

Research on discipline development and discipline difference of intelligence science in China

Intelligence
science in
China

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Abstract

Purpose – With the continuous change of research contents and methods of intelligence science, its integration with other disciplines is also deepening. The purpose of this paper is to further explore the interdisciplinary research characteristics of intelligence science in theoretical depth and application value.

Design/methodology/approach – This paper summarizes and explores in two aspects. The first is a large number of literature review, mainly combined with the historical characteristics of the development of intelligence science researches in China and international comparison. The second is to refine the discipline construction ideas suitable for the development of contemporary intelligence science.

Findings – From the perspective of the historical development of discipline relevance, the development characteristics and positioning of intelligence science in China are introduced, with the comparison of many disciplines including information technology, library science, information science, data science, management science and other disciplines. In order to better meet the practical needs of intelligence service in the new era, this paper mainly analyzes the construction method of intelligence science research system and the relocation of intelligence science research content.

Originality/value – This paper summarizes the historical characteristics and international comparison of the development of intelligence science in China. It proposes the development characteristics and orientation of intelligence science in China from the perspective of historical development of discipline relevance. It also proposes the discipline construction ideas suitable for the development of contemporary intelligence science.

Keywords Intelligence science, Discipline comparison, Discipline development, Discipline system, Discipline construction

Paper type Research paper

1. Introduction

The development of intelligence science in China comes from the intersection and integration of many different disciplines. In the general understanding of international academic circles, intelligence Science mainly involves psychology in human intelligence, cognitive science related to artificial intelligence and even military intelligence and national intelligence. In fact, the situation of intelligence science in China is very similar. In the historical development of



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intelligence science in China, different stages have reflected the characteristics of different connotations (Guo *et al.*, 2005, p. 524–528). For example, in the early stage, more emphasis was placed on human intelligence. In the later stage, with the development of economy, intelligence science in China paid more attention to competitive intelligence. Today, intelligence science in China gradually pays attention to the content similar to military intelligence and national intelligence. However, all these seemingly different contents are concentrated in a single discipline of Intelligence science in China. It brings more problems for people to think about. Especially in order to further discipline construction and development, it needs to clarify the subject and characteristics of the existing discipline research content for effectively designing the real way of future discipline development.

2. The history and current situation of intelligence science in China

The earliest intelligence Science Education in China began in 1958 when the Technology and Intelligence Science University was founded by the Institute of Science and Technology Intelligence of China. The university enrolled the first undergraduate of intelligence Science in 1959. In the same year, it was merged into the University of Science and Technology of China, and the intelligence Science major was also renamed the intelligence Science (Qiu *et al.*, 2002, pp. 112–120). After the resumption of the college entrance examination, Wuhan University took the lead in setting up the undergraduate major of science and technology intelligence in 1978 (Ma, 2013, pp. 4–12). The Institute of Science and Technology Information of China has also begun to recruit master students majoring in science and technology intelligence (China Institute of Science and Technology Information, 2011, p. 113). Beijing University and Nanjing University also set up related majors after that. Wuhan University founded the Library and Information Science School in 1984, which set up the intelligence science discipline and began to recruit postgraduate students of Intelligence Science. The Chinese People's Liberation Army University of International Relations also began to recruit master's degree students in Military Intelligence Science in 1986. In 1998, this University established the first doctoral program of Military Intelligence Science in China (Su, 2018, pp. 451–459). In 1990, Wuhan University founded the doctoral program of Intelligence Science and began to recruit students in 1991.

Most of the early Intelligence Science in China came from library science, but in the 1980s and 1990s, library science gradually faded out of the main field of Intelligence Science research with the development of Intelligence Science. Nowadays, information processing, information analysis and information management have become the main research contents of Intelligence Science, and the research of Intelligence Science in China has turned to a new direction with Information Management as the core. For example, the State Science and Technology Commission of China changed China Institute of Science and Technology Intelligence to China Institute of Science and Technology Information in 1992. The State Education Commission of China also changed the undergraduate major of science and technology intelligence to science and technology information in 1993. Meantime, many Chinese colleges and universities have renamed the library and intelligence science department to information management department and other similar names. The most typical example is that the new edition of the Catalogue of Undergraduate Majors of China in 1998 merged science and technology information, information science, management information system, economic information management, forestry information management into the new major named as information management and information system, which belongs to the major category of management science together with library science and archives science. Information management has become the main melody of Intelligence Science education in China, and has continued to this day. There has also been a widespread debate in the intelligence community whether it is necessary to translate intelligence into information.

3. The characteristics and orientation of the intelligence science development in China from the historical development of discipline relevance

In the face of the practical needs of processing and analyzing large-scale heterogeneous data resources on the Internet, the research content of intelligence science has already begun to merge with other related disciplines. For example, in terms of research technology and methods, intelligence science draws lessons from a large number of information technology discipline, especially including text mining, big data analysis, etc. In the field of application, Intelligence Science has widely absorbed the research focus from management discipline and other related disciplines and has carried out a large number of application combinations in such fields as enterprise competitive intelligence (business administration discipline) and government intelligence management (public management). It even gave birth to some research points of Intelligence Science in specific fields such as public security intelligence science (Ma and Su, 2013, pp. 49–57) and pushed the development of related theoretical research forward. All these made the development of intelligence science present complex and changeable forms. As a matter of fact, only if the Intelligence Science deeply promotes the wide cross of various disciplines in various ways and in a large span, can open, interactive and collaborative discipline ecological group be established (Ba *et al.*, 2018, pp. 653–667).

The characteristics of this integration with many disciplines are also reflected in the setting of intelligence discipline. For example, in terms of the overall discipline nature of the school where the discipline master program is located, at present only about 16% of the master's programs are located in management schools related to information (such as school of information management, school of information technology, school of information resource management, school of information management, etc.), about 29% of them are in management schools (including school of management, school of economic management, school of public management, etc.) and 55% of the major of intelligence science is also distributed in other schools, including school of history and culture, school of social sciences, school of humanities, school of business and school of media (Su, 2019, pp. 1-12). The more prominent feature of multi-discipline integration is the establishment of discipline directions of information science. At present, the common discipline directions of intelligence science mainly include the history of intelligence science, intelligence sociology, comparative intelligence science, intelligence metrology, intelligence psychology, intelligence management science, intelligence service science, intelligence economics, intelligence retrieval science, intelligence system theory, intelligence technology, science and technology intelligence science, intelligence science in social science, and other disciplines. The research contents involved in these directions are slightly outdated in many aspects, and do not reflect the latest information technology features. However, the biggest problem is still that the contents are scattered and the logic is unclear in the structure.

The interdisciplinary research characteristics of intelligence science often need more detailed and in-depth exploration in terms of theoretical depth and application value, especially in the exploration of research hot-spots (such as national security) and the innovation of research methods (such as knowledge map analysis and social network analysis). Now, with the deepening of the thinking and practice of intelligence science, it needs to rethink and sort out the existing problems and design a discipline system and content of intelligence science that is more in line with the social needs and development characteristics.

The development process of intelligence science should be understood only in this way can the characteristics and causes of intelligence science development be better understood. It cannot stand alone in a point of time to think about the problem, it must be analyzed and observed from the perspective of historical development, in order to better clarify the characteristics of intelligence science and its interaction with the times, so as to better understand the construction significance of intelligence science under different times

background and at the same time more clearly help us to clarify the future road of Intelligence Science development.

3.1 Relationship with information technology discipline

From the perspective of information technology, intelligence science tends to focus on the application of information technology. At present, the most concerned research is mainly in the application of modern computer information technology based on artificial intelligence in the field of Intelligence Science (Wang, 2019, pp. 615–618).

From the perspective of discipline development history, the emergence and development of intelligence science has always been closely related to the emergence of information technology. The development of information technology provides the necessary technical basis for the research and application of Intelligence Science. The change of information requirement brought by information technology itself is the fundamental driving force of the development of intelligence science.

Since Second World War, intelligence work has played an important role in the war. In the peace period after Second World War, the application of intelligence has gone out of the traditional field of war and espionage, and has gradually become an important work in safeguarding national security, supporting diplomatic activities, promoting scientific and technological innovation, assisting enterprise competition, carrying out economic activities and supporting government decision-making.

After Second World War, computer technology began to develop vigorously, and the exchange of scientific and technological intelligence was strengthened and deepened. The traditional intelligence service method based on document service could not meet the requirement of efficient intelligence research and exchange. Scholars from all over the world began to widely intervene in the improvement of intelligence science methods. For example, the Memex proposed by Vannevar Bush as early as 1945 believed that future human beings can store knowledge outside the human brain, maintain and manage it separately and form an independent knowledge body form coexisting with human beings (Bush, 1945, pp. 101–108). Today, it can be seen as the rudiment of the modern Internet. However, from the perspective of subject cognition, if intelligence science is a discipline that studies knowledge and its application, it actually reflects human's understanding of the value and feasibility of intelligence work based on knowledge analysis. Meanwhile, H.P. Luhn of IBM put forward the method of automatic extraction of article abstracts based on the principle of word frequency statistics in *The Automatic Creation of Literal Abstracts* in 1958 (Luhn, 1958, pp. 159–165). Although the method seems too simple today, it can be seen that people were fully aware of possible problems brought from information technology at that time. Although information technology produces a large number of information resources and results in information overload, it also provides a possibility to solve this problem.

However, information technology itself has been still in the process of continuous development and change and has a continuous impact on the development of related disciplines. From the early single computer computing, to network computing, and then to Internet computing, no matter the scale and type of information resources, or the corresponding processing methods and technologies, it has undergone fundamental changes. These will obviously have a great impact on the development of Intelligence Science. Intelligence science will be greatly influenced by the current mainstream information technology in the research methods and directions inevitably, and the integration of disciplines is inevitable. For example, according to the statistics of knowledge sources of international papers on intelligence science in China from 1998 to 2016, some scholars found that the category of computer information system and computer theory and method have always been in a high proportion (Tong *et al.*, 2017, pp. 24–34).

However, this kind of interdisciplinary changes also lead to misunderstanding of intelligence science discipline. Just as computer science, management information system and other disciplines appeared in the 1960s and 1970s, a similar controversy arose about whether these disciplines could exist alone at that time. Some scholars also questioned whether these are independent disciplines. Even today, many disciplines are still evolving rapidly and facing similar situation. For example, software engineering and cyberspace security have been separated from computer science. Although intelligence science itself has the characteristics of interdisciplinary, the premise of this interdisciplinary feature is that intelligence science has its clear theoretical core; otherwise it will seriously hinder the rapid and healthy development of intelligence science in the long run (Lai, 2008, p. 5).

In essence, intelligence science itself has the cultural characteristics of social science research. It pays attention to the phenomenon of cultural engagement, that is, from the perspective of social culture, it grasps the complex logical mechanism from intelligence phenomenon and constructs corresponding intelligence theory. If overemphasizing the application of information technology and quantitative processing, or even quantifying it for quantitative purposes, the original intention and goal of intelligence science will be lost. If the over quantitative model cannot explain and guide the practice well or does not relate to the practice at all, it has no value in intelligence science research (Lai, 2014, pp. 11–12). Some scholars even think that the excessive use of these technical tools will reduce the degree of reflecting social requirement (Buckland, 2016). Some scholars believe that intelligence science, which is divorced from social application, is the formalistic Intelligence Science, rather than realistic Intelligence Science that is really needed (Buckland, 2012, pp. 1-7).

3.2 Relationship with library science discipline

The relationship between intelligence science and library science discipline is relatively long, and library science has the greatest impact on the development of Intelligence Science. In the field of research, the two overlap most, which can best reflect the traditional characteristics of intelligence science research, such as bibliometrics (Zhu, 2016, pp. 18–22), information service (Liu, 2013, pp. 244–248, 253), etc.

3.2.1 The early relationship between two disciplines. The relationship between intelligence science and library science has a long history. From the literal understanding, the so-called library and intelligence science is to use the advanced technology of intelligence science to process all the documents and materials in the library, obtain valuable intelligence and meet the information needs in practice.

From the perspective of historical development, the Dutch scholar J.E.L.Farradance first proposed the term Intelligence Scientist in 1953 (Chen, 2016). In 1964, the University of Pittsburgh first merged library science and information science into library and information science (LIS) (Galvin, 1977, pp. 280–291). Later, some countries including China also had the similar discipline of library intelligence and philology (Maceviit, 2005). In 1978, the Chinese Academy of Sciences renamed the library of the Chinese Academy of Sciences as the Research Center of Library and Intelligence Science, which can be seen obviously that the early library science and Intelligence Science are very close.

There are profound historical reasons why these two disciplines are so close. In the early stage of its development, Intelligence Science mainly focused on the combination of library research because the research and application of intelligence science at that time mainly focused on paper-printed documents. The limitations of technical means determined the close relationship between these disciplines by means of documentation (Wang and Zhang, 2003, pp. 6-9). The research object and work object are mainly the literature resources stored in the library, so it involves a lot of researches on document collection, document organization (classification and indexing), processing, storage retrieval and circulation law. Even if the

later automatic information system merged, its function is mostly about document automatic processing. The corresponding theoretical research in intelligence science also comes from the literature field, such as Bradford law, Lott Carter law, Ziff's law and so on. Moreover, since the computer network has not yet realized the universal connection like the Internet today, all kinds of online retrieval services provided by librarians are the key link to realize the communication between users and documents. It also led to the research of human intermediary being very important in intelligence science, which even once became a feature of the times of intelligence science research in the former Soviet Union. In the early era when intelligence science was created, scholars would naturally associate it with library science.

This relationship still has a profound impact on the research characteristics of intelligence science itself. For example, through keyword co-occurrence analysis of intelligence science research content, some scholars found that from the perspective of node centrality, library is located in the central position of the co-occurrence network and is also the node with the largest centrality in the network, and the centrality of seven nodes namely information service, digital library, information resources, knowledge management, network environment, university library and information technology, is also greater. Among them, the relationship between intelligence science and library science is the strongest. Through the literature analysis of nine core journals of intelligence science from 2002 to 2011, some scholars found that the research topics of Chinese intelligence science were mainly under the category of culture, science, education, sports, other were under the category of economy, automation technology and computer technology. It can be seen that Intelligence Science research is closely related to economics, computer science, law, sociology and other disciplines. According to the secondary category of Chinese Library Classification, G25 (library science and librarianship) and G35 (intelligence science and intelligence work) are the main research topics of Chinese intelligence science in the past ten years, G20 (information and communication theory) and F27 (enterprise economy) following closely (Lv and Qiu, 2014, pp. 5-12).

Until today, there are still many scholars committed to the integration of library science and intelligence science. For example, our understanding of intelligence science from the perspective of focusing on data-information-knowledge should be expanded, and the ideal drive of library science with the technology drive of intelligence science should be integrated, so as to form the complementary knowledge system of library science and intelligence science, and the research frontier jointly can be developed (Ye, 2019, pp. 15-25).

3.2.2 The difference between two disciplines in the later period. The understanding and practice of binding library science and intelligence science together has distinct characteristics of the times. With the progress of technology and the development of the times, many problems have gradually exposed. The main reason is that the object of intelligence science research has been widely shifted from traditional paper-printed document to electronic document and network information. On the other hand, in the use of these information resources, although the traditional document management and analysis methods such as book classification can provide basic information organization function, in order to achieve a deeper use of information, more in-depth processing should be carried out. The most advanced information technology undoubtedly provides this possibility (Brookes, 1982, pp. 48-49). At the same time, the rapid development of information technology in the middle of the 20th century also led to the digital process of traditional libraries. Modern libraries are widely adapted to the change of information technology and the development of modern users' information requirements. All of these have produced new forms such as digital library and smart library.

Under the joint development of these two disciplines, information technology began to have an important impact in the field of intelligence science research. New information analysis methods represented by computer analysis technology began to appear, such as

automatic word segmentation, word frequency statistics, citation analysis, which greatly enriched intelligence analysis methods in the original era of paper-printed document. As a result, intelligence science and library science began to separate gradually from each other in the middle of the 20th century. Intelligence science began paying more attention to the comprehensive analysis and application of various information resources, such as electronic information, network information, data information and so on. In the application, it focuses on the research of new methods and new ideas to meet the service function of intelligence requirement at different levels, such as national level, enterprise level and personal level. The research vision of intelligence science has extended from the traditional library field to the whole social field. It has shifted the discipline orientation from the traditional library users as the service goal to the broader space of the social public as the service goal and provides basic theoretical support and application services for related information activities (Liu *et al.*, 2015, p. 17). In terms of research methods, intelligence science also emphasizes the integration of multidiscipline theories and methods and adopts an open and multi-dimensional research perspective (Fang, 2018, p. 292).

De-documentation became a major trend of intelligence science in that era. The representative event is that the American Documentation Institute (ADI), founded in 1937, was renamed American Society for Information Science (ASIS) in 1968, and its journal was also renamed Journal of the American Society for Information Science (JASIS).

After entering the 1980s, the popularity of personal computers and the rapid development of the internet have produced a large number of available data resources, and changed the access mode of information resource mainly based on paper-printed document. This has also impacted the traditional collection theory in library. For example, the accessibility mentioned in Morse's law of library collection no longer shows the geographical location of the library, but relates to whether the function of the retrieval and reading system is fast and effective (Wang, 1998, pp. 3-8). The traditional concept of physical ownership and geographical priority has gradually shifted to the integrated modern library collection concept of logical ownership and availability priority (Huo and Li, 1999, pp. 305-309). The distribution, growth, aging and dissemination of network information resources are greatly different from the traditional paper-printed document, showing more characteristics of complex network. Traditional Bibliometrics is gradually evolving to Webmetrics (Almind and Ingwersen, 1997, pp. 404-426). Moreover, the internet information dissemination has broken the traditional distinction between formal communication and informal communication, especially in the field of science and technology information dissemination (Fang, 2002, pp. 13-17). The user's ability of directly transmitting and receiving information has been greatly improved, which has completely changed the irreplaceable position of authoritative intermediary under the traditional information organization mode (Fang, 2001, pp. 122-138). More importantly, the rapid growth of network information has also led to the shift of intelligence science research to the study of information overload, which used to deal with scarce information (Wang, 1996, pp. 3-4). Accordingly, great changes have taken place in the discovery, revelation, organization and utilization of knowledge units, the process, characteristics and laws of knowledge exchange in the internet era (Ma and Song, 2007, pp. 1-34). Many scholars believe that the research object of intelligence science in the Internet era has developed from simple information to knowledge. The expression and organization of knowledge must be transformed from the document unit at the physical level to the knowledge unit or intelligence unit at the cognitive level, and the measurement of knowledge must develop from the grammatical level to the semantic and pragmatic level (Ma, 1996, pp. 337-343). The main goal of emphasizing knowledge is to emphasize the full integration of the original information resources. Only the fully related information can have greater application value. This is not only suitable for the requirements of modern massive network information resources, but also in the era of paper-printed document, Thematic principle and Codification Ideas

proposed by P. Otlet, the founder of philology (Rayward, 1994, p. 163–175), also reflect to a certain extent that the research object of intelligence science lies in the access, mining and utilization of knowledge (Liang and Liang, 2005, pp. 225–229).

Bibliometrics can be taken as an example to see the differences between library science and intelligence science. Although the information resources involved in intelligence science research are more generalized and comprehensive, the contents related to library science research still remain in the field of traditional document and information resources research. The typical content is bibliometrics, which emphasizes taking traditional document such as papers and books as the research object, using mathematical and statistical methods to deeply reveal the quantitative characteristics of document and other knowledge carriers, so as to reveal the laws and characteristics of document itself, and provide decision-making basis for library intelligence management services. Today, this kind of research content represented by citation analysis is still one of the main contents of contemporary intelligence science research. However, even in this traditional field, there are also the characteristics that the two disciplines differentiate and evolve to different emphases. For example, if focusing on the document resources, many researches like the traditional document analysis or the statistical analysis of ancient books mean more emphasis on the characteristics of library science (Chen and Li, 2012, pp. 27–32). If taking quantitative analysis as the focus especially with the help of modern computer methods, such as taking specific research topics as the research content, revealing the development characteristics and laws of research topics and presenting them through effective visualization, the research characteristics of intelligence science will be emphasized (Liu *et al.*, 2019, pp. 997–1011). But the existing research methods of bibliometrics are still mainly empirical, and the research results of theoretical research and principle analysis are rare. Further exploring the research content of traditional bibliometrics, constructing the theoretical analysis framework of bibliometrics under the modern generalized information resource system, and exploring the effective combination of bibliometrics, Informatics and scientometrics on the basis of data metrology research should become one of the important contents of contemporary intelligence science research (Wang and Li, 2015, pp. 12–16).

At the end of the 20th century, with the gradual trend of intelligence science toward information orientation and the emphasis on information management and knowledge management, the development of intelligence science itself is obviously different from that of library science. These can be also reflected in the renaming of colleges and departments at that time (such as putting information in front of the library in the name or canceling the library words in the name), curriculum reform (such as the abandonment of traditional library science courses and master's degree in library science) and the establishment of an Intelligence Science degree (Lai, 2003, pp. 80–84, 88). For example, through the research and analysis of the postgraduate education of library and intelligence science in the Yangtze River Delta, some scholars point out that the popularity of postgraduate education of intelligence science in China is much higher than that of library science and archives science (Gao, 2010, pp. 46–49). Today, the idea of further separating intelligence science from library science is still concerned by many scholars, such as many scholars put forward the idea of weakening the integration of library and intelligence at the 2018 Forum on the development of intelligence science and intelligence work (Si *et al.*, 2019, pp. 124–129). The iShool movement, which started in 2003 abroad, can also be regarded as the reform movement of library and intelligence science education in Europe and America facing the transformation of information age (Blaise, 2005, pp. 363–365). Many scholars believed that iShool has not completely solved the problem of effective integration of library science and intelligence science. Especially in the practice of library and intelligence science education in the United States, library science is becoming weaker and weaker with the development of intelligence science (Yu and Liang, 2017, pp. 18–33).

Of course, the de-librarianization of intelligence science reflects the practical requirements of modern information processing technology to a certain extent. Although the mixed formulation of library and intelligence reflects that document information in library is the most important and common information analysis data resource before the development and application of computer technology, but if adhere to this traditional belief, it will certainly not be able to adapt to the changes of social needs and real information resources in the new era. Meantime, it deeply reflects the dilemma of the development of intelligence science because the mixed formulation of library and intelligence more confuses the difference between discipline research method and discipline research purpose. For example, can intelligence science be called as computer intelligence or big data intelligence today? Obviously, this definition method seems to reflect the research method of keeping pace with the times, but it will lead to the confusion of discipline boundaries.

3.3 Relationship with information science discipline

Information science is a science which studies the dynamic process of information and its social background. In the 1970s, American information science research encountered the impact of the development of information technology, forming the cognitive bias that information science is a subject with information technology as the core (Schrader, 1984, pp. 227–271). Although intelligence science also pays attention to information research, the dividing line between intelligence science and information science lies in whether to use intelligence analysis method to create intelligence, that is to say, the main feature of intelligence science is to meet the needs of society and realize intelligence analysis (Xie, 1998, pp. 45–47). To a certain extent, the research methods of intelligence science are similar to the soft science analysis methods, and the process of intelligence analysis also has its own characteristics. For example, the organization process of intelligence analysis is similar to the organization process of intelligence work carried out by CAI (Lancaster, 1978, p. 179).

The main reason for the connection between intelligence science and information science comes from the rapid development of information technology in the 1970s and 1980s. Information itself has gradually attracted attention. The related research of the two disciplines mainly focuses on information exchange (Liu, 2009, pp. 66–68, 84), information retrieval (De Blik *et al.*, 1992, pp. S54-S56), network analysis (Zhu *et al.*, 2008) and other fields.

Whether in China or abroad, the relationship between intelligence science and information science is very close and the subject research content between them is very complicated. The fundamental reason is that in the development history of intelligence science, when it tries to get rid of the shadow of library discipline, it vigorously accepts and integrates the research direction and content of information science. Conceptually, intelligence and information are closely related and reflect a kind of interlinked, inherited and even interchangeable relationship.

In the 1980s, China shifted the research focus of intelligence science to information, further blurring the difference between intelligence and information (Bao and Li, 2007, pp. 29–34). Some scholars in China have also proposed that intelligence science should be defined as information Science (Liu, 2018, pp. 2-8). In fact, this situation not only occurs in China but also in foreign countries. For example, intelligence science and information technology are put in the category of computer and information sciences in CIP-2010 (Classification of Instructional Programs). In the research literature of many Chinese scholars, information, informatics and intelligence are often mixed. Many disciplines related to intelligence science include informatics, information science, management information system, information resource management and knowledge management (National Center for Education Statistics, 2016).

It is necessary for us to make a clear definition of the difference between intelligence science and information science. It might as well be thought from the perspective of whether information is subjective or objective. There have always been different views on this issue.

In the early classical understanding, there is such a view as Shera that information means a fact, a stimulus that can arouse our sense and perception, an intellectual entity can be accepted and a building block of knowledge. The definition of information is not different according to different subjects who use information (Shera, 1970). Some scholars think that information can be a kind of data reflecting the characteristics of things, and the uncertainty can be reduced by the dissemination of this data (Buckland, 1991, pp. 351–360). Some scholars think that information is the mode of organizing material and energy, which is an objective phenomenon (Bates, 2006, pp. 1033–1045).

But some scholars believe that information is the concept of adding subjective factors, which means information is the existence mode and movement state of things perceived or expressed by the subject. Information cognition integrates various factors of social, historical and cultural backgrounds. If information is divorced from the actual and specific situation, it will lose its significance (Wang *et al.*, 2012, pp. 6-12). Similar views also hold that subjective knowledge can be transformed into objective knowledge through information in the use of cognitive model, and the recognition of information value is actually a manifestation of subjectivity (Oppenheim and Stenson, 2003, pp. 159–166). Although different definitions will have different influences on various methods of organizing and managing information, the really useful definition should emphasize the subjectivity and contextualization of information for the discipline of intelligence science, that is information should be analyzed, described and expressed according to context, practicality and domain (Hjorland, 2007, pp. 1448–1456). No matter whether the object of intelligence science is information or intelligence, and regardless of the relationship between these concepts, all these have shown that the core concept of intelligence science is not a completely objective thing but constantly in-depth interaction with the social environment and will change according to the evolution of time. This further leads to the interaction and change characteristics of knowledge acquisition, knowledge transmission and cognitive behavior with social interaction. Information can be set as the basic object of intelligence science research and it reflects the difference with information science.

So the research objectives and contents of intelligence science are quite different from that of information science. It emphasizes not only the information processing itself but also the combination of its value application and social service. This kind of cognition has a long history. Social intelligence, which came into being in the 1970s, has further expanded the research contents of classical intelligence science with academic literature and other traditional information resources as its main research objective. It regards the intelligence process or activity that exists universally in society as an organized ability to adapt to the rapidly changing external world (Liao, 1998, pp. 1-28). The intelligence that intelligence science concerns must serve the practical needs of the society and people. Just as the international symposium on the theory and application of intelligence science research held in Copenhagen, Denmark in 1977, clearly put forward the cognitive view of intelligence science, it attaches importance to people's knowledge structure and cognitive ability in the process of intelligence utilization, emphasizes the importance of intelligence transmission system to understand and grasp the user's information needs and realize the interaction at the cognitive level rather than the physical level (Belkin, 1980, pp. 133–143).

Of course, the main motivation of informatization of intelligence science in the 1980s is that intelligence science tries to get rid of the influence of traditional library discipline. But this change directly brought the related research content and application of information science into the research field of intelligence science, even completely replacing the traditional research content of library subject, further weakens the characteristics of Intelligence Science

in another direction. The research of intelligence science is simply put on the angle of information processing and application, which weakens the content of traditional intelligence science and ignores the attention of the research and application of intelligence value in traditional intelligence science. This directly slowed down the development of intelligence science in China in the early 1990s. It is obvious that many academic journals in intelligence science have ceased publication and the number of published papers in intelligence science decreased sharply. This change reflects the urgent need for discipline development of intelligence science to keep pace with the times to a large extent. With the deepening of internationalization and the rapid development of social economy, the research methods of intelligence science should not remain at the level of information technology in the past, nor maintain the traditional service direction and field in the scope of application, nor take research methods and research technology as the discipline foundation at will. Providing support for social and national intelligence needs is the embodiment of the original intention of returning to the subject service value, which also constitutes the key content of development path design of current intelligence science.

3.4 Relationship with data science

In recent years, data science is one of the emerging disciplines closely related to intelligence science. With the continuous in-depth application of big data technology, the related research on big data management and application has gradually become the main field of intersection research between the two disciplines (Wang, 2014).

Different from the disciplines mentioned before, data science is relatively up-to-date. It is an interdisciplinary discipline with big data as its research object, and its theoretical basis mainly comes from computer science, applied mathematics, statistics, information science and other related disciplines. Data science must be combined with specific industry application fields, and there is no pure big data research. Data science research often needs to have expertise in the field or industry of big data.

Data science itself has not been established for a long time, and it has not become an independent discipline in China until now. North Carolina State University established the master's program of data analysis first in 2007, and New York University initiated the master's program of data science for the first time. There are mainly seven directions for master's degree related to big data in the world, including information system, data science, health care, business analysis, applied statistics, business intelligence and MBA big data. Many of the application fields are highly overlapped with intelligence science (Ruan *et al.*, 2017, pp. 29–36). In colleges and universities of iSchool alliance, lots of library and intelligence departments have opened the major of data science and big data technology (Zeng, 2018, pp. 109–118). At present, the two most relevant undergraduate majors in China are big data management and application and data science and big data technology. The former is under the discipline category of management science and engineering, while the latter is under computer science. Although the emphasis of the two is different, they both emphasize the use of big data technology and methods, especially the former is closely related to the data analysis and application of intelligence science.

Data science related undergraduate education in China has not been set up for a long time, and master education is mostly in the exploratory stage. The whole discipline education environment is not mature. Moreover, this major is mostly set up under the colleges of computer science, economic management and information management in China, so it might be a beneficial choice to explore the integration with intelligence science (Chen *et al.*, 2019, pp. 5-11). According to Ma Feicheng's point of view, the research object of intelligence science has experienced the change from traditional printed-paper literature to electronic information and then to knowledge. The current data science research just reflects the urgent need of the

society to discover effective knowledge from massive information resources, which is consistent with intelligence science.

However, the difference between them is also very obvious:

- (1) Data is not intelligence. Although intelligence comes from data, it is not only the original data but also not necessarily big data. It can only be said that the big data studied by data science is only a kind of information resource form under the current big data environment, while the information resource forms studied by the intelligence science are broader. Meantime, the goals of the two disciplines are not consistent. Data science focuses more on methodology and emphasizes the processing and application of data itself, which is different from the goal of intelligence science which emphasizes providing decision support and value services. Data science provides the practical basis and conditions for modern intelligence science to analyze and utilize big data resources. For example, intelligence science mainly studies literature big data, text big data and behavior big data and pays more attention to the collection and collation service of resources and has clear task orientation and established mode in data analysis. The application of big data is not only limited to the field of information analysis but also emphasizes the improvement of mining methods and the mining of new patterns.
- (2) Big data has brought opportunities for the development of intelligence science. In the current era of big data, there is a real need for the two disciplines to complement each other (Su, 2018, pp. 451–459).

First of all, big data analysis is the most important application direction of big data technology, which mainly realizes the process of identifying hidden patterns, unknown correlation relations and other useful information to help decision-making from massive data (Wang, 2016, pp. 52–56). Like intelligence science, they both take information and data as basic resources and research objects. Big data provides intelligence science with the ability to analyze massive heterogeneous data, especially in knowledge mapping and social network. Intelligence science has the characteristics of data science, and big data related technology can provide new and effective means for intelligence science. The integration of intelligence science and data science can further enhance the advanced nature of the existing intelligence science research methods and enhance modern intelligence analysis technology and capabilities.

Second, data science can seek the goal orientation of application value by combining intelligence science. In fact, intelligence agencies are also important members of the big data industry, and the existing analysis methods and theories of intelligence science can also provide more valuable application direction for big data analysis. For example, using citation analysis of medical literature to discover the hidden relationship between drugs and diseases (Song *et al.*, 2018, pp. 1355–1368) and using the knowledge map of character association to support the public security information decision-making (Feng, 2016).

Some scholars proposed to establish the major of data science and big data technology or big data management and application with the orientation of intelligence science, both of which can cultivate compound practitioners with big data thinking, solid professional foundation of intelligence science, master big data processing technology and analysis theory and be able to apply it to intelligence science theory and practice. The blending value of the two is that intelligence science can provide basic research methods and application service orientation for big data, while big data injects new methods and technologies into modern intelligence science research and application, and then the research efficiency and effect can be greatly improved. The specific curriculum design can include emerging courses closely combined with big data and intelligence science, such as literature big data analysis, research of user big data, etc.

From the perspective of job market, the social requirement for practitioners of intelligence science has gradually put forward the requirements of data science and big data technology related skills in recent years. For example, Guangdong Suding Technology company requires the ability of data analysis in the recruitment of information analysis personnel (yingjiesheng.com, 2016a). In recruiting operation and maintenance specialists, Changsha Library also emphasizes that candidates should have strong big data analysis ability and good qualitative analysis ability (yingjiesheng.com, 2016b).

Data science will become an important content and field direction of modern intelligence science research under the condition of clear research object and research goal.

3.5 Relationship with management science

This problem can be also regarded as why intelligence science can be and has been classified as management science. Because intelligence science faces the needs of social application, it has a great research intersection with management science in many aspects, such as information management (He *et al.*, 2003, pp. 14–17, 29).

As a large discipline, management science is also a comprehensive interdisciplinary, which mainly studies the basic laws and general methods of various management activities. From the perspective of management, library science is a discipline engaged in literature management research, information management is a discipline engaged in information management research and data science is a discipline engaged in big data management research. Intelligence science can be seen as a research discipline engaged in intelligence management. Of course, it is undeniable that the main reasons for the close relationship between intelligence science and management science today are not only totally from the relevance of the subject research content and method, but also some historical reasons. Especially in the 1980s, the information-management-oriented transformation of Intelligence Science has further accelerated the integration of the two disciplines. After analyzing the research contents of information management from the perspective of management in 2003, some scholars think that the main contents of integration include enterprise strategy in the theory of information technology and enterprise management, business process re-engineering, organizational change, information system management and enterprise culture. These are the research contents related to information management and enterprise management, which are not very close to the original research content of intelligence science (He and Lou, 2003, pp. 14–17, 29).

Some scholars analyzed the co-word matrix by multivariate statistical analysis method and found that there are two research domains in intelligence science in China: management science based on knowledge, library and information science based on information. Some scholars have found that there is a relationship between library and intelligence science and management science through the research on specific research topics such as e-commerce. Some scholars even proposed that the information economics related research in the field of library and intelligence science can promote the interdisciplinary and integration of library science and intelligence science (Xiao, 2009, pp. 2-9). In the specific quantitative research, some scholars use the citation relationship analysis of 23 discipline journal papers from 2008 to 2010 and find that there is a close relationship between management science and library and intelligence science (Sun and Tian, 2013, pp. 227–232).

According to the core journal papers of library and intelligence science and management science from 1994 to 2014, by using the methods of high frequency co-occurrence keywords, interdisciplinary knowledge map and discipline correlation coefficient, some scholars have found that the research topics of knowledge management, information service and technological innovation are the hot spots of library and intelligence science and management science, and visualization and citation analysis are the common research methods of library and intelligence science and management science. At the same time, they

found that the research content of management science lies in the connection between library and intelligence science and economics. There is also a tendency to strengthen the relationship between management science and library and intelligence science, which indicates that management science plays a bridge and intermediary role in the knowledge exchange between these two disciplines (Xie *et al.*, 2017, pp. 83–90, 120). Based on the data of international papers on library and intelligence science in China from 1998 to 2016, some scholars found that the most closely related discipline of international achievements of library and intelligence science in China is management science.

3.6 Relationship with other disciplines

Intelligence science also has a close relationship with other disciplines, which is inseparable from the wide application of intelligence science in many fields. For example, the contents of interdisciplinary intelligence science such as geographic intelligence, bio-informatics and medical informatics are added to the CIP-2010, which are scattered in different catalogs of discipline.

The situation in China is similar. The early application combination of intelligence science in China is in the field of public security. In the report of the 20th National Public Security Conference in 2003, it was pointed out that intelligence and information collection, research and judgment should be strengthened in public security work. In 2005, the People's Public Security University of China established the department of public security intelligence science, which specializes in the research of public security intelligence science and the training of public security intelligence practitioners. In 2011, the first level discipline of public security science was added under the category of law, and public security intelligence science was officially listed as a second level discipline (Peng, 2017, pp. 52–65). Public security intelligence science is a characteristic intelligence science discipline formed by the combination of intelligence science theory and police intelligence work practice. It mainly serves to guide and solve practical problems of public security intelligence work, and its research content mainly focuses on intelligence-led policing such as criminal intelligence science and criminal investigation intelligence science, which mainly focus on the process of public security intelligence activities and highlight the particularity of public security intelligence work. Public security intelligence science essentially belongs to the category of applied intelligence science and has become an independent specialty of public security science today (Code: 030511s).

In the field of medicine science in China, the application combination of intelligence science is also very common (Zhao, 2019, pp. 185–187, 191) (Zhong and Hu, 2015, pp. 71–75). It is mainly manifested in the combination of literature retrieval and information processing. These methods also constitute an important part of medical informatics and evidence-based medicine research. It can even be reflected by some journal names like Chinese Journal of Medical Library and Information in which the meaning of information is actually intelligence.

Generally speaking, the combination with these other disciplines often focuses on the application of intelligence science technology and methods, such as literature retrieval, information retrieval and information processing, which provides a basic method for the research and application of these disciplines.

4. Construction of research system of intelligence science

The discipline development of intelligence science and its wide integration with other disciplines lead to the different emphasis of research system in different periods in the historical development of intelligence science. The exploration of the theoretical problems of intelligence science is to better distinguish the differences between intelligence science and other disciplines, seek the accurate positioning of the discipline, improve the discipline system construction and promote the healthy development of intelligence science (Li *et al.*, 2012, pp. 30–35). It is necessary to reorganize and design the discipline research system of

intelligence science which meets the social requirement in this new era and strengthen intelligence science in more application scenarios.

First, the research of intelligence science should stick to its own characteristics. In fact, discipline is the product of specialization and refinement of theoretical knowledge, and theoretical system in turn can maintain the stability and specificity of the discipline. Only when the theoretical system of discipline studies firmly maintain the boundaries of disciplines and strictly distinguishing different theoretical systems, can the independence of disciplines be ensured. In the design of discipline research system, the attribute characteristics of our own discipline should be adhere to, not deliberately cater to some new hot spots and arbitrarily transform our theoretical system and retain the characteristics of multi-disciplinary research, dare to accept the penetration and integration of multi-disciplinary and emphasize the enrichment of subject research content. This can be seen as the dialectical unity of change and no change in the study of discipline theoretical system.

Second, intelligence science research should keep discipline open and constantly draw on the necessary theoretical knowledge of other disciplines. It can be seen that the discipline itself is also in continuous integration and development, and even many of the newer disciplines are the product of cross integration after the highly differentiated development of knowledge (Bai, 2010, pp. 49–51). Only when achieving a broad understanding of the application of the latest information technology in the field of intelligence science, exploring the new changes of existing theories and methods and summarizing and extracting the intelligence science research contents used in different fields and application scenarios, can the characteristics and positioning of intelligence science be better identified (Zhang, 2019, pp. 1). In fact, the existing discipline system of intelligence science is not only complex in content but also far behind the actual development of intelligence science research. For example, just like the research of the whole intelligence science, the research on the history of intelligence science started late and later than the study of other theoretical basis and basic theory of intelligence science (Qiu, 2001, pp. 79–82, 113).

5. Reorientation of research content of intelligence science

Some scholars put forward ten basic principles of intelligence science on the basis of summarizing previous studies such as discrete distribution principle, minimum effort principle and so on (Liang, 2007, pp. 3-7) (Ma, 2007, pp. 3-13) and try to build a complete discipline system of intelligence science (Zhang and Liang, 2008, pp. 1-54). However, many studies also show that some theoretical achievements in intelligence science research are not universal, lack of follow-up research and have not been effectively inherited and developed. At the same time, most of the theories of intelligence science have low exclusive degree; the proportion of unique theories is relatively few and the application still need to be further promoted. The vast majority of theories in current intelligence science are also applied in other disciplines, and the highly-frequent theory of intelligence science is also frequently used by other disciplines. This problem of theoretical deficiency in intelligence science research also exists in many countries so that some scholars believe that all attempts to build a grand intelligence science theory have failed (Laqueur, 1993, p. 113). Some scholars think that intelligence science lacks fundamental theory, and most of its researches have a practical attribute and lack more scientific analysis and generalization (Hjorland, 1998, pp. 606–621). Even in the 21st century, the American Intelligence Science community is still discussing whether to establish a general theory of intelligence or an American theoretical system of intelligence science.

5.1 Research content design based on decision requirement

On the whole, the change of intelligence science research content is not only reflected in the renewal of traditional research content but also in the expansion and creation of research content. For example, in terms of bibliometrics, the traditional analysis emphasizes the

analysis of discipline in certain types of databases. However, if extending these data to all relevant data in the network environment under the internet environment, new research methods and research findings will be produced. Another example is the issue of personal privacy protection. In the era of big data, the necessity and feasibility of relevant research have been greatly improved, and the research on relevant information policies, laws and regulations and social ethics has formed a new research direction, which also constitutes a new field of cross-border cooperation between modern intelligence science and other disciplines (Liu, 2015, pp. 2-4).

It can be considered that intelligence science has the characteristics of cross-sectional discipline. The cross-sectional discipline refers to that its research scope is not limited to a certain field and direction but often involves the common aspects of many disciplines. It also reflects that early people thought that the discipline of intelligence science had the characteristics of both social science and natural science. Science and technology intelligence science, military intelligence science, security intelligence science, economic intelligence science, medical intelligence science and agricultural intelligence science can be regarded as the application combination of intelligence science in different disciplines (Zhang and Li, 2020, pp. 5-13). The main reason is that many natural and even social disciplines have begun to strengthen quantitative research supported by data, showing the characteristics of data intensive and data-driven research. But data processing and analysis often need more professional and specialized learning, and the degree of data processing and analysis obviously greatly affects the final processing effect. The task of data processing and analysis faced by different subjects is not only data processing and analysis; otherwise, these will become the focus of statistics and computer science, which are specialized in data processing and analysis. On the contrary, they need to combine data processing tasks with related social, economic, political and national level strategic management issues, with mission objectives and practical application as the ultimate value. This constitutes the research content of intelligence science. From the early paper-based literature to electronic information and then to web information, intelligence science has been committed to filling the gap between different disciplines in data processing and application. In the era of big data, this situation is becoming more and more common with the continuous strengthening of the application of big data resources. It can be understood that big data also objectively urges modern intelligence science to carry out big data transformation to deeply combine the practical needs and application characteristics of contemporary discipline research.

Of course, not all data processing and analysis tasks are related to intelligence science. In a broad sense, data processing and analysis tasks should be more closely related to data science and information science. In the early development process of intelligence science, it also shows the characteristics of focusing on this application combination, but this will lead to the weakening of the characteristics of intelligence science. Intelligence science which faces the decision support of social commercial market and the strategic decision support of national level is a kind of modern intelligence science driven by decision-making requirement.

5.2 Research content design oriented by national strategic service

Intelligence science has regional characteristic, and intelligence science research often integrate regional characteristics according to the strategic service objectives in different countries. For example, Mikhainov, an intelligence scientist of the former Soviet Union, emphasized in his book *Scientific Exchange and Intelligence Science* that intelligence science research mainly involves intelligence collection, intelligence organization and management and intelligence dissemination, especially the informal intelligence exchange with scientists as the main body, which does not change the content of communication and only optimizes the channel system and takes the establishment of a perfect national intelligence resource communication system as the core goal. In contrast, the US Intelligence Science research emphasizes the participation

of specific research practice, the influence and support on scientific decision-making and scientific research, the organization, retrieval and utilization of intelligence at the technical level. At the same time, a large number of intelligence agencies, such as Rand Corporation, have been formed aimed at the service of national security strategy. Intellectual products and intellectual activities driven by them have also been greatly utilized. Japan is similar to US, but it places more emphasis on intelligence services in the business field, especially in the field of electronics, emerging science and technology industries. As a result, Japan quickly surpassed the developed capitalist countries at that time (Wang, 2012, pp. 4-9).

In fact, after the founding of the People's Republic of China, the science and technology intelligence industry once played the key role of practical participation and decision support of intelligence science. But since the 1980s, marked by the renaming of intelligence science, the extensive social informatization brought about by information economy and knowledge economy needs technical management practitioners of information management, and the research of intelligence science in China has begun to undergo great differentiation. At this time, China also timely opened up the management and application of scientific and technological intelligence work, canceled many of the original policy support and financial inclination to intelligence science research and allowed these relevant service agencies to freely provide more service suitable for social requirement. As a result, the orientation of intelligence science tends to be diversified, especially affected by the realistic demand from the development of market economy. Information management and digital library resources have gradually gained more attention. Due to the lack of a unified goal and excessive catering to the needs of the social market, the construction of related disciplines and specialties is very scattered, and there is a lack of integrated design and planning. Intelligence science has the attribute of social science, so that the biggest difference between intelligence science and other disciplines of natural science is that it cannot be studied separately. To explore the research content and development orientation of modern intelligence Science in China, it is necessary to condense the scattered subject research content and adhere to local practice, which is also one of the key methods to form a research system of intelligence science with Chinese characteristics.

For example, since the intelligence agencies are mainly government agencies, scientific research institutes and enterprises, they can provide three types of services, namely, intelligence support service for strategic decision-making, information and knowledge services and consulting services (Hua, 2012, p. 1). Some scholars believe that Intelligence Science in China can walk out of the Third Road with Chinese characteristics on the basis of integrating the research advantages of information, knowledge and intelligence, so as to distinguish the new information science model with emphasis on intelligence technology in US and the European model characterized by literature research (Lv and Li, 2007, pp. 20–28). On the basis of the orientation and reconstruction of the intelligence science discipline system and theoretical system, which serves the decision-making function, it can promote intelligence science from simple information processing and information development to deep mining of intelligence services for intelligence and decision-making. It will be the main way for the development and characteristic construction of intelligence science. Some scholars have proposed that in addition to the existing three research paradigms of intelligence science in China, namely, the research paradigm of soft science based on intelligence, the research paradigm of library information science based on information and the management science research paradigm based on information and knowledge management framework, there should also be research directions based on intelligence and decision-making ability including research on related topics such as public security intelligence, military intelligence, economic intelligence, political intelligence, business intelligence, competitive intelligence, interpersonal intelligence network, social intelligence network, early warning network of national defense intelligence, intelligent information processing and decision support information system.

Based on the existing research consensus, intelligence science can form the most characteristic development trend in two aspects. The first is to face the social enterprise departments and form the research contents such as enterprise intelligence science, intelligence consultation, economic intelligence science and intelligence behavior science. The second is to form the research contents of military intelligence science and public security intelligence science facing the national security departments. All these constitute the research direction of intelligence science which is worthy of further development in the new era and construct the research objectives including the national level of discipline research and the social level of research separately.

The research scope and application fields of the corresponding intelligence discipline are also gradually expanding and finally show two development characteristics, which can be summarized as up-and-down. The so-called up means that intelligence discipline begins to return to national security services, focusing on serving national intelligence exchange and scientific and technological development cooperation externally, while focusing on serving national security governance and other fields in national management. Although the development of intelligence science has brought some adverse effects, the state's attention to intelligence services has not been reduced but also has undergone far-reaching and huge changes, such as the level of national requirement for decision-making, the level of people's livelihood and the level of social development requirement. The so-called down means that the intelligence discipline has begun to move toward the economic application extensively. Especially with the continuous in-depth development of reform and opening up in China, the rapid growth of social economy has led enterprises to gradually pay attention to the collection and utilization of market competitive intelligence, and the commercial value of intelligence research has begun to appear.

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