New Developments in Chinese Studies of Contemporary Inductive Logic

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Abstract

Contemporary Chinese studies in inductive logic have long revolved around the unfolding of a philosophical investigation into Hume’s problem. Led by research in probabilistic logic, the principal content of contemporary Chinese logic consists of research into Pascalean and non-Pascalean probabilistic logic, precise and imprecise probabilistic logic, pure inductive logic and material inductive logic. A newly arisen trend in the development of Chinese inductive logic is represented by the research on causal inference, which came into vogue within the field of artificial intelligence (AI) in the last few years. Consequently, the future developmental tendency will probably gravitate towards the new paradigms that will emerge from the mutual contest and interactions between probabilistic logic and causal logic.

Keywords: inductive logic, Hume’s problem, China, new developments

Nov razvoj v kitajskeh raziskavah sodobne induktivne logike

Izvleček

Sodobne kitajske raziskave induktivne logike so dolgo potekale na področju pojasnjevanja filozofskih raziskav Humovega problema. Pod okriljem raziskav verjetnostne logike sesotojii jedrna vsebina sodobne kitajske logike iz raziskav paskalovske in nepaskalovske verjetnostne logike, natančne in nenatančne verjetnostne logike, čiste induktivne logike ter materialne induktivne logike. Novonastalo smer v razvoju kitajske induktivne logike pa predstavljajo raziskave vzročnega sklepanja, ki so v zadnjih nekaj letih postale popularne na področju umetne inteligence (UI). Posledično se bodo prihodnji razvojni trendi verjetno nagibali proti novim paradigmam, ki bodo vzniknile iz medsebojnega tekmovanja ter interakcij med verjetnostno in vzročno logiko.

Ključne besede: induktivna logika, Humov problem, Kitajska, nov razvoj

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What is the main problem of concern in Chinese research on contemporary inductive logic, and what are the new trends and developmental tendencies? What is the current state of relationship between probabilistic inference and causal inference in research on inductive logic? Because these questions are related to the development of the present state of development of Chinese inductive logic, they are of critical importance for us.

**Hume’s Problem: The Central Problem of Chinese Philosophical Research into Inductive Logic**

“Hume’s problem” is a well-known issue in the history of philosophy, which in the vast majority of both Chinese and foreign literature is viewed as a problem of induction. In fact, Hume’s problem can be subdivided into a problem relating to causality and problem of induction. However, as a causality-related problem, Hume’s problem was never able to attract much scholarly attention. As already noted by Ayer, in Hume’s philosophical thought no other issue has had a more profound or longer lasting impact than his theory of causality. Throughout its history, this theory was the object of constant attacks, as it was also constantly misinterpreted (Ayer 2000, 68). As a matter of fact, Chinese research on contemporary inductive logic started with this very problem, while its focus all along has been on rationality and the adequacy of the development of inductive logic. In this sense, Hume’s problem represents the core problem of Chinese research on contemporary inductive logic, and it was exactly this kind of research, which has caused endless polemics amongst philosophers and logicians, that has been an enormous driving force behind the advancement of Chinese research in this context. Most importantly, Chinese scholars have provided their own solutions to this difficult problem. Thus, scholars like Jiang Tianji, Ju Shier, Chen Bo and others have all performed relatively significant work with regard to this issue.

**Jiang Tianji’s Commentary on Proposed Solutions of Hume’s Problem**

One of the earliest Chinese scholars who provided his own commentary on psychological and evolutionary solutions to Hume’s problem was Jiang Tianji. Amongst other things, he pointed out that, in a certain sense, Hume’s solution to the problem of induction was correct: because inductive reasoning is not at all akin to deductive reasoning, the former cannot be the object of logical argumentation, while conclusions derived by induction are not deductively correct. However, in another sense, his solution was also completely flawed: since Hume
presupposed that the only form of rational inference is between mathematical proofs or conceptions, he hereby equated the scope of deductive inference with the scope of reason. In that way, Hume denied that empirical reasoning and scientific knowledge have got any rational basis, which further implies that one cannot present an argument for what he referred to as inductive inference, meaning that without rationality inductive conclusions are groundless (Jiang 1987, 93–94).

Jiang further maintains that unless we make a breakthrough in the conceptual architecture of Hume’s thought, any attempts to argue for the inductive method, including deductive argument (i.e. logical argument), inductive argument as well as pragmatic argument, will all be bound to fail. Jiang’s view is that inductive inference neither can nor must have a logical argumentation. Instead, what we have to do is to seek a persuasive yet at the same time non-logical argument. In other words, although our venture to prove or explain inductive conclusions are not necessarily true, they are still reasonable, and thus they possess a degree of probability or confidence level corresponding to the support degree of its evidence (including both empirical evidence as well as theoretical evidence) (ibid., 94–95). Evidently, both Jiang’s commentary as well as his own views are well-founded.

Ju Shier’s Localist Solution

Ju Shier’s solution to the problem of induction follows Jiang Tianji’s comparatively new and original solution to Hume’s problem. In his book (Ju 1993a, 77–95), Ju expounded on and demonstrated the insolvability of Hume’s problem and conducted a partial defence for the rationality of inductive inference. Moreover, in the process of proving the insolvability of Hume’s problem, Ju not only endeavoured to provide a positive or negative answer to the question of “whether Hume’s problem is solvable”, but on the basis of criticizing Karl Popper’s method of negative resolution also proved that the problem has got no logical solution. Ultimately, he also provided a partial method for justifying induction and the concept of logical rationality, thus providing an explanation for the possibility of partial justification, rejection or suspension of induction.

As indicated by Ju, it is logically impossible to provide a negative answer to Hume’s problem. From this it follows that within the scope of logic Hume’s problem can neither receive a positive nor negative solution, which, in other words, means that this problem is logically unsolvable. Looking from another perspective, however, Hume’s problem is solvable philosophically, while inductive inference can only receive partial justification. In order to expound on the method of partial justification of induction, by enumerating inductive method as an example, Ju advanced
his own argumentation for its partial rationality (Ju 1993a, 77–96). This kind of partialist solution had a considerably large influence on the future Chinese research on the problem of induction.

**Chen Bo’s Defence of Hume’s Problem and His Commentary on Jin Yuelin’s Justification of Induction**

In his work, Hume expressed scepticism about the objectiveness of causal relations and inevitability of the inductive method. Jin Yuelin 金岳霖 offered his own unique answer to this problem, but neither his nor any other solutions previously or subsequently raised by other Chinese or Western philosophers have been completely successful. Chen Bo maintains that the problem of induction as posed by Hume has no logical solution, due to the untenability of its three main presuppositions. Induction is a cognitive strategy which in in this boundless universe humanity is not only bound to adopt, but also represents the only strategy which we could adopt. Consequently, for humanity, induction possesses a practical inevitability. The cognitive strategy of induction helps us to establish a certain kind of certainty and regularity from repeated experience. In this regard, the establishment of inductive logic and an inductive method possessing partial rationality is possible (Chen 2001, 3, 35–46).

Chen Bo further indicated that Jin Yuelin was greatly influenced by the philosophies of Hume and Bertrand Russell. He reconstructed Hume’s sceptical argument about causal relationships and inductive inference, and in turn conducted an in-depth critical analysis of Russell’s justification of induction from the perspective of scepticism, the law of causality, principle of induction, empirical postulates and other major subjects in Hume’s philosophy. Subsequently, deriving from Hume’s critique of epistemology, his notions of reliability of causal relations, the perpetual trueness and priority of the principle of induction, and so on, he investigated Jin Yuelin’s justification of induction in detail. Finally, Chen offered a detailed comparison of the differences and similarities between Russell’s and Jin Yuelin’s research on the problem of induction, arriving at the following conclusion: they both failed to provide a tenable justification for induction (Chen 2011, 9, 4–25). Chen’s commentary is both objective and unbiased, while its arguments abound in enlightening explanations.

Although the continuous research into Hume’s problem has not yet yielded any commonly recognized conclusions, it has objectively promoted the forward development of Chinese research into contemporary inductive logic, and directly impacted the formation of new paradigms of “probabilitization” (gailūhua 概率化).
and “causalization” (\textit{yinguohua 因果化}) as the two main approaches to research on inductive logic and its varied development.

Scepticism Regarding Causal Inevitability and the Rise of Probabilistic Inductive Logic

Research on Hume’s problem eliminated the firm beliefs about causal inevitability as established in traditional inductive logic. One of the central consequences of the problem raised by Hume is that since inductive inference cannot guarantee the necessary entailment, then guaranteeing a certain degree of confirmation and probabilistic inference only creates the alternative of necessity as a secondary choice. Hume’s profound reflection on the problem of causality obliterated the attitude of blind optimism which underlay studies of causality in the academic world of his time. Because, at the time, it lacked further suitable mathematical instruments, research on causal logic gradually became marginalized. And it was in the context of the mathematical theory of probability, which became a mature subject at the same time, that Pascalean probabilistic logic arose and took the places of both causal logic and methodological research. By the end of the 20th century, studies in Pascalean probabilistic logic had already become the mainstream research direction in inductive logic. In this upsurge of research, the turn from research on Pascalean to non-Pascalean probabilistic logic, the opposition and the contest for supremacy between pure inductive logic and material inductive logic, and the antagonism and complementarity between research in precise and imprecise probability, turned into the new developmental trends in Chinese contemporary inductive logic.

The Rise of Pascalean Probabilistic Logic and the Difficulties it Encountered

Pascalean probability is a form of mathematical probability, which was founded by Blaise Pascal. The form of inductive logic which was established on the basis of principles of Pascalean probability is called Pascalean probabilistic logic. In the time of its foundation, it represented the main developmental trend in contemporary inductive logic. In the framework of Pascalean probabilistic logic, the research on the subjective Bayesian probability underwent a considerable advancement. The representative research regarding this aspect was conducted by Chen Xiaoping 陈晓平. In documents like “A ‘Solution’ to Hume’s Problem in the Subjectivist Theory of Probability” (Zhuguan zhuyi gailülun duiyu Xiumo wenti...
de ‘jieju’ 主观主义概率论对于休谟问题的 “解决” (1994)) and “A Solution to Hume’s Problem” (Guanyu Xiumo wenti de yige jiejue fang’an 關於休谟问题的一个解决方案 (1995)) Chen pointed out that the so-called “Hume’s problem” represented the 18th century British philosopher Hume’s attempt at calling into question the rationality of the inductive method, which has also been referred to as “the problem of induction” or “the problem of rationality of induction”. Although the “solution” of Hume’s problem as presented by the subjective Bayesian probabilistic logic has been rather unsuccessful, it has nevertheless been quite revealing. In his view, the justification of the rationality of induction as given by the subjective Bayesian method is a form of partial justification, which needs to be founded on some sort of aprioristic hypotheses. This is the point from which derive both the investigations of Kant’s aprioristic philosophy as well as Chen Xiaoping’s transformation of Kant’s philosophy. Lastly, Chen also moved on to major and immensely complicated problems related to inductive realism and scientific realism, such as the problems of analysis and synthesis, reduction and emergence, contrafactual conditionals and scientific laws, Duhem-Quine problem, and so on, to which he provided his own analysis and answers (Chen Xiaoping 1994, 1, 17–24; 1995, 2, 9–15).

Since the beginning of this century, Chinese research on inductive logic has unfolded mainly in the following directions: The first is research on pure inductive logic. In the text “Analogical Reasoning in the Framework of Pure Inductive Logic” (Chuncui guina luoji kuangjia xia de leibi tuili 纯粹归纳逻辑框架下的类比推理 (2019)), Liang Xianhua 梁贤华 indicated that pure inductive logic is a revival of the inductive logic advanced by Rudolf Carnap, whose basic goal was to research inductive logic by treating it as a branch of mathematical logic. Within the framework of pure inductive logic, analogical reasoning is established upon the foundations of first order logic, its theoretical nucleus uses distance function to convey resemblance, while, concurrently, treating the correlation function as its inferential basis. As a result, in this sense we could regard it as an instance of an extension of the correlation function, whereas, in a practical sense, it reflects the urge for formalization of analogical reasoning that arose in the sphere of AI. It is thus evident that the pure inductive method represents the continuation and development of Carnap’s formalized inductive logic. On the one hand, it emphasizes the necessity of formalizing inductive logic, and in turn theoretically improving the Carnapian formalized inductive logic. On the other hand, this theory found its practical application in AI, in the context of the attempts to set up inductive logic in AI (Liang Xianhua 2019, 4, 17–37).

The second developmental trend is represented by research on material inductive logic. This theory was proposed by John Norton, the American philosopher of
science and logician. A relatively systematic commentary of Norton’s theory was provided by Li Shuai 李帅 (2019, 5, 81–92). He explicitly proposed a new kind of theory of induction: a theory of material induction, which strives to resolve Hume’s problem. He further maintained that the validity of the formal theory of induction originates from a universal model of inference. Moreover, in this theory of induction the validity of inductive inference depends on material facts. This has transformed the justification of the inductive model into a justification of material facts, subsequently also eliminating Hume’s problem. On this very basis, Norton founded a kind of arch-structured non-hierarchical empiricist theory, advocating a form of the theory of induction without a universal model and rejecting previous systems of induction that involved universal rules. Deriving from his research background in the philosophy of science, Norton indicated that in all current models of inductive inference there exist particular flaws, which is what prompted him to propose a new kind of theory of inductive logic, in order to distinguish it from “theories of pure induction” that involve the principle of universal induction.

The third developmental trend consists of research in imprecise probabilistic logic. This theory propagates the development from probabilistic logic towards imprecise probability. It posits that, owing to the fact that all its meta-properties are generalized from meta-properties of propositional logic, imprecise probabilistic logic is an expansion of classical propositional logic—if a natural expansion generalized the deductive process of propositional logic, while the conception of coherence generalized the deductive closure and consistency of propositional logic. But in what way can imprecise probability be linked together with predicate logic, so as to form a kind of imprecise predicate logic? The answer is that in order to make probabilistic logic capable of expressing predicates, an entirely different approach must be taken. By means of introducing imprecise probability upon state description, one can in turn expand imprecise probability to QFSL, and subsequently extend it unto the SL by means of the natural expansion of the IP inference. In that way one has achieved the linking together of imprecise probability with predicate logic and obtained a system of imprecise probabilistic predicate logic. In other words, this result can be achieved by means of grafting subjectivism upon Carnap’s positivism (Pan 2018, 3, 38–45). It is not difficult to recognize that the above-mentioned theories contain two common points. Firstly, they are all attempts at resolving Hume’s problem, and, secondly, they all attach importance to their applications in AI and computer science.

The greatest challenge and the most controversial problem faced by the subjective Bayesian probabilistic logic is as follows: If we regard probability as a degree of confidence, then this kind of value of prior probability measuring the degree of confidence is actually freely chosen! In other words, it possesses a relatively large
degree of subjectiveness and possibly also inaccuracies, and the only restriction to these subjectiveness and inaccuracies is in its abiding by the axioms of the theory of probability. As a matter of fact, even if we set out to “dilute” the subjective ingredients or minimize inaccuracies through probabilistic updating, we will still be facing the perplexities of “the new riddle of induction” and censure of anti-inductionists like Karl Popper and others. To put things simply, it is precisely the defect of subjective Bayesian probabilistic logic of excessive arbitrariness of prior probabilistic assignments which became the main shortcoming hindering the further development of Pascalean probabilistic logic.

The Evolution from Pascalean to Non-Pascalean Probability

Non-Pascalean probabilistic logic emerged as an attempt to overcome the difficulties Pascalean probabilistic logic was confronted with. At the end of the last century, by introducing and commenting on J. Cohen’s theory of non-Pascalean probabilistic logic, a group of Chinese scholars started to shift the focus of their research to non-Pascalean probabilistic logic and thus promoting Chinese research in the field. In his book *Studies in Non-Pascalean Inductive Probabilistic Logic* 非巴斯卡归纳概率逻辑研究 (1993b) Ju Shier both analysed and criticized Cohen’s theory as well as advanced his own improvements and reconstruction of this theory. Ju discovered that in Cohen’s theory existed inconsistencies and inadequacies with regard to its overall properties. The most notable is where Cohen offered two different interpretations of the measured results of correlated variables, namely as 1) pseudo-regularity and 2) inductive support, while the logical structures satisfied by these two kinds of interpretations are mutually uncoordinated. In connection with this, assumption 1) has got different logical foundations from assumptions 2) and 3), which directly resulted in the inner inconsistency and inadequacy of Cohen’s system. More specifically, assumption 1) exceeded the scope of classical two-valued logic (if not false than necessarily true), since the postulation that H and non-H can at the same time both be false does not comply with the law of the excluded middle. At the same time, the exclusive induction of assumption 2) and the modal system of assumption 3) are both based on two-valued logic (cf. Gui, Ren and Zhu 1995, 170).

In addition to this, Ju Shier also provided a criticism of G. Shackle’s theory, positing that his non-Pascalean privatist interpretive theory contains flaws and other difficulties. Expanding Shackle’s theory of advantage functions, Ju proposed a method for measuring the degree of desirability, and ultimately established a
theory of decision-making based on an interpretation of non-Pascalean probabilistic logic (Ju 1993b, 115). Thenceforth, the research on non-Pascalean probabilistic logic in China gradually changed its direction toward research on the theory of decision making and gradually integrated together with game theory, forming a research paradigm of decision making and game theory in inductive logic. This has enormously broadened the research scope of inductive logic in this context.

**Attaching Importance to Hume’s Thought on Causation and the Revival of Causal Logic**

We know that Hume’s problem can be expounded on from many different aspects, of which at least two are worth paying closer attention to here. One is to regard Hume’s problem as a problem of causation, and the second is to regard it as a problem of induction. In fact, throughout his work *Treatise of Human Nature* Hume mainly discussed the problem of causation and causal relations, almost without even mentioning the terms inductive method or inductive inference. Consequently, we could claim that Hume’s problem is not only a problem of induction but also a problem of causation. In Chinese circles of logicians, however, Hume’s problem as a problem of causation has been completely neglected, but now is the time to change this.

The logical result of researching Hume’s problem of causation is causal logic with several ups and downs. Modern causal logic is represented mainly by the method for seeking causal relations as raised by Bacon and Mill. Following the rise of probabilistic logic and due to the challenges with regard to Hume’s problem, it underwent a gradual abandonment by the academic community. Even though, by having been introduced into the logic of conditionals and modal logic, modern causal logic attained a certain degree of development, generating new formal systems of causal logic, like causal logic of declarative clauses, causal modal logic, etc., it is still facing difficulties and lacks developmental impetus in aspects like semantic interpretation and philosophy, and thus such work can resemble a flash in a pan and lacks sustainable development.

Studies in causal inference in reality represent an ascending type of causal logic. Causal calculus as a system of causal logic from the perspective of AI represents one of the points of special interest in such research in the past few years. The research on causal inference has driven the development of the causalization of contemporary inductive logic. In the last decade of the previous century, Chinese scholars started combining their research in the theory of inductive logic with applied research on AI, bringing about a combination of research on inductive
logic and applications of AI. The Chinese scholar who initiated and launched integrative research on probabilistic logic and AI was Wang Yutian 王雨田. He proposed a tentative plan for “grafting” modern inductive logic upon AI, and established a research group for cooperation between logicians and computer scientists. The main backbone of this research team was represented by scholars like Ju Shier, Chen Wei 陈炜, Xiong Liwen 熊立文 and others. After the founding of the research team, Ju Shier and others engaged in research on formal systems integrating causal networks and probability, spearheading the combined research in theories of causality and probability in the country. They collectively indicated that, under the conditions of incomplete knowledge, and when we are determining the cause of certain events using an inductive method based on randomized experiments, the not yet eliminated causal assumptions obtain their evidential support on two different levels: 1) They are supported by the statistical data provided by the randomized experiment founded on the design of the respective assumption. 2) By means of the evidential support obtained by eliminating false hypotheses. For that reason, they introduced the concepts of causal binary indeterminacy and causal networks of binary indeterminacy composed of causal statistical strength and degree of implausibility. Furthermore, they formulated a method for acquiring the measure of causal binary indeterminacy, and proposed a networking method for causal networks of binary indeterminacy based on the statistical method and exclusive induction (Ju and Luo 1997, 23–30). Evidently, the work of Ju Shier and others paved the way for Chinese research of theory and application of causal logic.

On the other hand, because of the difficulties encountered by research on machine learning in AI due to its exclusive focus on correlations and disregard for causality, a few erudite and experienced scholars eventually recognized that neglecting in-depth research on causality will have serious consequences for their field of studies. Subsequently, they hung out the banner of “causal revolution” (yinguo geming 因果革命) and initiated the rise of a kind of “new science of causation” (yinguo xin kexue 因果新科学). They acknowledged that the main lesson given to us by the difficulties encountered by research into probabilistic logic is that merely observing data and facts will not work, and it is difficult to resolve complex problems involving numerous intertwined elements by means of reflecting on probabilistic correlations alone. However, this kind of view, namely that one ought to only discuss correlations and put data at the centre of research, is still deeply rooted in contemporary academia, and its influence still lingers (Pearl and Mackenzie 2018, 3–6). As a consequence, the problem of the contemporary revival of causal logic appears to be especially significant. Causal logic, as proposed by Pearl's and Ju Shier’s ideas on causal logic, represents merely two different means to achieve the
same end, which is also reflective of the fact that China's research into causal logic is more or less in line with foreign research.

Surprisingly, Hume's thought already contains abundant resources that can be used for breaking away from the problems of inductive logic. Hence, Hume's conception of causation has always been in line with the research on causal logic. In his *Treatise of Human Nature* (Chapter 3, “Of Knowledge and Probability”), Hume already probed into the constant conjunction which subsists between two objects, and also provided a definition of the “regularity” of causal relations. In his later work *An Enquiry Concerning Human Understanding*, however, Hume was already dissatisfied with this definition and provided a new one. He pointed out that:

> We may define a cause to be an object followed by another, and where all the object, similar to the first, are followed by objects similar to the second. Or, in other words, where, if the first object had not been, the second never had existed. (Pearl and Mackenzie 2018, 265)

This is Hume's contrafactual definition of causation, and it is clearly more profound than the definition of regularity. Because this kind of contrafactual thought can draw distinctions among human, animal, and machine intelligence, it has given rise to the pivotal question of whether we can achieve so-called “strong AI”. This view of Hume's has also had a profound impact on research into causal logic.

At the present time, the research on causal logic conducted in Chinese academic circles of philosophers of science and logic is still at its initial stages of introducing the discipline and attempting to bring forth innovation. In his article “Artificial Intelligence and the Language of Cause and Effect” (*Rengong zhineng yu yinguo yuyan* 人工智能与因果语言 (2021)) and elsewhere, the young scholar Wu Xiaoan and Zhang Yu explained why we should make use of a causal language by comparing it with controlled experiments, thereby elucidating its theoretical significance and applicative value (Wu and Zhang 2021, 1, 30–38). Wu also investigated the logical mechanisms and philosophical problematics of the contrafactual theory of causation, thus making a notable contribution to the propagation of causal logic and philosophy of causality in China.

In recent years, experts in AI and philosophers of logic restarted the initiative to interconnect probabilistic inference with causal inference, giving rise to attempts to merge the two forms of inference within a unified system. At the same time, Chinese scholars have already become aware of the fact that the same rationale of fusing these kinds of inference was suggested in Pearl's thoughts on causal inference. This has had an additional stimulating effect on the development of integrated research into probability and causality in Chinese academia.
Research on Inductive Paradoxes and Research on the History of Inductive Logic

Hume’s problem of induction and the “grue-bleen” paradoxes have been called by the scholars “the old riddle of induction” and “the new riddle of induction”, respectively. In Dun Xinguo’s opinion, inductive paradoxes represent a type of “inductive riddles” that have been the object of constant and persistent discussions and controversies in the academic world, and have yielded plentiful research results. Usually, these results would be used only to eliminate individual paradoxes, without having a grasp of inherent logical relations which exist between them or their intrinsic qualities. An investigation into the history of inductive paradoxes may reveal that its essence consists of a family of difficult problems encountered in the proof theory of reasonable belief, and that its “degree of difficulty” is just gradually increasing. Looking from the perspectives of the paradox structure and the gist of representative solutions, of the three major inductive paradoxes, the paradox of confirmation is a concrete outgrowth of the difficult problem of evidential coherence of confirmation; the “grue” paradox is a vivid exemplification of the difficult problem of projectability of confirmation; and the lottery paradox is a rigorous questioning of Hume’s presuppositions for confirmation. In order to resolve these major problems of confirmation, we must learn from the related results from the philosophy of mind and linguistics, to accurately show that the hypotheses and evidence are in a relationship of aboutness, and this is the criterion of the identity of the subject under discussion. On these same grounds we can further investigate the relationship of content-related and formal “matching” between evidence and hypotheses, so as to construct the epistemological principles of connectivity bridging existence and mental states. Within these types of research, evidence is a crucial link which at the same time still has not aroused sufficient attention. As a consequence, multidimensional research on the nature of evidence, its metaphysics, logic, and perceptual ethics should be regarded as the highest priority of contemporary research on the inductive theory of proof (Dun 2019, 1, 44–45).

There are also some scholars who indicate that the lottery paradox represents a confirmation of an inductive paradox concerning knowledge and belief, which has swayed our philosophical principles that depend directly on trust, such as the principles of high probability, consistency, conjunction closure and others, and this has had a relatively significant impact on current academia. The customary neglect of the subject of belief has led to a misuse of the principle of conjunction closure with regard to belief, while this kind of misuse represents an important origin for the emergence of the lottery paradox. From this it follows that, under the
premise of the lottery paradox as a paradox of faith, we reintroduce the subject of belief into the perspective, and this will be of significance for the resolution of the lottery paradox. When the subject of belief has been restored, it will not be difficult to discover that the principle of conjunction closure is not applicable to the situation in which multiple belief subjects and the single belief subject are dealing with the lottery paradox, thus resolving this paradox from a cognitive perspective (Shi and Xu 2021, 5, 51–58).

As Chinese scholars are well-aware, Whewell’s deductive logic-based hypothesis has always been neglected. But as the contemporary philosopher Norton has admitted, his conception of material induction has been enlightened by Whewell’s work. Meng Lingfang 孟令芳 believes that Whewell has carried on Bacon’s progressive thought on induction, insisting on a gradual yet continuous method. His invention of the “table of induction” made clear that the inferential process from particular facts to universal truth is a step by step procedure. On the other hand, with his antithetical epistemology he innovated Bacon’s extremely empiricist theory of knowledge. Maintaining that rationality is of the same importance as one’s experience, he emphasized the significance of “hypotheses” in inductive discovery. Naturally, this kind of epistemological innovation later also became the object of Mill’s criticism. Their debate about the essence of inductive reasoning runs through the entire process of Western research on Whewell’s philosophy of induction that started in the 1950s (Meng 2019, 2, 36–41).

To summarize: Chinese studies of contemporary inductive logic made new headway in three main respects. Firstly, definite advances have been made in the field of research on pure induction and material induction. Secondly, some preliminary advances have been made in the field of the causal inference in studies of AI and its philosophical questions, which set the foundations for in-depth interdisciplinary research on probabilistic logic and causal logic. If, however, we want to achieve breakthrough advances then much more work must still be done.

The important lessons which we can be surmised from the above survey are as follows: First, we have to strengthen interdisciplinary research on inductive logic. The desired achievements of Chinese research on inductive logic are inevitably linked to broad-field and multidisciplinary collaborative work, which stretches across disciplines such as logic, the philosophy of science, AI and computer science, and cognitive science. Future research will be able to follow along such a broad research route, prompting profound advances in research at the intersection of different sciences and disciplines. Secondly, we must preserve the necessary tension as well as an appropriate balance between antagonistic theories and concepts such as causation and probability, precise probability and imprecise probability, and
Pascalean-probability and non-Pascalean probability. For the developmental trend will likely lead towards a new paradigm of complementarity and mutual interaction between probabilistic logic and causal logic. And, finally, the research on Hume's problem will have a continued influence on Chinese studies of inductive logic.

*English translation by Jan Vrhovski.*

**References**


