Falsification of Popper and Lakatos
(Falsifikace podle Poppera a Lakatose)

Essay for FIL901

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ANNOTATION

This paper discusses works of Popper and Lakatos. Firstly, Popper’s rejection of inductive method and introduction of deductive method as mean of scientific progress is discussed. Furthermore, paper briefly touches on main aspects of Popper’s theory such as demarcation criterion, universal and existential concepts and falsifiability. Lakatos in his work introduced continual growth of theories for which he used Popper’s falsification as a basis. Progressive and degenerating problemshifts are discussed as well.

Keywords:
Deductive method, falsification, demarcation criterion, progressive and degenerating problemshifts
Introduction
In my paper I try to discuss and introduce work of Popper and Lakatos, two great philosophers of the twentieth century. In first part I attempt to introduce Popper’s deductive method and main aspects of falsificationism he proposed. These aspects include methods of comparison of scientific theories, discussion of demarcation criterion, universal and existential concepts and falsifiability. I am aware that this is not comprehensive description of the Popper’s theory but rather selected concepts are outlined in order to develop them in the second part of the paper dedicated to work of Lakatos.
In the second part I use work of Lakatos to build upon Popper and introduce three main stages of falsificationism, namely dogmatic, methodological and sophisticated falsificationism. The sophisticated falsificationism is of the main concern and represents advance brought by Lakatos to Popper’s basic theory. This advance is mainly brought by introduction of continual scientific progress or ‘positive problemshift’.

Popper’s falsification as method of scientific discovery
In his “Logic of Scientific Discovery” Popper\(^1\) rejects inductive method of thinking and scientific progress. Dismissal of method justifying universal conclusions derived and based on singular statements and introduction of his own method of based on deduction is Popper’s greatest achievement and gift to modern methodology of science. His interest lays in methods and results of examining and justifying new ideas not in the process by which new ideas are conceived. Creation of an idea as well as theory might be something irrational and includes ‘creative intuition’ but it is of zero interest to methodologists. Our main concern is on the method which is used for critical testing of new theories and selection of them in accordance with the results of the tests. There are four main types of testing the theory\(^2\):

a) “logical comparison of the conclusions among themselves, by which internal consistency of the system is tested”;

b) “investigation of the logical form of the theory, with the object of determining whether it has the character of an empirical or scientific theory, or whether it is tautological”;

c) comparison with other theories in order to determine whether this new theory constitutes scientific advance based on its survival of various tests; and

d) “testing of the theory by way of empirical applications of the conclusions which can be derived from it.”

It is this last type of testing of new theories which is of the utmost importance for a positive conclusion of the test can support the theory only for the time being but a negative test result can always overthrow such theory. Empirical testing is based on deductive process as well. From new and already standing theories are derived “predictions” in the form of singular statements which fulfil requirement of testability. Of such deductively determined statements are selected those contradicting new theory and are submitted for testing.

Demarcation criterion

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\(^1\) Popper, 2006
\(^2\) Popper, (2006), p. 9
Distinguishing of what is empirical testing and empirical sciences from metaphysical, unscientific speculation is called problem of demarcation. Solution to this problem will eliminate objections that by accepting deduction as method of scientific progress we removed barriers separating each other and allowed metaphysical twaddle to enter the world of science. To establish this we have to first define what exactly ‘empirical science’ is. According to Popper empirical theoretical system must be 3; 1) synthetic, thus representing non-contradictory, possible world; 2) satisfies criterion of demarcation (see further below); and 3) distinguished from other such systems as the one which represents our world of experience, meaning it is submitted to test and withstanding these tests.

Problem of demarcation was recognized as the important criterion for elimination metaphysics from science long before Popper’s proposals of deduction method. Inductivists in their proposal demanded statements of empirical science to be ultimately decidable as true or false. Logical possibility of conclusively decidable statements was a door opener for verifiability of theories. Inductivists, as already mentioned, considered universal statements as verifiable by the experience. But we can not determine that all swans are white no matter how many swans we observed. Therefore Popper reject verifiability as criterion of demarcation and proposes exact opposite - falsifiability. Scientific systems should be required to have logical form and be capable of being “singed out, by means of empirical tests, in a negative sense: it must be possible for an empirical scientific system to be refuted by experience” 4. In order to refute universal statements of theories we try to find singular statements which contradict them. Here we should emphasize the objectivity of the tested scientific statements as opposed to subjective statements. Subjective statements are related to the psychology. “Objectivity of scientific statements lies in fact that they can be inter-subjectively tested”5.

To avoid criticism of insufficiency of demarcation criterion in case theory is amended by auxiliary *ad hoc* hypothesis or adjustments of standing theories, Popper suggests condition upon which these auxiliary hypothesis (please see below discussion of ceteris paribus clauses in chapter dedicated to work of Imre Lakatos) are judged and admitted. Popper demands increased degree of falsifiability by these new and / or adjusted hypothesis. By increasing prohibited content it proposes new system which ought to be considered anew. Spatio-temporal amendment of universal statements means in fact ceteris paribus clause and thus if testing the theory we are testing both universal statement and ceteris paribus clause. For discussion of consequences please refer to part related to methodological falsificationism.

**Universal and existential statements**

Furthermore we should discuss already mentioned universal and existential statements. Of the primary concern to theoretician are the universal, more precisely *strictly universal statements*. Such statements can be characterised as an ‘‘all-statements’, i.e. universal assertions about unlimited number of individuals”6. We should make a clear distinction between universal, individual and existential statements. *Individual concepts* are mostly disguised in spatio-temporal coordinates and use of ‘proper names’ (e.g. Greenwich, Napoleon etc.) is indispensable. These individual concepts appear in each singular statement derived from universal concepts and theories. *Strictly existential statements* are in the form of ‘there-is’ statements,

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3 Popper, (2006), p. 17  
4 Popper, (2006), p. 18  
5 Popper, (2006), p. 22  
6 Popper, (2006), p. 41
meaning their content demands existence of certain kind (e.g. there exists blue elephant). This type of statements are always equivalent to negation of strictly universal statements and vice versa. Concept of prohibition of strictly universal statements and denial of existence are grounds for the falsification of these statements by proving contrary. Strictly existential statements on the other hand cannot be falsified (you cannot prove sufficiently that there is no blue elephant). Strict statements (both universal and existential) are not limited to spatio-temporal region which is the exact reason for the falsifiability of universal and non-falsifiability of existential statements.

**Falsifiability**

Falsifiability of theory depends on her ability to divide all possible basic statements (same meaning as ‘singular statement’) into two non-empty classes. The class of potential falsifiers (statements with which the theory is inconsistent) and the class of basic statements it does not contradict. In short, “theory is falsifiable if the class of its potential falsifiers is not empty”. When solving problem of falsifiability of theories now we can establish the criterion upon which we pronounce theory as falsified. We can consider theory as falsified if the proposed empirical hypothesis (‘falsifying hypothesis’) which describes effect contradicting the theory is corroborated. To show it in more understandable way Popper defines concept of ‘occurrence’ and ‘event’. Occurrence represents singular statement with certain spatio-temporal coordinates (e.g. it is warm in Prague in January). Event on the other hand represents universal part of the singular event (i.e. it is warm). Theory is considered as falsifiable in the case when it prohibits at least one event. Thus the class of potential falsifiers will always include (if not empty) unlimited number of basic (singular) statements.

**Lakatos’ continual growth of theories**

Lakatos starts his “Methodology of Scientific Research Programmes” with comparison of works of Kuhn and Popper. He sets against each other these two great philosophers on issue of change in science and how the transmission from one theory to another is possible. “…according to Popper science is ‘revolution in permanence’, and criticism the heart of the scientific enterprise”. On the other hand Kuhn contradicts this statement by exceptionalism of scientific revolutions. Introductions of new theories are only allowed during times of distress and crisis when current theories are unable to bear the burden of criticism and contradictory evidence. This mysticism of scientific changes has somewhat extra-scientific, mythical quality and thus falls within “psychology of science” while Popper’s belongs to “logic of scientific discovery”. Popper’s falsificationism [as introduced in previous chapter] can be distinguished in three levels (dogmatic falsificationism, methodological falsificationism and sophisticated falsificationism) which will be discussed herein.

**Dogmatic falsificationism**

This branch of falsificationism “admits the fallibility of all scientific theories without qualification, but it retains a sort of infallible empirical basis”. The shift from trying to prove the theories to trying to disprove them was the most important philosophical achievement in the past 100 years. Of this is the dogmatic falsificationism most

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7 Strictly universal statements thus can be called ‘there is not’ statements or non-existence statements.  
8 Popper, (2006), p. 66  
9 Lakatos in Lakatos & Musgrave, 1970  
10 Lakatos & Musgrave (1970), p. 92  
11 Ibid. p. 93  
12 Ibid. p. 95
According to falsificationism approach, to be considered as a scientific theory, proposition needs to be falsifiable. In other words it is of utmost importance for a proposition to define certain statements which by the use of empirical or mathematical techniques can be disprove it – a.k.a. potential falsifiers. Dogmatic falsificationism uses the empirical counterevidence as the only arbiter to judge theories. Any proposition unable to define its potential falsifiers (e.g. tautological statements) are then branded as metaphysical and non-scientific. Science grows and evolves according to dogmatic falsificationism via iterative dismissal of theories by the factual findings. Upon their overthrow theories are replaced by even bolder new propositions which are kept unproven until refuted. This permanent shift in scientific knowledge is according to Lakatos based on three false premises.

Firstly, it falsely assumes “natural, psychological borderline” between theoretical or speculative propositions and factual or observational (or basic) propositions (see Lakatos & Musgrave, 1970, p. 97). On example of Galileo’s observation of mountains of moon, Lakatos shows that we are unable to clear our mind of expectations and feelings and thus all observations are affected by our past experience and gained knowledge. There is no such thing as clear and empty mind able to accept observations in their state as they are. Inability to ignore our own expectations eliminates natural demarcation between factual and theoretical propositions.

Secondly, dogmatic falsificationism incorrectly assumes that, if proposition is indeed factual (satisfies first assumption) than this proposition is true, meaning it can be proven by experiment. But this is pure myth, because there is no such thing as factual proposition proven by experiments. Simply by observing any number of white swans we still did not prove the statement that all swans are white. Single observation of black or blue swan will lead to refutation of ‘all swans are white’ theory. Therefore if factual propositions are ultimately not provable than they are fallible and thus differences between theories are not clashes and falsification of such theories but simple inconsistencies.

And thirdly, Lakatos disputes too narrow criterion of demarcation of dogmatic falsificationism, which states that “theory is ‘scientific’ if it has an empirical basis” 13. Translated it means that theories forbid certain empirical events, which if proven correct can disprove the theories. Problematic is the fact that most of the theories (if not all) can be characterised as theories with ceteris paribus clause. Such clause means that all other conditions are unchanged and no other factors have influence on the event, an universal non-existence statement (well known concept in economics). Locking of spatio-temporal conditions by ceteris paribus clause means combining ‘basic statement’ and ‘universal non-existence statement’ (see above). Universal statement (a ceteris paribus clause) does not belong to the empirical basis and therefore they can not be proved or observed. Shortly, some scientific theories are interpreted as with ceteris paribus clause and as such they are refuted. In refuting these statements we did not disproved specific theories but only spatio-temporal combination of specific theory and conditions surrounding it. Scientific theories with ceteris paribus clause are theories without empirical basis and thus dogmatic falsificationism relegates them to metaphysics (unscientific). Similar case can be made for the probabilistic theories. If projected to the extreme, by accepting demarcation criterion of dogmatic falsificationism we can end up in the state of

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13 Lakatos & Musgrave (1970), p.98, emphasis added by author
scepticism when all “scientific theories are not only equally unprovable, and equally improbable, but they are also equally undisprovable”\(^{14}\).

Furthermore ceteris paribus clauses might be used as a back door for theories refuted by experiments. Auxiliary theory including ceteris paribus clause can amend the scientific proposition under test and explain the unwanted results of the test (more on this later).

**Methodological falsificationism**

Before discussing methodological falsificationism first let’s discuss conventionalism of which it is school. In general there are two main streams of theories of knowledge. *Passivists*, ready to dismiss our attempts to think, as biased and having unwanted influence on understanding of nature’s knowledge. This knowledge can be accepted only through clear mind, free from any expectations and influence of past experience. Best known passivist school is classical empiricism. Second stream of theories of knowledge is *activists* approach, underlining the need of our activity to interpret nature and its secrets. Activists are than divided into *conservative activists* and *revolutionary activists*. According to Lakatos in Lakatos & Musgrave (1970) conservates state that we are born with certain predispositions according to which we shape our surroundings and understanding of these surrounding. In acting so we are creating our own prison where we are forced to live. Applying this concept on scientific theories we can say that after certain period a ‘methodological decision’ is taken about irreputability of scientific theory by explaining anomalies via introduction of auxiliary hypothesis. Revolutionaries, led by Popper’s methodological falsificationism, believe in our ability to shape our conceptual framework of understanding and replacing this conceptual framework by improved ones. The criterion upon which it is decided that it is time to replace and finally reject the theory is subject of next few lines.

Revolutionary conventionalists a.k.a. methodological falsificationist “makes unfalsifiable by fiat some spatio-temporally singular statements which are distinguished by the fact that there exists at the time a ‘relevant technique’ such that anyone who has learned it will be able to decide that the statement is acceptable”\(^{15}\). Such statement are called than ‘basic statement’. Group of basic statements determined by the objective mutual agreement\(^{16}\) is set aside (and regarded as true) by the decision corresponding with second condition of dogmatic falsificationism, thus creating the group of ‘observable’ states. Main difference between methodological and dogmatic falsificationism is that the scientist using the former is aware of possible fallibility of the theories he is using to interpret the facts. He applies experimental techniques based on these theories for the time being and regards them as ‘unproblematic background knowledge’. By doing so he widens the scope of techniques which can be used for testing of scientific propositions (from purely experimental basis of dogmatic falsificationism), he widens the ‘empirical basis’ of the theories\(^{17}\).

Accommodating the distinction into demarcation criterion we arrive at statement that; “only those theories (non-observational propositions) which forbid certain

\(^{14}\) Ibid. p.103

\(^{15}\) Lakatos & Musgrave (1970), p.106

\(^{16}\) By objective we mean free from psychological considerations.

\(^{17}\) Please note the use of ‘ ‘ (inverted commas) which distinguish empirical basis of dogmatic and methodological falsificationism. Methodological falsificationism uses besides purely empirical facts also observable states which are regarded as acceptable as part of unproblematic background knowledge to test the scientific proposition.
‘observable’ states of affairs, and therefore may be ‘falsified’ and rejected, are ‘scientific’\textsuperscript{18}. Although such demarcation criterion greatly helps with acceptance of theories otherwise refuted by dogmatic falsificationism as metaphysical, it still does not solve the problems caused by scientific propositions with ceteris paribus clause. When scientific theory with ceteris paribus clause failed the test, we must decide whether such refutation is of the scientific theory or it was due to specific conditions applicable. In later case we are back to square one and does not regard scientific theory as disproved. On the other hand we might consider initial conditions as unproblematic background knowledge and refute the scientific theory. This can be done only upon corroboration of ceteris paribus clause via testing specific other assumptions assumed to having an influence. Introduction of the fourth type of decisions\textsuperscript{19} related to testing of ceteris paribus clauses will solve the above mentioned problem and opens doors to accepting further scientific propositions.

**Sophisticated methodological falsificationism**

Main distinction of the sophisticated falsificationism over naïve is the demarcation criterion. Naïve as mentioned above finds propositions scientific if they are falsifiable through observable experiments. Sophisticated falsificationism demands from scientific propositions introduction of novel facts over the previous theories it aims to refute and / or replaced. These novel facts must be in some way corroborated. Basic rules of sophisticated falsification state that new theory should be introduced and this new theory is distinguished by:

a) new theory has excessive empirical content. It predicts new facts which are either unexplained or forbidden by the previous theory.

b) new theory explains fully scientific content of previous theory.

c) new content of novel theory is at least partially corroborated.

Sophisticated methodological falsificationism offers also explanation and solution to the problem of auxiliary hypotheses introduced to save the theory refuted by the test. Answer to the question of which auxiliary hypotheses are scientific progress and which are mere linguistic exercise and represent degeneration of science\textsuperscript{20}. Lakatos in his “Methodology of Scientific Research Programmes” distinguishes progressive and degenerating problemshifts. Furthermore he recognises *theoretically progressive* and *empirically progressive* theories. Theoretically progressive are those which predict new empirical content over its predecessor meaning they foresee some new facts. Empirically progressive are theories which in addition to prediction of new facts also corroborate them, meaning new facts being discovered by empirically progressive theories. He works with series of theories in which new theory supersedes previous one only when it is both empirically and theoretically progressive. Supersession of theories is defined as *progressive problemshift*\textsuperscript{21}. Anything else is called *degenerating problemshift*.

In this highest form of falsificationism focus shifts from appraisal of theories to the appraisal of series of theories. We are not any more concerned with single stand alone theory but on the series of theories. Theories are not refuted by negative test and test no longer decide fate of the theory but refutation happens only upon introduction of

\textsuperscript{18} Lakatos & Musgrave (1970), p. 109

\textsuperscript{19} Other three types include; regarding statement as spatio-temporally acceptable, distinguishing group of such statements and demarcation criterion.

\textsuperscript{20} See sections 19 and 20 of Popper (1934). He calls inadmissible auxiliary adjustments an ad hoc hypothesis.

\textsuperscript{21} Furthermore problemshifts are scientific if they are at least theoretically progressive, otherwise they are pseudoscience.
theories explaining them and also novel facts. By demanding new content we are widening empirical basis of the theories. This is another distinctive feature of sophisticated falsificationism over naïve one. Naïve falsificationism do not require introduction of new and broader empirical basis but it allows refutation of theory and its substitution by the new one (possibly with the same empirical basis). When compared with naïve methodological falsificationism, sophisticated falsificationism does not require so called fourth type of decision making (please see above for more details). Furthermore it introduces an appeal procedure which enables scientist to defend his theory from the refutations by the experimentalist testing it. Theoretician can demand disclosure of ‘interpretative theory’ used and replaced it with better one which supports his scientific proposition dismissed by tests in accordance with the old interpretative theory. Of course such replacements have only postponement character as there might be developed new testing techniques which ultimately will result in refutation of scientist’s theory. Last but not least Lakatos eliminates so called ‘tacking paradox’ from his theory by demanding connection of new theories and newly introduced content with the previous theory content. It disregards bunching of several hypothesis disconnected with each other as not progressive problemshift.

**Conclusion**

In my paper I attempted to briefly introduce methodological falsificationism of Popper and its basic concepts. In his theory Popper rejects inductive method and introduces instead his own proposition of based on falsification. He furthermore elaborates on new demarcation criterion which is falsifiability of scientific theories. His insistence on survivor of the fittest theories (which sustain the strongest and most serious tests) might be viewed as inclusion of the Darwin theory into philosophical discussion. Also in his book he dismisses probabilistic theories as unscientific unless certain precautions are made. In his turn Lakatos builds on the grounds laid down by Popper and distinguishes three main stages of falsificationism. Basic or dogmatic falsificationism, methodological falsificationism and ultimately sophisticated methodological falsificationism. In this third concept Lakatos introduces continual growth of science and lays three main conditions upon which new theories can be introduced and accepted. These are:

- excessive empirical content of new theory;
- fully explained scientific content of previous theory; and
- new content of novel theory is at least partially corroborated.

Lakatos’ work brings dynamism into Popper’s falsificationism. It explains and establishes conditions for inter-temporal increase of scientific content.

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22 Popper, (2006), p. 190
References