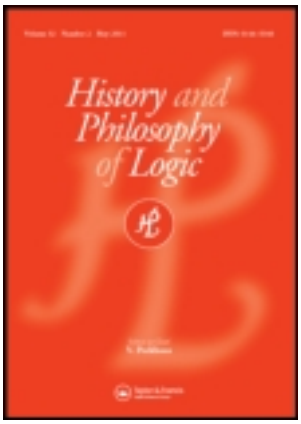

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Justification of Induction: Russell and Jin Yuelin. A Comparative Study

Chen Bo [a]

[a] Department of Philosophy, Peking University, Beijing, 100871, People's Republic of China

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Justification of Induction: Russell and Jin Yuelin. A Comparative Study

CHEN BO
Department of Philosophy, Peking University, Beijing 100871, People's Republic of China

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Jin Yuelin (1895–1984), a Chinese logician and philosopher, is greatly influenced by Hume's and Russell's philosophies. How should we respond to Hume's problem of induction? This is an important clue to understand Jin's whole philosophical career. The first section of this paper gives a brief historical review of Russell and Jin. The second section outlines Hume's skeptical arguments against causality and induction. The third section expounds Russell's justification of induction by discussing his views on Hume's skepticism, causality, principle of induction, and empirical postulates. The fourth section clarifies Jin's justification of induction by discussing his critique of Hume's epistemology and his arguments for the reliability of causality and the eternal truth and apriority of the principle of induction. The final section compares Jin's justification of induction with Russell's and concludes that there are similarities and differences between their projects and that both their attempts fail. This paper takes the similar responses to the problem of induction by Jin and Russell to demonstrate the communication that there has been between Chinese philosophers and the Western ones.

1. A brief historical review

Before the First Opium War in 1840, except for a few western missionaries who came to China, Chinese intellectuals had almost no contact with the Western ones. Whereas after the War, especially at the end of the nineteenth century and the beginning of the twentieth century, the government of the Qing Dynasty began to pursue the official policy of dispatching overseas students to study western culture abroad. Then, government-funded students, plus family-funded students, went to Europe, America or Japan for overseas study and thus initiated the communication between Chinese intellectuals and the Western ones, including the communication between them in philosophical fields. In this paper, I will take Jin Yuelin's and Russell's responses to Hume's problem of induction as a model of the communication and dialog between Chinese and Western philosophers and focus on making a comparative study of their justifications of induction.

Bertrand Russell (1872–1970) once had a close contact with China. In response to invitations made by various Chinese academic groups, he came to Shanghai accompanied by Dora Winifred Black on 12 October 1920 and conducted a series of tours and lectures in Chinese cities, such as Shanghai, Hangzhou, Nanjing, Changsha, Beijing, and Baoding, in 9 months. Because of catching a bad cold during his speech hosted in Baoding City, which finally led to bronchitis and pneumonia, he had been severely ill for over 2 weeks with life-threatening situations and then he had to rehabilitate for over 3 months.

During his stay in China, Russell gave over 60 speeches, which ranged widely, for example, from theory of relativity by Einstein, mathematical logic, utility of education, religious belief, social reformation theory, bolshevism, international politics, China's road to freedom to analysis of mind, analysis of matter, and others (see *Sun Jiaxiang 2004*, pp. 308–309). His speeches in Beijing were quite systematic and could be grouped into five series: Problems of Philosophy, Analysis of Mind, Analysis of Matter, Mathematical Logic, and Social Structure, all of which were given at Peking University. During the period of his visit, some

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students and faculties of Peking University founded 'Russell's Theory Seminar', gathering once every 2 weeks, which Russell himself even regularly attended. He wrote in his *Autobiography* that

> The National University of Peking for which I lectured was a very remarkable institution. The Chancellor and the Vice-Chancellor were men passionately devoted to the modernizing of China. The Vice-Chancellor was one of the most whole-hearted idealists that I have ever known. …The students deserved what their professors had to give them. They were ardently desirous of knowledge, and there was no limit to the sacrifices that they were prepared to make for their country. The atmosphere was electric with the hope of a great awakening. (*Russell 1968*, p. 183)

Most of Russell's speeches in China were recorded, some of them were soon published by Chinese newspapers and periodicals, and some were officially printed into books and distributed. His lecturing activities caused a great sensation in China, even formed the so-called Russell Fever at that time, and produced a relatively profound impact on the ideological circle of China. Later, Russell used a whole chapter (more than 40 pages) in his *Autobiography* (Volume 2, 1968) to describe his visit to China. It can be seen from his lines that he highly approved the natural scenery of China and the ways of life of Chinese people, but he seldom mentioned academic exchange with his Chinese colleagues. This is understandable, because at that time, almost no or at least very few Chinese intellectuals could completely understand what he said, not to mention engaging in substantial dialog with him. Russell left China by ship from Tianjin City on 11 July 1921 and made a 12-day visit to Japan by invitation. According to his *Autobiography*, Russell's Japanese trip was rather unpleasant; one time he lost his control of his emotions to Japanese journalists (see *Russell 1968*, pp. 191–194). One year later, he published a book about China, that is, *the Problem of China* (*1922*).

Jin Yuelin (1895–1984, hereafter Jin) is a Chinese logician and philosopher and a famous educator, one of his students was Hao Wang (1921–1991), who became an internationally known Chinese-American logician, philosopher, mathematician, and computer scientist. Jin was born in a Courtier's family of Qing Dynasty in Changsha City, Hunan Province, China. He was admitted into (Imperial) Tsinghua College, the predecessor of Tsinghua University, and then passed the examination for the government-subsidized overseas students, which enabled him to go to the USA to study at the University of Pennsylvania from 1914. He first studied business, in which he had no interest, and then decided to study political science; he was admitted to study at Columbia University, where he majored in political science in 1918 and obtained Doctor's Degree in 1920 with a dissertation on the political theory of T.H. Green (1836–1882). During his doctor's study, he had developed a tremendous interest in philosophy under the influence of Green. From the end of 1921–1925, he went to Europe for a touring study mainly in England, Germany, France, and Italy. During this time, he studied for quite a long time in Economic School at the University of London and at the University of Cambridge. When studying in London, he was influenced significantly by two books: *The Principles of Mathematics* by Russell and *A Treatise of Human Nature* by Hume. Later, he wrote that

> At that time I might not really understand that book by Russell, but this book impressed me deeply that, philosophy does not necessarily rely on big issues; if it carefully and deeply analyzes ordinary concepts used in our daily life, it still can get some profound thoughts or even a system of theories. Since then, I focused on analysis, and gradually became far away from the influence of Green's thoughts. (*Jin 1940a*, pp. 3–4)

> Hume's arguments make me feel that induction does not make sense and causation is not reliable, and that the theoretical foundation of science has been shaken. Right now this may not create a big problem in my mind, but it was certainly a serious problem at that time: my theoretical difficulties were almost turned into my emotional agony. Nonetheless, I have a quite firm belief in science, thus felt that something is wrong with Hume's statements. Later on, I slowly discovered that Hume's predicament does lie not only in his theory of causation, but also in his whole philosophy. (*Jin 1940a*, p. 4)

It was in Europe that Jin's probe into reason had been completely turned into philosophy and that he also had become interested in logic. At the end of 1925, Jin came back to China. He began to teach logic and philosophy at National Tsinghua University in 1926 and founded the Department of Philosophy at that university later. In the 1930s, he wrote a textbook, *Logic* (1936), in which he introduced to China the logical system of *Principia Mathematica* (1910–1913) by Whitehead and Russell, that is, propositional calculus and predicate calculus, and by which he educated the earliest generation of mathematical logicians in China, of which Hao Wang is the most excellent one.

As has been described above, when staying in Europe, Jin realized that if he did not organize his theory of knowledge into orderliness, he cannot systematically reply to Hume's problem and write a book on induction; moreover, his theory of knowledge requires an ontological foundation. So, from the 1930s to the 1940s, Jin finished two books: *On Dao* (*1940a*) and *Theory of Knowledge* (written in 1948, formally published in 1983), of which the first focuses on his metaphysics and the second on his theory of knowledge. He also published numerous papers on the problem of induction, for example, 'Relation between Free Will and Causation' (*1926*), 'Critics of Hume's *Theory of Knowledge* in *Treatise*' (*1928*), 'Interpretation of Necessity' (*1933*), 'The Principle of Induction and *A Priori*' (*1940b*), 'Principle of Situation Occurrence' (*1943a*), and 'Principle of Induction and Future' (*1943b*), in which he developed *a priori* and deductive justification of induction, which is essentially similar to Russell's replies to Hume's problem. From the 1950s to the 1960s, he did quite a systematic investigation of Russell's philosophy and finished an expository and critical book, that is, *The Philosophy of Bertrand Russell* (published in 1988). Of course, this book had obvious and heavy traits of ideology in China at that time.[1]

For quite a long time, Jin was one of the pioneering leaders of philosophy and logic in the Chinese circle and had taken important academic posts for many years, such as the vice-director of the Institute of Philosophy, Chinese Academy of Social Science, and the president of Chinese Association of Logic. His main academic contribution has been included in his three books: *Logic*, *On Dao*, and *Theory of Knowledge*, and almost all his writings have been edited in *Collected Works of Jin Yuelin* (four volumes, 1995).

2. Hume's problem and its influence

Hume asserts that 'all the materials of thinking are derived either from our outward or inward sentiment: the mixture and composition of these belongs alone to the mind and

[1] When Russell visited China in 1920–1921, Jin was a doctorial candidate at Columbia University, USA, so he did not meet Russell during that period. There is no evidence to show that when Jin stayed in London from 1921 to 1925, he had any personal contact with Russell, even met Russell once. In 1943, Jin was invited by US Department of State to give lectures and do research in the USA for one year. According to the chronology of Jin Yuelin edited by Liu Peiyu, it was in that year that Jin went to Washington to visit Russell who was there (*Liu 2000*, p. 493). In 1958, as the deputy head of Chinese culture delegation, Jin made a visit to Europe for more than three months. During the period of his visit, Jin gave a lecture at the University of Oxford and visited the University of Cambridge, where he paid a visit to Professor Ernest Baker (1874–1960), who was Jin's former teacher, whose courses Jin attended in the USA, but there is no record that Jin also visited Russell (cf. *Liu 2000*, pp. 54–55, 506).

the will. Or, to express myself in philosophical language: all our ideas or more feeble perceptions are copies of our impressions or more lively ones'. (*Enquiries*, hereafter *E*, p. 19) By this empiricist principle, he develops his radical doubts of the necessity of causal relation, which imply his radical doubts of the rationality of inductive reasoning. His skeptic arguments of causation and induction are customarily called 'Hume's Problem' or 'Problem of Induction', which has had significant and profound influence on the history of philosophy and logic.

It should be noted that Hume does not use the word 'inductive reasoning' and that he often mentions 'reasoning concerning causes and effects', 'non-demonstrative inference', or 'probable argument', which is actually 'predictive inductive reasoning' such as

> The Sun has risen from the east every day in my experience.
> So, it will rise from the east tomorrow.

Or

> So far, the observed $a_1, a_2, \ldots, a_n$ are all Fs that are also G.
> The unobserved a_{n+1} is also F.
> Thus, the unobserved a_{n+1} is also G.

This kind of reasoning infers from the observed instances to the unobserved; actually, this is the common feature of the different forms of inductive reasoning. So, what Hume says about predictive inductive reasoning applies to the different kinds of inductive reasoning.

I outline Hume's skeptical arguments about causation and induction as follows:

a. All the materials of thinking are derived from perceptions, which include impressions and ideas, of which impressions are the most powerful and vivid and ideas are the copies of impressions.
b. The objects of human understanding are divided into 'relation of ideas' and 'matter of facts'; human knowledge is also divided into 'knowledge concerning relation of ideas' and 'knowledge concerning matter of facts'.
c. The validity of the first-kind knowledge shall be solely determined by intuition or by demonstration.
d. The validity of the second-kind knowledge seems to be founded on the relation of cause and effect.
e. All causal inferences are built on experience, but cause and effect are different, and we cannot find effect in cause by whatever analysis.
f. The relation of cause and effect has three key factors: space contiguity, time continuity, and necessity, of which necessity is not originated from the observation of things.
g. Causal inference must rely on the so-called principle of similarity or principle of the uniformity of nature: 'If reason determined us, it wou'd proceed upon that principle, *that instances, of which we have had no experience, must resemble those, of which we have had experience, and that the course of nature continues always uniformly the same*' (*Treatise*, hereafter *T*, p. 89).
h. The principle of the uniformity of nature has no demonstrative certainty, 'since it implies no contradiction, that the course of nature may change, and that an object, seemingly like those which we have experienced, may be attended with different or contrary effects' (*E*, p. 35).
i. No probable argument can be provided for the principle of the uniformity of nature, since 'probability is founded on the presumption of a resemblance betwixt those

objects, of which we have had experience, and those, of which we have had none; and therefore 'tis impossible this presumption can arise from probability' (*T*, p. 90). Otherwise, we would have a circular reasoning or an infinite regress, which is logically invalid.

j. The certainty of the principle of the uniformity of nature cannot be guaranteed by appealing to the capability of an object to produce another, for the concept 'capability' derives from the observation on the sensible qualities of some objects, and the inference made there must depend on the principle of the uniformity of nature.

k. Therefore, the principle of the uniformity of nature has not been validly argued.

l. As a result, causal inference based on the principle of the uniformity of nature is logically invalid, for we can assume that event as cause occurs, while the other event as effect does not follow; in other words, when the premise(s) of a causal inference is true, its conclusion could be false.

Right now Hume can make his final conclusion:

> Thus not only our reason fails us in the discovery of the *ultimate connexion* of causes and effects, but even after experience has inform'd us of their *constant conjunction*, 'tis impossible for us to satisfy ourselves by our reason, why we shou'd extend that experience beyond those particular instances, which have fallen under our observation. We suppose, but are never able to prove, that there must be a resemblance betwixt those objects, of which we have had experience, and those which lie beyond the reach of our discovery. (*T*, pp. 91–92)

Hume's skeptical arguments are mainly aimed at causal relation, in which a skeptical argument about inductive reasoning is derived. I reformulate the latter as follows:

1. Inductive reasoning cannot be justified by deduction. There exist two logical leaps in inductive reasoning: one is a leap from the finite instances actually observed to the universal conclusion regarding potential infinite objects unobserved; the other is a leap from experience of the past and present to the anticipation of the future. Neither of the two leaps has guarantee from deductive logic, since what applies to the finite may not apply to the infinite, and the future may be different from the past or the present.
2. Inductive reasoning cannot be justified by induction, because the justification of induction by resorting to the successes of induction in the past has to employ inductive reasoning, so it will end up in a circular argument or an infinite regress.
3. Inductive reasoning depends on the universal law of causation and the principle of the uniformity of nature, but the objectivity of the latter has not yet been proved, for sense organs tell us at most how things have looked like, but not how things will look like in the future; moreover, what sense organs tell us is the constant conjunction and successive connection between phenomena, but not necessary causal relation; law of causation and the principle of the uniformity of nature have no empirical evidence and are merely derived from people's habitual mental associations. 'Custom, then, is the great guide of human life' (*E*, p. 44).

It should be pointed out that Hume's problem turns out to be a set of difficult problems, for example, whether or not empirical knowledge, being universal and necessary, is possible? If yes, how is it possible? Therefore, Hume's doubts of causation and induction are profound and very challenging and have attracted much attention from generations of philosophers.

In order to reply to Hume's problem, philosophers have put forward several projects of justifying induction, some of which I summarize as follows:

1. Deductive justification of induction, with J.S. Mill as one of its representatives, adds a major premise such as the principle of the uniformity of nature to inductive reasoning in order to necessarily ensure the truth of inductive conclusion. This project acquiesces in the fact that inductive reasoning itself cannot necessarily entail its conclusion.
2. *A priori* justification of induction, with Kant and Russell (and Jin in China) as its representative figures, defends inductive reasoning by adding some principle(s) *a priori* as the major premise of the reasoning.
3. Conventional justification of induction, with H. Poincaré as one of its representatives, regards the (implicit) major premise of inductive reasoning as a sort of subjective or social conventions.
4. Probabilistic justification of induction develops some probabilistic logics of induction and makes the partial justification of inductive logic by means of Bayesian approach.
5. Pragmatic justification of induction, with C.S. Peirce and H. Reichenbach as its representative figures, maintains that induction is the best strategy among all strategies adoptable to obtain truth and is a continuous self-correcting process that ultimately drives us to reach the truth.
6. K. Popper developed a procedure of falsification, that is, $PS_1 \rightarrow TT \rightarrow EE \rightarrow PS_2$. That is to say, in response to a given problem situation (PS_1), a number of tentative theories (TT) are systematically subjected to the most rigorous attempts at falsification possible. The process, error elimination (EE), performs a function for science that is similar to that performed by natural selection for biological evolution. Theories that better survive the process of refutation are not more truer, but rather more applicable to the problem situation at hand (PS_1) than others. However, they may have to face new problems (PS_2) and so on.

So far, we still have to accept the famous apothegm that inductive reasoning remains 'the glory of Science' and 'the scandal of Philosophy' (*Broad 1952*, p. 143) or that 'Induction is the triumph of science and the disgrace of philosophy' (*Stegmüller 1977*, p. 68).

3. Russell's justification of induction

Russell explores the problem of induction in many of his writings, for example, *The Problems of Philosophy* (*1912*), *Our Knowledge of the External World* (*1914*), *An Outline of Philosophy* (*1927*), *A History of Western Philosophy* (*1945*), *Human Knowledge: Its Scope and Limits* (*1948*), *My Philosophical Development* (*1959*), and so on. His most important views of induction are included in Chapter VI of *The Problems of Philosophy* and Part VI of *Human Knowledge*, which expound his two ways of justifying induction.

3.1. Hume's skepticism

In *A History of Western Philosophy* (*1945*), Russell regards Hume as

> [o]ne of the most important among philosophers, because he developed to its logical conclusion the empirical philosophy of Locke and Berkeley, and by making it self-consistent made it incredible. He represents, in a certain sense, a dead end: in his direction, it is impossible to go further. (p. 659)

He focuses on Hume's philosophy on Book I of *Treatise* and takes *Of Knowledge and Probability* as the most important part of that book. He says that

> What Hume is concerned with is uncertain knowledge, such as is obtained from empirical data by inferences that are not demonstrative. This includes all our knowledge as to the future, and as to unobserved portions of the past and present. In fact, it includes everything except, on the one hand, direct observation, and, on the other, logic and mathematics. The analysis of such 'probable' knowledge led Hume to certain skeptical conclusions, which are equally difficult to refute and to accept. (*Russell 1945*, p. 663)

Russell thinks that Hume's doctrine of causation contains two parts. One is objective:

> When we judge that *A* causes *B*, what has in fact happened, so far as *A* and *B* are concerned, is that they have been frequently observed to be conjoined, i.e. *A* has been immediately, or very quickly, followed by *B*; we have no right to say that *A* must be followed by *B*, or will be followed by *B* on future occasions. Nor have we any ground for supposing that, however often *A* is followed by *B*, any relation beyond sequence is involved. In fact, causation is definable in terms of sequence, and is not an independent notion. (*1945*, p. 666)

The other is subjective:

> The frequently observed conjunction of *A* and *B* causes the impression of *A* to cause the idea of *B*. But if we are to define 'cause' as is suggested in the objective part of the doctrine, we must reword the above. …, the above becomes: 'It has been frequently observed that the frequently observed conjunction of two objects *A* and *B* has been frequently followed by occasions on which the impression of *A* was followed by the idea of *B*'. (*Russell 1945*, p. 666)

Russell seems to basically agree to or at least poses little objection to the objective part of Hume's doctrine, but he has much criticism on the subjective part. Against Hume's policy of attributing causation to constant conjunction or succession between phenomena and to the habitual mental associations by human beings, he comments that '…the law of habit is itself a causal law' (*Russell 1945*, p. 667).

A number of evidences show that Russell interprets Hume's arguments about causation and induction as thoroughly skeptic. He thinks that Hume completely denies causal relation and inductive reasoning and 'arrives at the disastrous conclusion that from experience and observation nothing is to be learnt', thus resulting in self-denial and irrational outburst. 'The growth of unreason throughout the nineteenth century and what has passed of the twentieth is a natural sequel to Hume's destruction of empiricism. It is therefore important to discover whether there is any answer to Hume within the framework of a philosophy that is wholly or mainly empirical. If not, there is no intellectual difference between sanity and insanity' (*Russell 1945*, p. 673). In my view, Russell's above interpretation of Hume's philosophy, which has taken a dominant position in the philosophy of the twentieth century, is a misreading. Actually, the conclusions Hume really reaches are quite mild and temperate: we have not certified or even cannot certify the objectiveness and necessity of causal relation by means of reason; we have not given or even cannot have logical guarantee for the validity of inductive reasoning; for the questions such as whether or not causal relation is objective and necessary and whether or not inductive reasoning can reach a universal and necessarily true conclusion, we only can say that 'we do not know', at least we have no sufficient reason to say that 'we do know'.

3.2. Causal law

In *Our Knowledge of the External World* (*1914*), Russell discusses five questions concerning 'cause', of which three are hereby examined:

1. What is the significance of causal law? *Russell 1914* says that in virtue of causal law, 'it is possible to infer the existence of one thing or event from the existence of another or a number of others' (p. 171). He gives two different expressions of causal law, one of which is

> There are such invariable relations between different events at the same or different times that, given the state of the whole universe throughout any finite time, however short, every previous and subsequent event can theoretically be determined as a function of the given events during that time. (*Russell 1914*, pp. 177–178)

2. What is the evidence for causal law to be valid so far? Russell almost repeats Hume's argument: what we have truly discovered is the constant 'succession' or 'coexistence' between phenomena, and such belief as that one phenomenon 'necessarily' causes another is only generated from habitual associations by animals. However, he holds deep doubt all along his life regarding the psychological explanation of causality and resists accepting it.
3. What is the evidence for causal law to be valid in the future? Some people may say that we actually have experience of 'past futures', that is, 'yesterday' is the 'future' of 'the day before yesterday', whereas 'today' is the 'future' of 'yesterday', and we all have experience of 'yesterday' and 'today' and discover that endless 'yesterdays' and 'todays' are all similar, so we can infer that the future futures are similar to the past futures. However, Russell states that

> But such an argument begs the very question at issue. We have experience of past futures, but not of future futures, and the question is: Will future futures resemble past futures? This question is not to be answered by an argument which starts from past futures alone. We have therefore still to seek for some principle which shall enable us to know that the future will follow the same laws as the past. (*1912*, p. 65)

He suggests that we switch this question into another: if the inference concerning the future is justified, then, when making this kind of inference, is there any necessary principle included inside? This is the approach Russell himself adopts.

3.3. The principle of induction

In *Problems of Philosophy* (*1912*), Russell formulates the problem of induction as follows: 'When two things have been found to be often associated, and no instance is known of the one occurring without the other, does the occurrence of one of the two, in a fresh instance, give any good ground for expecting the other?' He emphasizes that

> On our answer to this question must depend the validity of the whole of our expectations as to the future, the whole of the results obtained by induction, and in fact practically all the beliefs upon which our daily life is based. (*Russell 1912*, p. 65)

Russell replies to this problem by appealing to his so-called principle of induction (hereafter PI) and gives the principle two different expressions, of which the first is as follows:

a. When a thing of a certain sort A has been found to be associated with a thing of a certain other sort B, and has never been found dissociated from a thing of the sort B, the greater the number of cases in which A and B have been associated, the greater is the probability that they will be associated in a fresh case in which one of them is known to be present.
b. Under the same circumstances, a sufficient number of cases of association will make the probability of a fresh association nearly a certainty, and will make it approach certainty without limit. (*Russell 1912*, p. 66)

Russell thinks that, according to this expression, the PI shall only be applied to testify our anticipation of individual fresh cases. But causal relation is universal and can be applied to many cases. Therefore, he makes the second expression of the PI:

a. The greater the number of cases in which a thing of the sort *A* has been found associated with a thing of the sort *B*, the more probable it is (if no cases of failure of association are known) that *A* is always associated with *B*.
b. Under the same circumstances, a sufficient number of cases of the association of *A* with *B* will make it nearly certain that *A* is always associated with *B*, and will make this general law approach certainty without limit. (*Russell 1912*, p. 67)

As is well known, the traditional simple inductive reasoning is as follows:

> So far, the observed *A*s are always *B*s, and no *A*s have been found not to be *B*s. Therefore, all *A*s are *B*s.

According to his expressions of the PI, Russell revises the above reasoning as follows:

> So far, the observed *A*s are always *B*s, and no *A*s have been found not to be *B*s. Therefore, (probably) all *A*s are *B*s.

Why does Russell make this revision? There is only one explanation: he acquiesces to Hume's skeptical conclusion concerning induction and thinks that inductive reasoning 'can never quite reach certainty, ……Thus probability is all we ought to seek' (*Russell 1912*, p. 66). However, even if that is the case, we can ask a question further: how can we be sure that if the *A*s observed so far are always *B*s, and no *A*s have been found not to be *B*s, therefore, (probably) all *A*s are *B*s? If there is no sufficient reason for a universal conclusion inferred from the premises, then there shall be no sufficient reason for a probable conclusion either.

However, Russell asserts that the PI stated above is a principle *a priori* and argues for his assertion as follows:

1. The PI cannot be disproved by resorting to experience. Russell argues that probability is always relative to certain data. There may be some other data which might be taken into account and would gravely alter the probability. But this knowledge would be a fresh datum, by no means proving that the probability relatively to our previous data had been wrongly estimated. He gives an example that a man who had seen a great quantity of white swans [and never seen black ones] might argue, by our principle, that based on the data it was *probable* that all swans were white. The argument is not disproved by the fact that some swans are black, because the probability of 'all swans are white' is estimated relative to the original evidences; once fresh evidences are found, we have to re-estimate the probability of that proposition, but have no reason to conclude that the original estimation is wrong.

2. In the same way, the PI shall not be proved by an appeal to experience. Russell argues that experience about the observed instances can indeed provide support for the PI and that as for the unobserved instances, it is the PI itself that can prove the rationality of the inferences from the known to the unknown.

> All arguments which, on the basis of experience, argue as to the future or the un-experienced parts of the past or present assume the principle of induction; hence we can never use experience to prove the principle of induction without begging the question. (*Russell 1912*, p. 68)

3. The PI is the necessary precondition for all our common senses, behaviors, habits, and scientific inferences.

> All our conduct is based upon associations which have worked in the past and which we therefore regard as likely to work in the future; and this likelihood is dependent for its validity upon the principle of induction. (*Russell 1912*, p. 69)

> The general principles of science, such as the belief in the reign of law, and the belief that every event must have a cause, are as completely dependent upon the principle of induction as are the beliefs of daily life. (*Russell 1912*, p. 69)

So, there are some kinds of dilemmas: we must either accept the PI on the grounds of its intrinsic nature or forgo all justification of our expectations about the future; 'Either, therefore, we know something independently of experience, or science is moonshine' (*Russell 1948*, p. 444). He firmly believes that it is extremely unreasonable to forgo all justification of our expectation about the future and to assert that science is moonshine, so he asserts that we have to acknowledge that the PI is valid upon its intrinsic nature and is a principle *a priori* without the support from experiential evidences.

However, I cannot help but ask a question: are Russell's arguments for his assertion that 'PI is a principle *a priori*' rational and sound? My answer is that only the second sub-argument is acceptable, but neither the first nor the third is. By inductive reasoning, we infer from the proposition that certain observed instances occur with a particular probability in the whole discovered evidences to the proposition that those instances shall occur with the same probability under all circumstances (including those of the future). However, after discovering counter-evidences, the probability of occurrence of the observed instances is largely decreased, thus the original inductive conclusion has to be rejected, although the original calculation of the probability remains valid. Only presuming that our behaviors, habits, common senses, and sciences are all rational and reliable can we reach the conclusion that the PI is true upon its intrinsic nature. But the acceptance of the presumption equals to the beforehand acknowledgment of the rationality and reliability of inductive reasoning; it is in serious conflict with Hume's skepticism of induction, and it makes Russell's second argument a typical circular one; more radically, it makes his justification of induction redundant. So, Russell does not successfully prove his claim that the PI is a principle *a priori*.

3.4. Empirical postulates

In *Human Knowledge* (*1948*), Russell has changed his position: the PI is not a principle *a priori*; actually it is invalid. He states that

> *…Induction invalid as a logical principle*. It is obvious that, if we are allowed to select our class β as we choose, we can easily make sure that our induction shall fail. Let $\alpha_1, \alpha_2, \ldots, \alpha_n$ be the hitherto observed members of α, all of which have been found to be members of β, and let α_{n+1} be the next member of α. So far as pure logic is concerned, β might consist only of the terms $\alpha_1, \alpha_2, \ldots, \alpha_n$; or it might consist of everything in the universe except α_{n+1}; or it might consist of any class intermediate between these two. In any of these cases the induction to α_{n+1} would be false. (*Russell 1948*, pp. 355–356)

In common parlance, when we conclude 'all αs are βs' from '$\alpha_1, \alpha_2, \ldots, \alpha_n$ are all βs', its necessary condition is that β is the intrinsic attribute of α, and from β, we can get a natural class; if β is the occasional attribute of α, or even like an unusual predicate such as 'grue' (green-blue) and 'bleen' (blue-green) fancied by Goodman, then from such β, we can only get a manufactured class and cannot get the conclusion 'all αs are βs' by inductive reasoning without logical mistakes.

However, the following views are ingrained in Russell's sub-consciousness: that although we cannot make sure that science and common sense have nothing wrong, they are generally reliable, or at least they are well grounded; that most inferences in science and common sense are not demonstrative, being different from the inferences in mathematics and logic; that by means of non-demonstrative inferences, which rely on empirical data, we can obtain law-like knowledge; that even animals are able to do some kinds of 'reasoning', for example, I have just untied the dog chain and the dog immediately excitedly expects to go for a walk outside: its 'habit' and 'anticipation' come from the long-term repetition of the relevant process; and that after experiencing countless sunrises from the east, it is not understandable to anticipate that tomorrow the sunrise will not come from the east as usual but from the opposite west. So, even if his defense of inductive inferences using the PI fails, Russell still wants to find some new ways of defending induction. Now, he appeals to a group of the so-called postulates of scientific inference or empirical postulates, which in his judgment have their own relatively reliable evidences. He adds them as the major premises of inductive reasoning in order to warrant that the conclusions of induction are rationally reached.

Russell thinks that the group of empirical postulates shall satisfy the following conditions:

> On the one hand, the postulate or postulates must be sufficient, from a purely logical point of view, to do the work that is asked of them. On the other hand – and this is the more difficult requirement – they must be such that some inferences which depend upon them for the validity are, to common sense, more or less unquestionable. …There must, of course, be no positive grounds for regarding a suggested postulate as false. It should be self-confirmatory, not self-refuting, i.e. inductions which assume it should have conclusions consistent with it. (*1948*, p. 386)

Russell continues to say that each postulate

> has an objective and a subjective aspect: objectively, it asserts that something happens in most cases of a certain sort; subjectively, it asserts that, in certain circumstances, an expectation falling short of certainty in a greater or less degree has rational credibility. The postulates collectively are intended to provide the antecedent probabilities required to justify inductions. (*1948*, p. 429)

Right now, we can state five empirical postulates given by Russell:

A. *The postulate of quasi-permanence*: 'Given any event A, it happens very frequently that, at any neighboring time, there is at some neighboring place an event very similar to A' (*1948*, p. 430).

This postulate is mainly used to replace the commonsense notion of 'thing' and 'person', in a manner not involving the concept 'substance'. It analyzes 'things' of common sense as sequences of similar events.

B. *The postulate of separable causal lines*: 'It is frequently possible to form a series of events such that from one or two members of the series something can be inferred as to all the other members' (*1948*, p. 430).

A series of events connected with each other in the manner suggested by this postulate is what Russell calls 'causal line'. What makes the inference possible is a 'causal law'. He asserts that this postulate has many uses, but perhaps the most important is in connection with perception, for example, in attributing the multiplicity of our visual sensations in looking at the night sky to the multitude of stars as their causes.

C. *The postulate of spatio-temporal continuity in causal lines*:

> When there is a causal connection between two events that are not contiguous, there must be intermediate links in the causal chain such that each is contiguous to the next, or (alternatively) such that there is a process which is continuous in the mathematical sense. (*1948*, p. 432)

This postulate is designed to deny 'action at a distance' by requiring that if there is a causal connection between two events that are not congruous, there must be a chain of intermediate links between them. A large quantity of our inferences to unobserved occurrences, both in science and in common sense, depend on this postulate.

D. *The structural postulate*:

> When a number of structurally similar complex events are ranged about a centre in regions not widely separated, it is usually the case that all belong to causal lines having their origin in an event of the same structure at the centre. (*1948*, p. 432)

This postulate is intended to make sense of the idea that there exists a world of physical objects common to all perceivers. The structure of time and space can explain how a complex event has causal relation with another event, as long as they are sufficiently similar in the aspect of abstract properties in space–time structure, though they are different in some qualities.

E. *The postulate of analogy*:

> Given two classes of events A and B, and given that, whenever both A and B can be observed, there is reason to believe that A causes B, then if, in a given case, A is observed, but there is no way of observing whether B occurs or not, it is probable that B occurs; and similarly if B is observed, but the presence or absence of A cannot be observed. (*1948*, p. 434)

This postulate can be illustrated by the following example: when a body is both seen and touched, hardness is associated with a certain kind of visual appearance, and this postulate allows us to infer that hardness is probably associated with this visual appearance even when the body concerned is not being touched. It also allows us to infer mental occurrences connected with bodies other than our own.

About the above-mentioned postulates, Russell asserts that '…it is likely that further investigation would show that they are not all necessary for scientific inference. I hope and

believe, however, that they are sufficient' (*1948*, p. 435). But after stating these postulates, he says that

> I think, therefore that we may be said to 'know' what is necessary for scientific inference, given that it fulfils the following conditions: (1) it is true, (2) we believe it, (3) it leads to no conclusions which experience confutes, (4) it is logically necessary if any occurrence or set of occurrences is ever to afford evidence in favour of any other occurrence. I maintain that **these conditions are satisfied** (by the postulates). (*1948*, p. 436; bold added)

So, we can conclude that, in Russell's view, the above postulates provide both necessary and sufficient conditions for validating scientific inference.

However, we can ask an important question further: how do we warrant the truth and validity of these postulates? *Russell 1959* explains that

> The above postulates, I repeat, are justified by the fact that they are implied in inferences which all accept as valid, and that, although they cannot be proved in any formal sense, the whole system of science and everyday knowledge, out of which they are distilled, is, within limits, self-confirmatory. (p. 204)
>
> The general principles necessary to validate scientific inferences are not susceptible of proof in any ordinary sense. They are distilled out by analysis from particular cases which seem totally obvious, …. (p. 200)
>
> It should be noted that all of them [i.e. the postulates] states only probabilities, not certainties …. (p. 202)

Thus, about these postulates, we know from Russell that they are distilled out by analysis from particular cases which seem totally obvious, that they are necessary for our whole system of science and everyday knowledge, that they are implied in inferences which we accept as valid, that they cannot be proved in any formal sense, and that they state only probabilities, not certainties. In other words, the truth and validity of these postulates have not finally warranted. Then, by means of the postulates, we cannot completely justify our science and common sense reached by induction and cannot have the absolute certainty of our knowledge. '[T]here is no such claim to certainty as has, too often and too uselessly, been made by rash philosophers' (*Russell 1959*, p. 207).

3.5. Can the problem of induction be finally solved?

In *A History of Western Philosophy* (*1945*), Russell writes that '[t]he analysis of such "probable" knowledge led Hume to certain skeptical conclusions, which are equally difficult to refute and to accept. **The result was a challenge to philosophers, which, in my opinion, has still not been adequately met**' (*Russell 1945*, p. 663; bold added). The bold assertion implies that Kant, Mill, Poincaré, and others do not successfully solve the problem of induction raised by Hume.

In *Human Knowledge* (*1948*), Russell makes a detailed investigation of the mathematical treatments of induction, especially probability theory by Keynes and frequency theory by Von Mises and Reichenbach. His conclusion is also negative: 'There is nothing in the mathematical theory of probability to justify us in regarding either a particular or a general induction as probable, however large may be the ascertained number of favourable instances' (*Russell 1948*, p. 367). Here, the so-called particular induction is predictive inductive reasoning mentioned above; the so-called general induction is the induction by simple enumeration.

Russell himself has a contradictory position on induction. On the one hand, he almost completely accepts Hume-style skepticism: 'I came to the conclusion that inductive arguments, unless they are confined within the limits of common sense, will lead to false

conclusions much more often than to true ones' (*Russell 1959*, p. 190). On the other hand, he acknowledges that habits, common senses, and sciences based on induction are reasonable and reliable most of time, while it is unreasonable not to think and not to act by following our habits, common sense, and science.

> I have come to accept the facts of sense and the broad truth of science as things which the philosopher should take as data, since, though their truth is not quite certain, it has a higher degree of probability than anything likely to be achieved in philosophical speculation. (*Russell 1959*, p. 207)

Therefore, he tries to find the so-called *a priori* and 'general' principles or postulates of induction to justify inductive reasoning, in essence, to justify our common sense and science. Obviously, it is impossible for Russell to take care of the two sides: if his assertions about induction are true, when justifying induction, science, and common sense, he is doing something impossible to succeed in its nature, so he shall be destined to fail. Indeed, he fails in his justification of induction.

4. Jin Yuelin's justification of induction

4.1. Critics of Hume's Theory of Knowledge in Treatise

Jin studied Hume's *Treatise* and especially the epistemology of *Treatise* quite carefully and systematically. The question as to how should we respond to Hume's skepticism about causation and induction has been a main clue to understanding his whole philosophical activities. According to Jin, his book *On Dao* (*1940a*) tries to lay the ontological foundation for solving Hume's problem and his another book *The Theory of Knowledge* (wrote in 1948, hereafter *Knowledge*) tries to provide the epistemological preparation for solving the problem.

Although Jin concedes that Hume's arguments are reasonable and challenging, he still has serious doubts or even objections to them:

> Hume's arguments make me feel that induction does not make sense and causation is not reliable, and that the theoretical foundation of science has been shaken. …Nonetheless, I have a quite firm belief in science, thus felt that something is wrong with Hume's statements. Later on, I slowly discovered that Hume's predicament lies not only in his theory of causation, but also in his whole philosophy. (*Jin 1940a*, p. 4)

He thinks that Hume's troubles come from two fields: one is his ontology and the other is his theory of knowledge.

In Hume's view, all knowledge is originated from impressions and perceptions ('images'). Jin comments that Hume's 'sources of impressions and images are limited with little scope, his classes of reality are not many', so he cannot affirm or deny the existence of external things.

> His listed relations are not fundamentally clear, are not of fundamental types; his theory and facts are by no means strictly differentiated, while his theory cannot be very precise, so its potential scope is too small; his experience has no specific range, his time and space cannot intersect, and his causal relation has various difficulties. Meanwhile, his theory of knowledge also has problems. (*Jin 1928*, p. 376)

In Jin's opinion, these problems are all derived from the lack of enough ontological assumptions in Hume's philosophy.

> Assumptions are also necessary for a theory, without which theory shall have nowhere to start. Hume approves inferences, but he seems not to be able to accept inferences beyond the circle of phenomena, so the range of his theory is decreased

> dramatically. However, assumptions are inescapable for a theory. Hume's philosophy has assumptions from its very beginning to clarify his purposes. Assumptions cannot be approved by him in his theory, so all his own assumptions become irrational. …When encountering theoretical difficulties, he resorts to 'habits' rather than assumptions to eliminate those difficulties. (*Jin 1928*, p. 346)

Jin chooses a way different from Hume's: increasing necessary assumptions in his philosophy. For example, his *Knowledge* sets off from two assumptions. One assumption is that 'there are authentic perceptions'. By 'authentic perception', he means reliable sensory experience, which differs from dream vision, hallucination, delusion, wild vision, etc. The other assumption is that 'there are external things', that is, there are self-existent objects being independent of cognitive subjects. In Jin's view, besides sensible physical objects, the generalized 'external things' also include universals or perceptions, all of which cannot be observed by sense organs, but can be learnt by cognition. Why do we have to admit these assumptions? Jin takes the help of 'common sense', which is the system of beliefs in our daily life. Some of our beliefs are very basic, which he calls 'instinctive beliefs': 'The beliefs of the reality of the seen-and-heard and of the existence of external things are both our instinctive beliefs' (*Jin 1983*, p. 73). He argues that 'Any part of our common sense can be criticized, even its major part may be abandoned, but common sense can never be thrown away totally', because 'the final grounds for revising common sense are still common sense'. Moreover, 'if common sense is thoroughly demolished, all knowledge shall have nowhere to start'. Jin's *knowledge* 'starts its arguments by means of common sense; it admits not only that there is knowledge in common sense, but also that common sense is the base of scientific or philosophical knowledge' (p. 896). He also proposes a more fundamental defense for his policy of introducing assumptions into his philosophy: for a philosophical theory, its most fundamental part 'perhaps is consisted of its assumptions, or beliefs, strictly speaking, all of whom are almost the thoughts that can never be proved or disproved, or even cannot temporarily be proved or disproved. If a thinker has to wait to acknowledge the validity of this part of thoughts until he has proved it, he will not have his philosophy'. *Jin 1934* claims that 'Philosophy is a set of preconceptions assumed with reasons' (p. 625).

By Jin's analysis, Hume's difficulties in the problem of induction originate from his philosophical system. His philosophy 'can only make him admit images, not make him accept ideas. Image is concrete, but idea is abstract. Since he cannot accept idea, he will have no abstract thought in his theory' (*Jin 1940a*, p. 4). Hume 'implicitly admits universals, while refuses to accept real universals in his formal philosophy' (*Jin 1983*, p. 419). Moreover,

> what knowledge wants to reach is an objective order, which in Hume's view can only be negatively received from impression. Impressions are always of the past or present. Hume officially has no real universals, and he also has no real order that we want to clarify afterwards. He can only follow the order of current and past impressions. Under such circumstances, if the future demolishes the past and present, his hard-earned order shall also be demolished. (*Jin 1983*, p. 419)

That is to say, since Hume constrains himself within the extent of sensory experience, denies any rational abstracts, fails to understand the relations between individuals and the general, between particulars and universals, and between the concrete and the abstract, and does not understand that 'particular facts illustrate general laws or principles' and that 'the associations of universals or authentic laws or principles' also incorporate themselves in particular facts, so he meets severe difficulties in the problem of induction: he has no means to explain reasonably why universal laws or principles can be abstracted from or distilled out of particular instances. Based on his judgment of the source of Hume's difficulties, Jin

adopts the opposite policy, that is, acknowledging the interconnection between universals and particulars, between concreteness and abstractness, and between experience and reason, meanwhile accepting both the descriptive function and the normative function of concepts:

> So far as a concept as a descriptive means is concerned, it describes the association of universals presented by the given, and is itself a symbol of such association, that is why it can describe the given being congruous with such association, and convey and preserve this association after the disappearance of the relevant given. So far as a concept as a classifying means is concerned, it is our means to deal with the given in the future, if the given is congruous with the association of a universal (i.e. definition), then it realizes the universal; if it is not congruous with the association of a universal, then it does not realize the universal. … The two aspects cannot be divided apart: a concept cannot describe external things without classifying them…; it cannot classify external things without describing them. (*1940a*, p. 7)

4.2. The reliability of causal relation

Jin agrees with Hume that causal relations are not necessary, but he does not follow Hume to attribute causal relation to 'habits' and 'associations', because he is conscious that the results thereof may be disastrous: if causal relation is not reliable, the PI shall lose its grounds, and the foundation of science shall be unstable. In discussing the question of whether or not causality is reliable, Jin proposes to divide this big question into two: one is the intrinsic question about A–B (a general proposition for causal relation), where he differentiates 'necessity' and 'certainty' of laws or principles and clarifies the thesis that 'laws or principles have their intrinsic certainty'; the other is the realization question about A–B, where he argues for the thesis that 'situations have no necessity of occurrence'.

'Li (理, laws and principles)' and 'shi (势, situation)' are a pair of traditional categories of Chinese philosophy. In Jin's definitions, 'The association of universals is simply called law or principle. Situations are the occurrence and disappearance of particulars in continuation and succession' (*Jin 1983*, pp. 339, 684). Then, he divides the 'laws or principles' into 'pure laws' and 'practical laws' and makes distinction between the necessity of pure laws and the certainty of practical laws.

Jin argues that logical propositions are 'pure laws' that represent transcendental forms of the given, being the necessary conditions for the given to exist and being the forms to which the given has to subordinate. They are not the representation of facts at all, but are the necessary conditions by means of which experience is formed and obtained. In this sense, logical propositions are knowable *a priori*. Meanwhile, logical propositions are completely negative: they admit all sorts of possibilities as possible, so they cannot be false rather than true; they deem no possibility as a fact and have no positive statement of the 'authentic' and the 'natural' world, no expression of the facts therein, so they could never be false. In this sense, logical propositions are necessary, and 'only logic relations are necessary' (*Jin 1983*, p. 679). Here, 'necessary' means that it cannot be false, on the one hand, and must be true, on the other hand.

The causal propositions and other natural laws are 'practical laws', which are still intrinsic laws of the 'authentic' or the 'natural' world and are followed by individual instances. At the same time, they are abstracted and generalized from the 'authentic' or the 'natural' world and are the 'laws' that represent the world. These 'laws' have their intrinsic certainty, for they reflect the association of universals, have a universal application without exception, and are 'definitely reliable' and 'inescapable for external things'. However, Jin emphasizes that 'Certainty is not necessity'.

> A law being certain is not a logical proposition, but merely a universally true proposition or a natural law. … A proposition that conform to the laws being certain is only

> applicable to matters of fact; a proposition that conform to the laws being necessary is applicable to all sorts of situations. As long as a situation is thinkable, it has to follow necessary laws. (*Jin 1983*, pp. 680–681)

Specifically speaking, although causal relation has its own certainty and has no exception, its particular realization is an event which is not necessary, that is, it is not the case that causal relation will be realized in all circumstances: whether or not it is realized depends on the presence of other corresponding conditions. For instance, although the causal proposition A–B is universally effective, in some specific occasions, after the occurrence of at_ms_m (in which t_m is a certain time point and s_m is a certain position) as cause, whether or not bt_ns_n will occur as effect still depends on many other background conditions, some of which combining with at_ms_m will push bt_ns_n to occur, and others combining with at_ms_m will hinder bt_ns_n to happen. Moreover, these background conditions have their own background conditions. Therefore, after the occurrence of at_ms_m as cause, it is very difficult to predict whether or not bt_ns_n as effect will occur. So, we must say that causal relation has no intrinsic necessity in its realization.

In my judgment, 'laws or principles have their intrinsic certainty, and situations have no necessity of occurrence' is Jin's typical statement of the reliability and realization of causal relation. But Jin's assertion can produce a lot of troubles, for example, the conflict between the universal applicability of causal relation and the restriction of its individual realization and between the inescapability of causal relation and the conditionality of its individual realization. I think that, although Jin asserts the reliability of causal relation, he develops no convincing argument for it, for he does not say much about the origin and grounds of our conception of causality.

4.3. The eternal truth of the PI

Hume's problem is firstly the problem of causality: we can only perceive the spatial adjacency and temporal succession of the phenomena, but not the necessary causal relation between them; in order to make the inference from cause to effect (i.e. inductive reasoning), we must assume the principle of the uniformity of nature or the thesis that the future resembles the past, both of which are not strictly proved, so there is no guarantee of the validity and rationality of inductive reasoning. As a result, Jin says that

> Hume once proposed such a question: can we guarantee that the future will resemble the past? After the proposal, Hume only showed how difficult the problem is, but did not solve the problem, and had no way to solve it. However, he once said that the PI will not help us solve the problem, because he thought that if we cannot guarantee the future will resemble the past, the PI itself will lose its function and effectiveness. (*1943*, p. 419)

The PI mentioned by Jin is the combination of (a) and (b) of the second expression of the principle in Russell's *Problems of Philosophy*. When Jin wrote his paper 'The Principle of Induction and *A Priori*' (published by *The Journal of Philosophy* [USA], *1940b*), China was in the war of resistance against Japan, and Jin was teaching at National Southwest United University,[2] placed in a remote area with shabby conditions, and had no way of finding that book by Russell, so he only used quotations by means of his memory of the book. From this fact, we can know that he certainly read *Problems of Philosophy* and is very familiar with its contents.

[2] This university was the war-time union of Peking University, Tsinghua University, and Nankai University, so it was temporary; when the war ended up, the original three universities were recovered, and then it did not exist.

> I shall take for the purpose of discussion the principle of induction as formulated by Mr. Russell: 'If in a large number of instances a thing of one kind is associated in a certain way with a thing of another kind, it is probable that a thing of the first kind is always similarly associated with a thing of the second kind; and as the number of instances increases, the probability approaches almost to certainty'. Not having a single book at hand, I can not vouch further correctness of the above quotation, nor will I say anything as to whether or not it is an adequate formulation of a weighty principle. (*Jin 1940b*, p. 179)

Jin 1940a revises the PI into a conditional, 'whose antecedent lists particular instances and consequent is a universal proposition with a conclusion-style' (p. 9). He thinks that inductive reasoning shall always be the inference from the past to the future, which includes the anticipation of the future, involving time elements, so he reformulates the PI as follows (*Jin 1983*, p. 440):

If at_1–bt_1
at_2–bt_2
at_3–bt_3
⋮ ⋮
at_n–bt_n
Then, (probably) *A*–*B*.

Here, 'at_1–bt_1' means that 'at the time point t_1 *a* is *b*', and '*A*–*B*' almost equals the universal proposition that 'all *A*s are *B*s'. The antecedent of this conditional can be rewritten as follows:

① $\varphi(at_1, bt_1) \wedge \varphi(at_2, bt_2) \wedge \varphi(at_3, bt_3) \ldots \wedge \varphi(at_n, bt_n)$

and the consequent as follows:

② (probably) $(a, b)\varphi(a, b)$.

② is a universal proposition, which equals a conjunctive proposition such as

③ $\varphi(at_1, bt_1) \wedge \varphi(at_2, bt_2) \wedge \varphi(at_3, bt_3) \wedge \ldots \wedge \varphi(at_n, bt_n) \wedge \ldots \wedge \varphi(at_\infty, bt_\infty)$.

Here, '$\varphi(at_1, bt_1)$' means 'at t_1 *a* and *b* have relation of φ', while '$(a, b)\varphi(a, b)$' means that 'for all *a* and *b*, *a* and *b* have relation of φ' (cf. *Jin 1983*, pp. 444–445).

We have to consider the modifier 'probably' in (2). According to Hume, inductive reasoning has no logical necessity: when its premises are true, its conclusion may be false. Russell (implicitly) acknowledges this, but meanwhile he thinks that although inductive conclusions are not necessarily true, they will be true with a very high probability, because they get the support from many positive instances; especially, when the positive instances increase, this probability shall be more and more approximate to 1, that is, certainty. However, Jin's explanation is quite different:

> 'probably' means the nature of the relation between inductive instances and inductive conclusion. If the instances cannot exactly represent a general situation, then the degree of probability is low; if the instances can exactly represent a general situation, then the degree of probability is high. What 'probably' emphasizes is the representativeness of particular instances. (*1983*, pp. 420–421)

In considering the eternal truth of the PI and the question of whether or not the PI could be demolished by the future, Jin argues that if the future demolishes the past, and also

demolishes the PI, the problem of calculation of probability cannot occur since we know the probability shall be 0 without calculation. So, the modifier 'probably' is not significant for our consideration and can be disregarded completely.

Jin 1983 asserts that the PI 'is a principle *a priori* and eternally true, as long as our experience is continued, the principle is always true' (p. 424). When he argues for this assertion, he considers two situations as follows:

4.3.1. *Situation one.* Time stops at t_n. This is a supposed situation, but it is allowable by logic.

Under this situation, t_{n+1} will not occur, so does $\varphi(at_{n+1}, bt_{n+1})$ or $\neg\varphi(at_{n+1}, bt_{n+1})$. All we have only include $\varphi(at_1, bt_1)$, $\varphi(at_2, bt_2)$, $\varphi(at_3, bt_3)$,…, and $\varphi(at_n, bt_n)$ listed in the premise. Thus, the conclusion $(a, b)\varphi(a, b)$ shall be a historical summary as a shortened form of the premise and can be seen as the conclusion obtained by complete induction. But Jin thinks that complete induction is by no means a real type of inductive reasoning, because its conclusion does not exceed the extent stated by its premises, nor does it include anticipation of the future.

I have severe doubts about Jin's above assertion. Even though time stops at t_n, can we enumerate all instances of a certain scope? My answer is 'No'. Take 'Chinese people on 12 June 2011' as an instance, the number of Chinese people on that day is finite and fixed, but we have no precise method to learn what the number is. For the question 'how many Chinese people there are', the conclusion that we make is not a simple shortened form of all samples, but a conclusion generated from statistical sampling. If we consider the possibility of infinite extension of time toward the past direction or that of infinite segmentation of point in time, we can never take the antecedent of the PI as a finite enumeration. Besides, Jin states that the key point for the PI is the question 'whether or not the future can demolish the past'. I think that this statement is highly problematic. The key point of inductive reasoning lies in the fact that it is an inference from the observed instances to the unobserved or, more simply, from the known to the unknown. Only when the quantity of the objects examined is quite small can we make a finite enumeration of their instances, thus reach a necessarily true conclusion by complete induction. When the quantity of the objects examined is very big or even infinite, we can only enumerate their instances and make an assertion about the whole class of the objects based on the small amount of samples. Then, the conclusions of induction will tremendously exceed the extent of the premises and is easy to be rejected. This shows that it is not completely rational to infer this conclusion on the basis of these samples, so the PI is prone to question even in Situation one.

4.3.2. *Situation two.* Time does not stop at t_n. This is an actual situation in our world. Then, there is t_{n+1} to come and the given will continue to occur. So, we may have $\varphi(at_{n+1}, bt_{n+1})$ or $\neg\varphi(at_{n+1}, bt_{n+1})$. Jin considers two questions: one is whether or not $\varphi(at_{n+1}, bt_{n+1})$ or $\neg\varphi(at_{n+1}, bt_{n+1})$ can refute the inductive conclusion $(a, b)\varphi(a, b)$; the other is whether or not they can refute the PI itself.

Jin argues that when the new evidence is $\varphi(at_{n+1}, bt_{n+1})$, it cannot reject the original inductive conclusion $(a, b)\varphi(a, b)$ or the PI itself. Refuting the PI means affirming its antecedent and denying its consequent. But $\varphi(at_{n+1}, bt_{n+1})$, as a new evidence, will not deny the consequent of the principle $(a, b)\varphi(a, b)$, so it cannot deny the PI itself. He further asserts that $\varphi(at_{n+1}, bt_{n+1})$ actually provides a new positive instance for the conclusion $(a, b)\varphi(a, b)$, which is thus strengthened by the instance, but 'this does not mean that the principle of

induction is also strengthened. If the principle were strengthened by a positive instance, it should be weakened by a negative instance, but it isn't' (*Jin 1940b*, p. 182).

When the new evidence is $\neg\varphi(at_{n+1}, bt_{n+1})$, Jin thinks that it can definitely deny the original conclusion $(a, b)\varphi(a, b)$, since we discover that a and b do not have the relation of φ at t_{n+1}, 'all a and all b have the relation of φ' is false. But the question that we care about is whether or not this can refute the PI itself. Jin's answer is 'No'. His argument has two key premises. One is that all inductive instances (i.e. the experienced things) must exist in the past or the present, because they have been experienced by the observer, but the not-yet-occurred things of the future cannot be experienced. The other is that time always flows and has no end: 'present' does not refer to a fixed point in time, but continuously becomes 'past', and 'future' also continuously turns into 'present'. Jin says that 'present' is a non-specific word, being able to refer to any point in time. When $\neg\varphi(at_{n+1}, bt_{n+1})$ becomes new evidence, our present time has been changed into t_{n+1}, so the evidence possessed by observers at t_{n+1} is

④ $\varphi(at_1, bt_1) \wedge \varphi(at_2, bt_2) \wedge \varphi(at_3, bt_3) \wedge \ldots \wedge \varphi(at_n, bt_n) \wedge \neg\varphi(at_{n+1}, bt_{n+1})$.

From ④, we can get

⑤ $\neg(a, b)\varphi(a, b)$.

So, what $\neg\varphi(at_{n+1}, bt_{n+1})$ refutes is the consequent of the PI, but the PI itself has not been undermined at all, because the PI as a conditional sentence is false only if its antecedent is true and its consequent is false; when $\neg\varphi(at_{n+1}, bt_{n+1})$ occurs, its consequent is certainly false, but so is its antecedent, thus the situation of true antecedent and false consequent will not occur for the PI.

After finishing *a priori* argument for the PI, Jin develops a deductive justification of inductive reasoning. He constructs an argument such as

> If $\varphi(at_1, bt_1) \wedge \varphi(at_2, bt_2) \wedge \ldots \wedge \varphi(at_n, bt_n)$, then (probably)$(a, b)\varphi(a, b)$;
> $\varphi(at_1, bt_1) \wedge \varphi(at_2, bt_2) \wedge \ldots \wedge \varphi(at_n, bt_n)$.
> Therefore, (probably) $(a, b)\varphi(a, b)$.

That is to say, he takes the PI as the major premise of the argument, some individual instances as the minor premises, and a universal proposition reached by inductive generalization as the conclusion. He argues that if the conclusion is false and the argument is not wrong, either both premises are false or one of them is false. He thinks that when this situation occurs, it is not true that we must revise the PI, because we can choose to deny the inductive instances (cf. *Jin 1983*, p. 436).

I will argue that Jin's above argument is unsound, in which logical fallacies are contained.

First, inductive reasoning questioned by Hume is the inference from particular instances to a universal proposition, but the PI accepted by Russell and Jin has an uncertain generalized proposition '(probably) all *A*s are *B*s' as its consequent. Russell and Jin have changed the objective aimed at by Hume, perhaps because they unconsciously accept Hume's skepticism of induction: by inductive reasoning, a universal conclusion cannot necessarily follow from its particular instances. As Sainsbury comments, 'probably' policy will face some problems:

> There appears to be this difficulty: as presently stated, the principle of induction has no chance of entailing the desired conclusions. These, it would seem, have the form 'All *A*s are *B*s', whereas if we use the principle [the one with 'probable' conclusion]

> the most we could hope to end up with is something of the form 'Probably all *A*s are *B*s'….But how do we pass to 'All *A*s are *B*s'? (*1979*, p. 169)

Moreover, even if the PI is described in Russell's way, there is still no logical reason to ensure that the PI holds forever. For 'probably' means rendering the consequent a high probability, while attaching certain probability to a conclusion of inductive reasoning still has to add a new PI to inductive premises: 'If we have observed a large quantity of phenomena such as *A* is *B* without exception in all kinds of circumstances, then the proposition that all *A*s are *B*s has a high probability'. The truth of the new PI still needs to be proved. If inductive conclusion is a universal statement involving infinite objects, no matter how many observed instances are positive, the quantity of the observed instances is always finite; when any finite amount, large or small, is divided by infinity as dividend, the quotient or probability is always 0 or very close to 0. Therefore, inductive reasoning can receive neither necessary nor probable justification. Adding the modifier 'probably' to inductive conclusion is not helpful.

Second, Jin's arguments for the eternal truth of the PI contain some steps close to sophism, for example, he arbitrarily changes the point in time referred by the 'present'. Originally, if the PI (p for short) is true, then according to the fact that all observed *A*s are *B*s at t_n (q for short), we can logically infer that all *A*s are *B*s (r for short). Such a conclusion includes anticipation of the future: all the will-be-discovered *A*s are *B*s at $t_{n+i} (i \geq 1)$ (s for short). If *A* is discovered not to be *B* at $t_{n+i} (i \geq 1)$ (i.e. $\neg$s), according to logically valid inference '$(r \rightarrow s) \rightarrow (\neg s \rightarrow \neg r)$', the conclusion that all *A*s are *B*s reached at t_n by the PI is falsified. Then, according to the logically valid inference '$(p \wedge q \rightarrow r) \rightarrow (q \wedge \neg r \rightarrow \neg p)$', we can infer that the PI with the parameter t_n is not true. Therefore, the counter-example that falsifies the consequent of the PI is also the counter-example rather than the positive example of the PI itself. When Jin says that '*A* is not *B* at t_{n+i}' $(i \geq 1)$ is not the counter-example but the positive instance of the PI, he takes advantage of the change of the reference point in time: if *A* is discovered not to be *B* at t_{n+i}, he takes the inductive generalization at t_n as that made at t_{n+i} $(i \geq 1)$, which includes the new discovery in the antecedent of the PI, so the antecedent become false. In this way, Jin considers that the new evidence '*A* is not *B* at t_{n+i}' only falsifies the consequent of the PI, but verifies the PI itself, since a conditional with a false antecedent is always true. However, it is not legitimate to change the reference point in time as Jin does. By a method similar to Jin's, I can even prove that all the futures are the present; in other words, only the present exists but the future does not. Because of the never-ending nature of time, any point in time $t_1, t_2, t_3, \ldots, t_n, t_{n+1}, \ldots$ has the chance of becoming the 'present'; moreover, supposing we say something at any point in time, the point will turn into the 'present', so all points in time are the 'present' points in time. This is ridiculous!

Third, there is the fallacy of begging a question in Jin's arguments. Jin argues that when new evidence $\neg\varphi(at_{n+i}, bt_{n+i})$ falsifies the consequent of the PI, it necessarily falsifies the antecedent of the PI; therefore, the PI has no chance of having a true antecedent and a false consequent, so it is always true. In my view, this argument is invalid since it presupposes the truth of the PI. In his argument, Jin adopts *modus tollens* '$(p \rightarrow q) \wedge \neg q \rightarrow \neg p$', that is,

> PI: If all inductive premises are true, then inductive conclusion is true.
> It is not the case that the inductive conclusion is true.
> Therefore, it is not the case that all inductive premises are true.

But this inference must presuppose that the PI is true, otherwise we have another choice, that is, refuting the PI rather than denying the antecedent of the PI. So, Jin's argument is a typical circular one: he commits the fallacy of begging a question, because he argues for the truth of the PI by supposing that the PI is true.

4.4. The apriority of the PI

As has been stated above, Jin argues that if inductive instances collected at a certain time point falsify the consequent of the PI, they also make the antecedent of the PI false, but do not falsify the PI itself: the PI is true eternally. In this sense, Jin asserts that the PI is a principle *a priori*,

> That is to say, the principle is a necessary condition of experience, and if the principle is false, although there are some things in the world, none of cognitive subjects can have experience of these things. Certainly the result is that, no matter what kinds of experience we have, the principle of induction is always true; although we can conceive a world of which we have no experience, we still cannot conceive a world of which we have experience and meanwhile the principle of induction is false. (*1983*, p. 453)

Jin continues that although the PI is a principle *a priori*, it is not a tautology. Tautology exhausts all possibilities of this world, which equals to saying nothing about the world. But Jin thinks that the PI says something about the world:

> Though it [PI] is not identical with any specific induction which may be concerned with the objects of inquiry in a particular field, it yet assumes the existence of particular instances, the subsistence of general relations, and the subsumption of particulars under universals; and in assuming that the universals with which it deals are not empty possibilities, but are realized by orderly instances, it assumes a world differentiated into the scaffolding of time and space. What it asserts is therefore entirely nullified by the supposed timeless and lumpy state of affairs, for the antecedent which is a summary of instances is still true, but the consequent is false, since with the stoppage of time, there are no natural laws of the kind meant. (*Jin 1940b*, pp. 186–187)

Jin further asserts that the PI is the general principle of acceptance. When we face the colorful, manifold objects in the world, if we want to put them into our thinking frame, we have to use concepts and categories to classify them: this is a table, that is a horse, that is a rose, etc.; moreover, there are categories over categories: horse is a kind of animals, table is a kind of furniture, and rose is a kind of plant. Jin calls such a job as the 'acceptance', 'treatment', 'classification', and 'regimentation' of the given by human thinking. In these jobs, we can know the presence of the PI: for example, when we say that 'this is a table', we are actually doing 'abstraction' and 'generalization', where we classify the object in front of us into the category 'table'. So, *Jin 1983* asserts that 'Actually, any application of concepts is meanwhile the application of the principle of induction' (p. 456).

5. Comparison and comments

There are many evidences to show that when replying to the problem of induction raised by Hume, Jin was obviously influenced by Russell. Here, I would like to make it clear in what aspects and in what degrees is Jin affected by Russell and what similarities and differences are there between their justifications of induction.

First, there are similarities between Jin's and Russell's justifications of induction. I list five points as follows:

1. The motivations of Russell and Jin are similar: they both believe in the rationality and power of habits, common senses, and sciences, and both try to defend common sense and science to some extent when facing Hume's skeptical challenge. As has

been discussed above, Russell firmly believes that although we cannot guarantee that science and common sense have no mistake, they are generally reliable or at least they have rational bases and grounds; while the inferences used by science and common sense rely on the experiential data and are not demonstrative, they are usually reliable: by means of them, we can obtain knowledge of general laws. What Russell has to do is to conceive various ways and methods to defend the rationality and effectiveness of common sense and science; when one of them fails, he will seek for another. In Jin's philosophy, there are two important assumptions, that is, 'there are authentic perceptions' and 'there are external things', which together constitute the starting points of his theory of knowledge. Jin defends the assumptions from the viewpoints of common sense: they are both the fundamental beliefs of our common sense or even belong to our instinctive beliefs; if we do not assume them, we would have no beginning to get the knowledge of the world, and our actions to change the world would be impossible; since science based on experience and induction has made great achievements, it has been impenetrable to suppose that induction, common sense, and science are irrational, groundless, or completely coincident. So, Jin is determined to defend common sense and science by replying to Hume's problem of induction.

2. Both Russell and Jin interpret Hume's skepticism of causality and induction in a radical way. It is very obvious that Russell does so. He thinks that Hume's philosophy denies the objectivity and necessity of causal relation and the rationality of inductive reasoning and denies the rationality of the whole empirical science. He almost takes Hume as a radical skeptic or even as an agnostic.

> Hume's philosophy, whether true or false, represents the bankruptcy of eighteenth century reasonableness. He starts out, like Locke, with the intention of being sensible and empirical, taking nothing on trust, but seeking whatever instruction is to be obtained from experience and observation. But having a better intellect than Locke's, a greater acuteness in analysis, and a smaller capacity for accepting comfortable inconsistencies, **he arrives at the disastrous conclusion that from experience and observation nothing is to be learnt**. (*Russell 1945*, p. 672; bold added)

At this point, Jin is affected heavily by Russell. He also says that 'Hume's arguments make me feel that induction does not make sense and causation is not reliable, and that the theoretical foundation of science has been shaken' (*Jin 1940a*, p. 4).

Actually, Hume's skepticism is firstly aimed at causal relation rather than at inductive reasoning and also quite moderate. He does not claim that there is no necessary connection between cause and effect, but only that we cannot *know* anything about such a possible necessity. In this sense, his thesis is epistemological, not ontological. Moreover, he does not say that we should not expect the balls to act in the same way in the future as they have up to the present. He just says that we cannot know this whether by reason or by experience.

3. Both Russell and Jin try to justify the rationality of inductive reasoning by appealing to some hypotheses *a priori*. For Russell, his PI comes first and then appear five 'empirical postulates', which are necessary hypotheses for any scientific inference (or inductive reasoning). He thinks that the effectiveness of the PI and empirical postulates cannot be warranted by experience and induction, but have to be supposed *a priori*. Jin also thinks that it is the core of the PI proposed by Russell that the future has resemblance to the past, which shall not be demolished by future experience,

so the PI is a principle *a prior*. In my position, when Russell and Jin adopt *a priori* ways to justify induction, they do not reply to Hume's problem, but cancel it from its roots, for the introduction of *a priori* precondition of experience equals cancellation of a radical empiricist position from which Hume's problem is derived. According to Hume's empiricism, all knowledge is originated from some kind of sensational experiences, so there is no place for the *a priori* in his philosophy.

4. Both Russell and Jin attach the modifier 'probably' to inductive conclusion. This shows that they unconsciously accept Hume's doubt of induction, that is, that induction cannot necessarily infer a universal conclusion from particular instances. As has been argued above, even if they do so, there is no logical reason to ensure that the PI formulated in this way will be eternally true. Because 'probably' means rendering the consequent of the PI quite a high probability, while attaching certain probability to the conclusion of an inductive reasoning still needs the help of a new PI as an attached premise: 'If we have observed a large quantity of phenomena such as *A* is *B* without exception in all kinds of circumstances, then the proposition that all *A*s are *B*s has a high probability'. The truth of the new PI still needs to be proved. If inductive conclusion is a universal statement involving infinite objects, no matter how many observed instances are positive, the quantity of the observed instances is always finite. When any finite amount, large or small, is divided by infinity as dividend, the quotient or probability is always 0 or very close to 0. Therefore, inductive reasoning can receive neither necessary nor even probable justification. Adding the modifier 'probably' to inductive conclusion is useless.
5. Both Russell and Jin do something almost impossible to succeed, and their respective efforts to justify induction indeed fail. As has been stated above, on the one hand, *Russell 1959* almost completely accepts Hume's skepticism of induction: '… it can be shown that the conclusions of inductive inferences from true premises are more often false than true' (p. 207). On the other hand, he also thinks that habits, common sense, and science based on induction are quite rational and reliable. 'We must start from a broad acceptance of whatever seems to be knowledge and is not rejected for some specific reason' (*Russell 1959*, p. 200). But Russell can hardly take care of the two aspects at the same time: if his first assertion is true, it is impossible for him to succeed when justifying induction, common sense, and science (even in a way *a priori*). For Jin, his justification of induction inherits all the difficulties met by Russell's and also has some other steps close to sophism, for example, arbitrarily changing the reference point in time of the 'present' and then explaining all the later discovered counter-instances as the positive instances of the PI.

Second, there are differences between Russell's and Jin's justifications of induction. I list at least two points as follows.

1. Russell and Jin have different attitudes toward Hume's philosophy. Russell basically accepts Hume's epistemological premises and skeptical conclusions, but disagrees with his psychologist explanation of the causality and induction, that is, reducing them to 'habitual mental association by human beings'. Thus, when defending induction, common sense, and science, Russell seems to be not so confident: sometimes he appears quite hesitant, at least not so determined; sometimes he even has pessimistic moods: 'To justify induction as such is impossible, since it can be shown to lead quite as often to falsehood as to truth' (*Russell 1948*, p. 381). On the contrary, Jin has more strong criticism of Hume's philosophy than Russell and thinks that Hume's philosophy has two big problems: one is that it has too few ontological hypotheses

and the other is that it does not correctly understand the relations between individuals and the general, between particulars and universals, and between the concrete and the abstract. As a result, Jin has made some improvements in Hume's philosophy, for example, adding two assumptions, one of which is ontological and the other is epistemological. When defending induction, common sense, and science, Jin seems to be more confident than Russell and has a more determined attitude.

2. As far as the justification of induction is concerned, Russell comes up with two successive projects: one is resorting to the PI in *Problems of Philosophy* (*1912*), in which he provides two different statements of the PI and tries to certify its apriority: the PI can be neither proved nor disproved by experience, and it is the precondition of having experience, common sense, and science, so it is a principle *a priori*. Later, he knows the problems of the PI and turns to the five empirical postulates in *Human Knowledge* (*1948*). But Russell seems to have a contradictory attitude toward the five postulates: on the one hand, he says that they provide necessary and sufficient conditions for scientific inference, by adding them as (implicit) major premises of the inference, and the rationality of the inference has been somehow guaranteed; on the other hand, he says that these postulates are 'empirical', which have only a high probability rather than certainty. How can these postulates, which themselves have no certainty, provide the guarantee for the certainty of scientific inference? In contrast, Jin has justified induction only in one way: adding the PI proposed by Russell, which in his view is *a priori*, to an inductive reasoning as its major premise; in this way, he provides a deductive justification of induction. Jin gives an explanation of the PI that is little different from Russell's: Russell thinks that the supposed PI shall be used even when arguing that the future resembles the past, whereas Jin deems that the key point of whether the PI is true lies in whether the future resembles the past; so when arguing the apriority and eternal truth of the PI, he focuses on arguing that the future cannot demolish the past. Compared with Russell, Jin has a more firm belief in the effectiveness of the PI and provides more detailed arguments. However, Jin's arguments are not successful just like Russell's: besides the difficulties met by Russell's, they contain some other steps close to sophism, for example, arbitrary change of the reference point in time of the 'present'.

After a long-term segregation of China's intelligentsia from the Western one, a generation of Chinese philosophers, with Jin as a representative figure, have overseas study experience, understand western philosophy to some extent, and have relative familiarity with the western methodology of philosophical study. They have attempted to investigate philosophy in the problem-oriented approach like western philosophers and endeavored to develop their own philosophical theories, even their own systems of philosophy. In this way, they have tried to exchange their ideas in accordance with their western colleagues and to merge into the western academic community. Jin is a pioneer at this side, although his trial does not succeed. After 1949, due to complex historical factors, the already opened doors of China to the western world had been closed again; Jin and other Chinese scholars lost the opportunity to communicate with their western colleagues. However, one of Jin's students, Hao Wang, has successfully stepped into the international philosophical circle and won international reputation in logic, mathematics, computer science, and philosophy, although he accomplished his jobs with the status of a Chinese-American. For Chinese philosophers, entering the international circle of philosophy, making their original contribution to philosophy, and wining international reputation and respect from their international colleagues are missions to be accomplished.

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