warrant its truth. He stresses that many empirically successful theories were eventually turned out to be false in the history of science. If past successful theories could be false, Laudan holds that it is reasonable for one to suspect that the current successful theories may probably be false too.

Laudan maintains that the aim of a scientific theory is problem-solving rather than the search for truth. The problem-solving capability of a theory is not wholly, and mainly, determined by its status of truth. In other words, Laudan denies that a theory which excels in problem-solving is necessarily true or approximately true. The progress of science is not determined by the verisimilitude of truth, but by the problem-solving effectiveness. Since increasing the capability of problem-solving is the aim of scientific theories, it is expected that Laudan would have maintained that truth should not be the criterion for theory choice. Nor does the relativist criterion can be the criterion for theory choice. Instead, the criterion for theory choice should be a pragmatic one, which could promote the problem solving effectiveness in science. According to Laudan, a theory which can solve more problems than its competitors would be favored.

Determinations of truth and falsity are *irrelevant* to the acceptability or the pursuability of theories and research traditions.

(Laudan 1977, 120)

The *acceptability* of a research tradition is determined by the problem-solving effectiveness of its latest theories.

(Laudan 1977, 119)

..... *choose the theory (or research tradition) with the highest problem-solving adequacy.*

(Laudan 1977, 109)

It is rational for a scientist to choose the theory with the highest problem-solving capability because, according to Laudan, science is a problem-solving enterprise. Science progresses as the solved problems are accumulated. Although Laudan rejects the realist approach to the criteria of theory choice, he does not advocate relativist approach either. The pragmatic criterion of theory choice, i.e. problem-solving capability, is a

rational approach. The rationality that is exhibited by the problem-solving effectiveness does not parallel with the rationality of correspondence truth. Besides, Laudan holds that the problem-solving effectiveness as a rational criterion shares no common grounds with the irrational relativist criterion.

In conclusion, antirealists distance themselves from realist correspondence theory of truth. They do not agree with scientific realists that fundamental reality is real and can be captured completely by fundamental theories and laws. Scientific realists need to be committed to the existence of an objective reality and theories which capture that reality because their doctrine presupposes a one-to-one correspondence between theory and reality. Although some antirealists (e.g. Cartwright) hold that unobservables are real entities, they do not think that a single fundamental law accounting for theoretical entities is available. Because of the rejection of the fundamental reality, antirealists (such as van Fraassen) tend to accept that empirical adequacy should be the epistemic criterion for a scientific theory. Antirealists do not need to subscribe to the truth-valuability of theories in theory evaluation. By detaching truth from theory evaluation, antirealists do not have the pressure to adhere to a strict criterion of theory choice as scientific realists do. Because the objectivity of theory is stressed by antirealists, they are not relativist in the issue of theory choice. However, objectivity as an attribute of scientific theory remains a hard nut to crack for antirealist in terms of theory evaluation. Putnam, for example, as an antirealist who has subscribed to both objectivity and subjectivity (“human face” of theories) of scientific theories, can hardly articulate his account of theory choice

convincingly, without being accused as a relativist by realists, and being accused as a realist by relativists.

Furthermore, antirealists share realists' impasse that they can hardly provide a rank order for a wide variety of rival theories. An objective implementation of the theory evaluation seems implausible. Both antirealists and realists are stranded in providing an unambiguous and objective ranking for all the rival theories. The easiest way to escape from this impasse, albeit is a costly move, is to embrace the notion of incommensurability, for "incommensurable theory cannot be ranked as better and worse" (Moberg 1979, 246). However, this move is unattractive for realists and antirealists because it invites relativism.

1.4.3 Relativism and Theory Choice

Relativism always presupposes pluralism and perspectivism. The salient attribute of relativism is its war against foundationalism, such as the notion of one truth, one unifying law, one reality, and one method of doing science. Relativism is sometimes viewed as a version of skepticism (Grayling 2006), for relativists reject the idea that it is possible to know the final and complete truth of the reality. Relativists always claim that there is no such truth. Rather, truth is pluralistic due to the multiplicity of human cultures and societies. Hence, relativists claim that there are more than one ways of doing science. Consequently, there are also more than one ways of evaluating scientific theories.

Nelson Goodman espouses a relativistic view about the reality. He views the everyday world in terms of a multiplicity of different worlds (Goodman 1978). A poet lives in the world of poetry, whereas a scientist lives in the world of science. What makes the poet and scientist live in the different worlds are the different world-versions. World-versions can be distinct among individual. Scientists who subscribe to their own world-versions would subscribe to different scientific theories. According to Goodman's relativism, worlds are made, not found. Hence, he claims that one's world is not truer than others'. In the same vein, any scientific theory is not truer than others.

Notably, although Goodman grants that there exists more than one world, he stresses that the world-making is not arbitrary. The worlds are to be interpreted as the actual worlds that objectively exist (Goodman 1978). Worlds are made by right versions (Goodman 1993). By saying "right versions" of world, Goodman does not preclude the possibility of conflict between them. The reason scientific realists find Goodman's notion of pluralistic right world-versions unintelligible is that they assume the one-to-one correspondence between reality (world) and theory (world-version). Some scholar has criticized Goodman for "demoting truth and promoting rightness" (Künne 1993, 107) because of Goodman's rejection of the correspondence theory of truth.

...his [Goodman] master idea of "worldmaking" was impossible for me to accept... Noting that "world" in Goodman's usage was ambiguous, at times applying to what he called "right world versions", at times applying to the things referred to by such versions, I argued that his claim that we make worlds can be true only for the "versional" but not the "objectual" interpretation of "worlds".

(Scheffler 2001, 668)

... I think, what bother Scheffler is that he cannot reconcile common sense with talk of multiple worlds or conflicting right versions or worldmaking. What

bothers me, on the other hand, is that I cannot make any sense whatever, common or uncommon, of a notion of *the* world independent of all versions yet such that all right versions, however much they disagree, correspond to it.

(Goodman 1993, 11-12)

... I have argued that the world is as many ways as it can be truly described, seen, pictured, etc., and that there is no such thing as *the* way the world is.

(Goodman 1968, 6)

The fabricated worlds are “actual words made by and answering to true or right versions.” (Goodman 1978, 94) True or right versions are formed based on the entities in our residing world, such as “physical particles or phenomenal elements” (Goodman 1978, 95). Goodman proceeds further to claim that right versions of the worlds may also base on “whatever else one is willing to take as individuals” in the version-making (Goodman 1978, 95). This implies that although Goodman holds that his acceptance of a multiplicity of right world-versions “does not mean that everything goes” (Goodman 1978, 94), his willingness to allow any individual entities to be used as the constituents of world-versions is still amounting to relativism. However, it is reasonable to infer that Goodman’s notion of the rightness of world-versions delimits the liberation in world-making to the micro-level; the world-maker is not permitted to make her world arbitrarily at the macro-level. That is to say, a scientist may have a different world-version from his peers, in the sense that their disagreement lies in the minor/local constituents of the world (e.g., the disagreement about the actual number of quarks that exist). Interpreting Goodman’s notion of world-making in this way, his relativism is a local version. Perhaps this is the reason that Goodman asserts that his acceptance of a multiplicity of right world-versions “does not mean that everything goes” (Goodman 1978, 94).

The notion of world-version is of anti-foundationalism. As opposed to foundationalism which offers an ultimate version of the world, anti-foundationalism is a pluralistic way of interpreting world and its constituents. Goodman rejects the reduction of pluralistic world-versions to a single world (Goodman 1978, 4). The irreducibility of pluralistic world-versions implies that there are no unique truth and objective reality, where this absence of uniqueness is the core doctrine of relativism (Gellner 1982, 183). For Goodman, reductionist approach is implausible because it undermines the diverse-yet-integrated world-versions that one possesses.

The existence of multiple worlds and world-versions can also be accounted from the perspective of cultural and societal background. Men live in different society see things differently, and hence construct distinct world-versions. Goodman stresses that “worlds may differ in that not everything belonging to one belongs to the other” (Goodman 1978, 8). Cultural or societal impact on the multiplicity of worlds and world-versions is an unavoidable practical need (Goodman 1978, 9). Though Goodman does not dwell on the actual process of worldmaking in the context of cultural and societal background, Hacking insists that Goodman’s constructivist conception of worldmaking ought to be interpreted as a social process because it is people who make the world (Hacking 1999, 45).

Goodman’s constructivism is a version of contextualism, which holds that the world-making is not determined by a single grand principle. The context of world-making involves subjective elements such as perception, cognition and cultural factors. Hence, it

is impossible to create an (scientific realist's sense of) objective world-version which is faithfully corresponding to the reality-as-it-is. Indeed, such objective world-version is repudiated by Goodman in his stance of anti-fundamentalism. By rejecting the traditional notion of true/false dichotomy, Goodman redefines the objectivity of world-versions in terms of rightness. Contra to the notion of a unique true theory about the reality, there could have a multiplicity of right theories operating equally well in different contexts. One such example given by Goodman is his recognition of both geocentric and heliocentric world-version as right versions, albeit they are in conflict, in their context of arguments (Goodman 1978). For Goodman, the conflicting right theories can be resolved by taking them to be "true in different worlds" (Goodman 1978, 110).

Thus, the problem of theory choice appears to be a problem of choosing the *right* theory/world-version. As Goodman accepts conflicting rival theories to be the right world-versions, scientists are allowed to choose any rival theory legitimately provided it is the right one. However, the context (or using Goodman's term, the world) in which the scientist is working determines the rightness of the chosen theory. It seems that Goodman does not grant two rival theories to be the equally right ones in the same context/world, because he states that the conflicting right theories can be "true in different worlds" (Goodman 1978, 110). Because any two rival theories can be right only in the sense that they are true in different worlds/contexts, it becomes questionable whether the rival theories are commensurable. However, the commensurability of theories may not appear to be the concern in Goodman's relativism because this would require a common world-version as a benchmark for theory comparison, which is a

foundationalist notion repudiated by Goodman. It is unlikely for one to compare scientific theories, and make a rational theory choice, across different contexts. Then, it remains a mystery how science may progress if there is such a multiplicity of worlds and world-versions/theories which are right on their own context yet incomparable with others.

Another relativist who shares Goodman's notion of pluralistic worlds is Thomas Kuhn. It is an interesting fact that Kuhn, as a well-trained physicist, embraces a relativist view (but he sees himself as a rationalist) about science. Although we can find some physicists, especially quantum physicists, are relativist too (about the quantum phenomena), Kuhn's relativism is more likely a corollary of his interpretation of the history of science, and not a corollary of his training in physics. This is evidenced by his conception of paradigm and incommensurability, which were raised in the context of the history of science. In his later career, Kuhn has been consciously associating his relativism with sciences, likening incommensurability to biological speciation and to the discipline specialization in sciences (Kuhn 2000). A detailed account of Kuhn's relativism is provided in Chapter 4.

The problem of theory choice in Kuhn's philosophy is closely related to his conception of paradigm. Paradigm is an ambiguous notion used in many contexts by Kuhn with different meanings, explicitly and implicitly. According to Masterman, this term was used in at least twenty one different ways by Kuhn, in a somewhat quasi-poetic style (Masterman 1970, 61). In the broadest sense, paradigm is a framework that characterizes

the development of science. It has been used to distinguish different discrete stages of development of a scientific discipline. Each discrete stage is characterized by a set of governing beliefs, theories, and standard practices. In a somewhat narrower sense, paradigm is meant to be a research guide which provides the legitimate problem-solution for the practitioners in their research. Different scientific communities with different values and beliefs have distinct paradigms. Hence, paradigm is always interpreted as a relativistic concept by many critics, for the underlying shared values and beliefs are deemed relative to different scientific communities, notwithstanding the fact that Kuhn has rejected a relativistic interpretation of epistemic value in his article 'Objectivity, Value Judgment and Theory Choice'.

Paradigm was initially adopted by Kuhn as a notion to describe "the way a tradition worked in terms of *consensus*." (Kuhn 2000, 299). But Kuhn's use of the term becomes somehow arbitrary in the course of his career as he "proceeded to use the term for the whole lot, for all of the things, which made it very easy to miss what [he] thought of as [his] point entirely, and to simply make it the whole bloody tradition, which is the main way it has been used since." (Kuhn 2000, 299). Paradigm has most often been used to characterize normal science, where there is a consensus about scientific practices and theories in scientific communities. There is a standard problem-solution set defined by the paradigm in normal science. The consensus of problem-solution in normal science must fulfill two requirements to sustain the paradigm. First, the achievement derived from such consensus must be "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity" (Kuhn 1970, 10). This

requirement has presupposed the social influence of the paradigm if it is to gain dominance among scientists. Second, the problem-solution set must be “sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve.” (Kuhn 1970, 10). This second requirement of problem-solution allows the scientist to “force nature into the conceptual boxes” (Kuhn 1970, 5) with their creativity that bound by the paradigm. Kuhn does not allow a radical relativist attitude of “anything goes” in scientific practices, but he grants that scientist is allowed to do whatever that is permitted by the paradigm. However, this second requirement of the open-endedness of problem-solution that makes possible the application of scientific theories to the uncharted realm has been criticized as resurfacing the traditional problem of induction, for the paradigm-governed knowledge rests on the generalization from experiences which cannot be established conclusively (Baillie 1975). However, this criticism may lose its force because Kuhn does not confine the meaning and application of paradigm to the inductive knowledge. In his discussion of scientific revolution, Kuhn has pointed out the attribute of paradigm which he thinks is most essential: “the new paradigm must promise to preserve a relatively large part of the concrete problem-solving ability that has accrued to science through its predecessor” (Kuhn 1970, 169). What is pivotal to a paradigm is its problem-solving ability, which could be influenced by personal style and the cultural background of the scientific communities, rather than the paradigm-specific knowledge. Besides, support for Kuhn’s account of non-inductive paradigm-governed knowledge can be found in Reisch (1991), where he holds that paradigm as a way of conceiving nature defines its standard of explanation and the form of explanation (Reisch 1991). Thus, contra to what has been claimed by Baillie (1975), a paradigm may not always adopt

inductive reasoning as a standard practice in the explanation of physical phenomena. Hence, Baillie's charge of Kuhn's reintroduction of the problem of induction in the conception of paradigm is untenable.

In the stage of normal science, the criteria of theory choice are defined by the prevailing paradigm. A paradigm may favor simplicity, while another may favor breadth of applicability of theories, for example. Interestingly, truth is not a goal of the proposed criteria for theory choice in Kuhn (1970), considering Kuhn's academic background in physics.

There is, I think, no theory-independent way to reconstruct phrases like 'really there'; the notion of a match between the ontology of a theory and its "real" counterpart in nature now seems to me illusive in principle.

(Kuhn 1970, 206)

However, Kuhn has changed his mind, in his later career, with regard to the place of truth in theory choice. In *The Road since Structure*, Kuhn holds that truth is the goal of theory evaluations, that is, the goal for the criteria such as accuracy, consistency and others (Kuhn 2000, 114). However, this change of mind does not signify that Kuhn has accepted scientific realist conception of truth. Rather, Kuhn's notion of truth is still paradigm-based and relativistic.

...if the notion of truth has a role to play in scientific development, which I shall elsewhere argue that it does, then truth cannot be anything quite like correspondence to reality.

(Kuhn 2000, 115)

Whatever scientific truth may be, it is through-and-through relativistic.

(Kuhn 2000, 156)

Crisis emerges when accrued anomalies have endangered the basic beliefs in a scientific community. New paradigms begin to compete with the existing paradigm because the latter is unable to solve the accrued anomalies. Scientific revolution, which is characterized by the change of paradigm, is ensued if the crisis persists and deteriorated. Multiple rival paradigms, each of which contains rival theories, compete to attract adherents. Some scholar, such as Kuukkanen, argues that Kuhn has put more emphasis on the puzzle-solving capability of a theory/paradigm over other virtues (Kuukkanen 2007) when come to a process of deciding between rival theories/paradigms. If this argument is true, one may hold that Kuhn would have claimed that puzzle-solving may serve as a decisive criterion for the theory/paradigm choice in the phase of crisis in science. However, Kuhn does not explicitly proclaim that puzzle-solving capability is the decisive criterion for scientist to arbitrate between rival theories. Notwithstanding, as pointed by Alexander Bird (2003), that Kuhn has recognized puzzle-solving as a driving force that propels science to progress, other values such as simplicity, scope, and aesthetics play an important role in theory choice as well. It is partly because of these values and partly because of the socio-psychological account of paradigm shift, that incur the charge of irrationalism and relativism on Kuhn's thought. Although Kuhn has denied the charge, he fails to provide a persuasive account of paradigm shift and theory choice. The incommensurability of paradigm/theory adds to the mystery of theory choice, for Kuhn claims that the succeeding paradigm bears no theoretical continuity with its predecessor because of the meaning change. Communication breakdown is widespread among scientists subscribing to different paradigms.

Incommensurability thesis has been widely recognized as irrational and relativistic (e.g., MacIntyre 1980; Devitt 1979). Critics have argued that there is no way to rationally compare two rival theories/paradigms because of the translation failure, notwithstanding the minority has argued that incommensurable theories can be compared and rational theory choice is possible (e.g., Szumilewicz 1977; Chen 2002; Collier 1984). Kuhn's initial account of incommensurability has been formulated to reject the point-to-point comparison of two successive theories/paradigms (Kuhn 1970b). He claims that "communication across the revolutionary divide is inevitably partial" (Kuhn 1970, 149), without saying that communication is completely impossible. Kuhn does not preclude the possibility of partial comparison or translation between theories. Any attempt to translate scientific theories into a neutral language would inevitably result in meaning loss.

The claim that two theories are incommensurable is then the claim that there is no language, neutral or otherwise, into which both theories, conceived as sets of sentences, can be translated without residue or loss.

(Kuhn 1982b, 670)

Kuhn holds that successive theories can be translated with the price of meaning loss. However, Kuhn stresses that translation is not a prerequisite for communication. In the face of translation failure, communication can still be established, though partial, among scientists working under different paradigms.

Translation is, of course, only the first resort of those who seek comprehension. Communication can be established in its absence.

(Kuhn 1982b, 683)

Kuhn's claim that communication breakdown across the revolutionary divide is partial does not save him from the accusation of irrationalism and relativism. It is because the partial communication may prevent some useful information (e.g., empirical evidences), which is critical in forming a rational theory decision, to be accessible to the scientist who is making a theory choice. The partial communication/translation between paradigms may lead one to choose an unfavorable theory due to the incompleteness of available information. In other words, the corollary of partial communication may influence one's ability to make a rational judgment on rival theories. In addition, Kuhn throughout his career does not reject the role of social and subjective factors in science. For example, the notion of lexicon, one of the central themes of Later Kuhn, has been associated with culture (Kuhn 2000). Taken together, the partial communication as an external constraint and the subjective factors as an internal constraint may, if not inevitably, lead one to make an irrational theory choice.

Feyerabend appears to be the most radical relativist among philosophers of science. Though his relativism has been juxtaposed and compared to Kuhn's, some has argued that Feyerabend promotes pluralism while Kuhn promotes monism (commitment to one paradigm) in their conception of scientific progress (Munévar 2000, 65). Despite the minor disagreement, both Feyerabend and Kuhn share the belief about the role of subjective elements in science. In the last interview carried out two weeks before Feyerabend died, Feyerabend concurred that "science is influenced by emotions, by feelings, by irrationality." (Jung 2000, 161). Despite Feyerabend is well-known because of his relativism, he started his career as a scientific realist (Preston 1997b). Preston

(1997b) argues that realism was still serving as a premise for incommensurability in Feyerabend's *Against Method*. The transition from realism to relativism can be found in Feyerabend's *Science in a Free Society*, Preston argues, and Feyerabend had appeared to be a radical relativist in 1990s.

Feyerabend opposes to the realist correspondence theory of truth, according to which there is a one-to-one correspondence relation between theory and reality. Feyerabend holds that such correspondence does not guarantee truth, for "any false theory can be made to fit the facts" (Feyerabend 1981, 5). The biggest mistake of the correspondence theory of truth is its universal claim about the nature of reality. Feyerabend insists that there is no such thing as a universal principle that binds all phenomena.

A relativist who deserves his name will then have to refrain from making assertions about the nature of reality, truth and knowledge and will have to keep to specifics instead. He may and often will generalise his findings but without assuming that he now has principles which by their very nature are useful, acceptable and, most importantly, binding for all.

(Feyerabend 2002, 78)

It is this prudent attitude about the reality and truth that drives Feyerabend to embrace relativism. Notably, relativism is not a solution to the problem of certainty. The certainty of knowledge may not necessarily imply truth, for it may mean that the knowledge is certain in terms of usefulness. For instance, relativists may reject the realist interpretation of quantum mechanics while admitting that it is a certain theory because it is useful in industry (e.g., quantum theory is used in laser technology). Proliferation of theory in science will not increase the certainty of knowledge. On the contrary, it may decrease the certainty due to the absence of a dominating theory. With respect to

increasing knowledge certainty, Feyerabendian theory choice plays little, if no, role. Regardless of whatever criterion of choice and whichever theory has been chosen, Feyerabend teaches us that the certainty of the explained reality will never be definite. The central theme of “anything goes” does not imply the liberty to propose any theory or methodology, but rather to suggest that proposed methodological rules have limited applicability. “Anything goes” is unproductive in the sense that the certainty of knowledge will not be increased as the result of theory choice. Though theory choice plays little or no role in enhancing the certainty of knowledge, it is not dispensable because theory choice involving alternative theories is needed to check and balance the dominating theory. If theory choice does not have a crucial role in increasing the certainty of knowledge, the whole scientific enterprise may be meaningless too. Besides, non-sciences such as myth and magic (which are epistemically significant in Feyerabend’s philosophy) fare no better, for theory choice in these enterprises can increase no certainty either (e.g. certainty about the detailed practice of magic or about human life). If certainty could not be increased via the activity of theory choice, in both sciences and non-sciences, the slogan of “anything goes” does not justify embracing relativism.

However, the main reason Feyerabend advances “anything goes” is to prevent the so-called tyranny of science. All theories, regardless of good or bad, logical or ridiculous, should receive equal attention. By “anything goes” Feyerabend means that the options should always be kept open to a wide variety of theories. The expected corollary is the proliferation of theory in science. According to Feyerabend, proliferation of theory

provides alternative solutions to problems by approaching reality in various ways. The consequence of the check-and-balance mechanism provided by rival theories is that no single theory will dominate science and human life.

However, it is not clear how such a check-and-balance mechanism could operate if the chosen theory is more decisive than its rivals in explaining physical phenomena (e.g., Astronomical theories vs myths in explaining astronomical phenomena). For a check-and-balance mechanism to realize its practical power, the rival theories have to exert their impact (such as overriding or taking-over) on the dominating theory. If a decisive theory has been chosen, there would be no rational way that a check-and-balance mechanism could be exerted by the rival theories, for their impacts are non-decisive. It would be irrational to use a non-decisive theory to account for the observed phenomena if one has a more decisive one as his choice, though what counts as a decisive theory is contentious. However, Feyerabend does not see it as a problem. Rather, he maintains that such a check-and-balance mechanism is needed in a free society. A free society “is a society in which all traditions should be given equal rights *no matter what other traditions* think about them” (Feyerabend 1995a, 75). For Feyerabend, liberation in theory choice is more important than the irrational consequences that ensued.

It is apparent that Feyerabend’s relativism and outlook of free society entail both rationality and irrationality. What Feyerabend against is the dominance of the realist notion of rationality and the exclusion of irrationality. In fact, Feyerabend’s understanding of rationality is relativistic. The examples of this kind of rationality, as

given by Feyerabend, are myth, magic, and traditional medicine. For Feyerabend, these fields are merit in their own context. They are rational in their respective field, for they can account for the reality in their respective context. They are not universally rational (in the sense defined by scientific realist), but relativistically rational. Hence, the highest principle of theory choice is to keep all possibilities open, including the theories which had been proved false in the past or those which are non-scientific. Because rationality is interpreted relativistically, there would be no standard protocols and criteria for theory choice. In fact, the legitimacy of Feyerabendian criteria of theory choice hinges on the consequences of the choice—whether it promotes scientific progress. Any criterion of theory choice that does not lead to scientific progress will not be advanced by Feyerabend. It is reasonable to infer that Feyerabend does not have fixed criteria for theory choice. For the same criterion (say, simplicity) may yield different consequences (i.e. different extents of scientific progress) in theory choice in different problem situation, depending on the available candidate rival theories at hand. We may imagine such a situation:

[Situation A]: To solve problem P_1 , given a list of criteria for theory choice (C_1, C_2, \dots, C_n) in the face of a list of available rival theories (T_1, T_2, \dots, T_n), C_1 is the best criterion that promotes the greatest progress in science; while C_2 is the worst criterion that is detrimental to scientific progress.

[Situation B]: To solve a different problem, P_2 , given the same list of criteria as in Situation A. In the face of a list of different rival theories (U_1, U_2, \dots, U_n), C_2 is the best criterion that promotes the greatest progress in science; while C_1 is the worst criterion.

In Situation A, C_I is the favorable criterion for theory choice because it promotes scientific progress to the greatest extent. In Situation B, C_I is the least favorable criterion because it is detrimental to scientific progress. Thus, the same criterion (C_I) may not be endorsed in the different problem situations. The absence of a fixed standard set of criteria for theory choice is consistent with Feyerabend's relativism and his principle of "anything goes". Indeed, Feyerabend's relativistic rationality of theory choice is pragmatic. A criterion is rational (favorable) only if it can bring about scientific progress.

1.5 Contributions of This Work

- (1) The first work that systematically discusses the thesis of theory choice in the context of scientific realism and relativism.
- (2) This work demonstrates the connection between the conception of scientific progress and the thesis of theory choice. I argue that scientific progress is a common theme championed by scientific realist, antirealist, and relativist. However, the means to achieve the goal of scientific progress, via theory choice, is different among the philosophers from different camps.

1.6 Organization of Chapters

The main body of this thesis consists of four chapters (Chapter 2 to Chapter 5). In Chapter 2, the challenges posed by the thesis of theory choice to scientific realism were discussed. The scientific realist's account of the theory of truth and the

underdetermination thesis were elaborated at length, and the relation between these accounts to the thesis of theory choice was discussed. This chapter demonstrates that in what ways does the stringent criterion of rational theory choice put scientific realists into predicament.

Chapter 3 deals solely with the relation between anti-realism and the thesis of theory choice. Here, I separate relativism from anti-realism. Though some literatures incline to categorize relativism under anti-realism, there are philosophers who make a distinction between them, e.g. Sylvan (1988) and Laudan. In this work, “anti-realism” is a school of thought which is neither relativistic nor realist. The salient characteristic of the anti-realists is that they oppose the epistemic fundamentalism and the correspondence theory of truth. In this chapter, I show that anti-realists do not have the pressure to adhere to a strict criterion of theory choice as scientific realists do. However, I argue that anti-realists have the pressure to warrant that their criteria of theory choice are capable of singling out the objective theory from the rivals.

Chapter 4 and 5 are allocated for relativism. I discuss, in Chapter 4, the relation between relativism and the thesis of theory choice. I argue that the severe problem that challenges relativists is that they have no recourse to validate whether the framework-dependent scientific theories are genuinely depicting the reality. In Chapter 5, I dwell on the plausibility of genuine theory choice in relativism. I attempt to answer whether a relativistic theory choice could be counted as a genuine theory choice in science.

Chapter 6, the final chapter of this thesis, concludes the strengths and limitations of each school of thought in dealing with the problem of theory choice. Throughout this work, all the emphases (*italic font*) in the quoted paragraphs are original unless otherwise specified.