An approach to the newly developed informatics: exceeding the traditional information theories

Ke Li,　Jing-Ping Ouyang

Medical college, Wuhan University, Hubei, Wuhan, China. 430071　likekeli@msn.com

Abstract: The author considered that ''To the newly developed informatics'' prompted by Wolfgang Hofkirchner include three tasks: developing the theoretical informatics, perfecting the framework of informatics, and implement the worldview and the methodology of informatics.　And the exceeding of the traditional information theories is the priority.　So, in this paper, we discussed how to exceed the traditional information theories from six aspects: improving Shannon's communication theory, perfecting Wiener's Concept of "Information", supplementing Turing's "Computing Model", generalizing human ''intelligence'', analyzing the theory of triple factors (substance, energy and information) of the cosmic constitution, and decoding the Mind-body problem of Descartes.

Key words: information science, theoretical informatics, the worldview of informatics

"To the newly developed informatics", promoted by Wolfgang Hofkirchner, is the task for all the scientists working in the basic theories of information science in 21st century. We think three steps are needed to establish the new informatics, which is developing the theoretical informatics, perfecting the framework of informatics, and implement the worldview and the methodology of informatics. And the developing the theoretical informatics is the primary task, because it's the solid foundation of the whole informatics framework, and provide the theoretical support for the worldview and the methodology of informatics.

Traditional information sciences is mainly composed of the communicational science, control science, and computer science based on Shannon's communication theory, perfecting Wiener's Concept of "Information", supplementing Turing's "Computing Model", and the field-informatics which implementing the techniques from these sciences to other fields, like, bio-informatics, medical informatics, language informatics, and etc. Because of the technique and engineering properties of the tool informatics and domain informatics, and their tight connection with the products and the markets, many scholars think there is no information science, but informational technique. And currently if all the informational techniques and application has been taken away, the information science will be empty. The traditional information science, especially Claude E. Shannon's "*A Mathematical Theory of Communication*", is accepted by the traditional material science, and is in conformity with the world view and methodology of material science.

To establish the theoretical informatics will give all the application of the informatics a common theoretical foundation. Theoretical informatics will support the frame of the information science, and provide the explanation and illustration to the world view and methodology of information. After this, information science has its own theory, and the new informatics will be developed and perfected based on the information philosophy.

1. Improving Shannon's Communication Theory

In mid-20th century, Shannon published his famous article, *"A Mathematical Theory of Communication"*. At the same time, Wiener proposed control theory, and John von Neumann established the stored-program computer model based on Turing's calculation theory. However, in a long period, the computers and the control technology have remained in the ivory tower, and keeps by the military. The public can only access the telecommunication technology and the corresponding products. Nevertheless, the publics amazed by the accomplishment of the information technology, and acclaimed that Shannon build the "information theory". This also led to the misunderstanding that the information science is just about the communication.

Another misunderstanding is that the publics considered Shannon found the whole information theory, although Shannon had never declared it. Strictly speaking, Shannon's great contribution is the "Communication theory", and it's still far from the

"information theory", or the essence of the information. This is because that the information is a non-material existence and is the meaning of its carrier. To study the information without its meaning is just to analyze the existence and the motion course of the carriers. In such circumstance, it has no difference from the subjects studied in Physics, and can be study by the mathematical-physical methods which is easily accepted by the scientists. The real existence and the process of information is abstract, which need to be studied by the logistic-programming approach. Professor Zongrong Li has already made big progress in this area. By improving Shannon's academic standpoints and methods and developing Shannon's ideological line, Prof. Li propounded to establish the framework of the information science, especially the approaches of the fundamental research in the information science.

To explain that Shannon's "communication theory" is different from the "information theory" is extremely important for the development and promulgation of information science. Many scientists regarded the Shannon's "communication theory" as "information theory", because of the superficially interpretation and preconceptions of the words. Even more, they also could not accept that the Turing and von Neumann's computing model as a part of the information science. The two misunderstanding led them to conclude that information model is just communication model, and the essence of the information process can be reached by analyzing the source-channel-receiver paradigm model. So it's difficult to break the frame of "the three old methodologies", the systematic theory, information theory, and cybernetics, in the discussion of the phenomena in social information. Instead of entering the "information theory" level, staying at the level of the "communication theory" is a major obstacle to the process of "informationzation" in humanities and social science.

2. Perfecting Wiener's Concept of "Information"

Norbert Wiener's formula, "information is information, not matter or energy" became more and more popular all around the world. The materialism also accepted it. The scientists' community and the whole society have gradually accepted the Trialism (matter energy and information) after long-time believing of Dualism (matter and energy). This is a remarkable achievement that human's worldview and methodology have a great step toward the upcoming Information Age. However, there still have two issues, which we need manage to overcome them.

One is Wiener's information theory is still in the theoretical framework of Physicalism. As the 1st generation of information scientists bred by the traditional material science, Wiener has the inclination of scientism. Although he found that the information is a challenge to the materialism, but his worldview is still far from the "informationism". So, from the ontological point of view, Wiener's theory hardly inspired people to recognize the information has the same position as "matter" does; and from the epistemology point of view, it was hardly to exceed the reflection theory of materialism. The other is that the trialism has a wrong hypothesis: the physics energy cause the evolution of information.

Based on this, few experts excellently explain the universe by the trialism: the matter forms the shapes of everything, the energy provides the power for motion, and information takes the role of control.   Anyway, there is not other type of energy except the energy of physics.   According to this theory, the effects of the physics, chemical, and biological energy are regarded as the power of the evolution, like the increase of the DNA from prokaryotes to eukaryotes, from the simpler lives to the most complicated one; the emergence of the human culture and intelligence. One basic fact, which is that an abstract, logic, and non-physics energy existed and accompanied with information, was denied by this theory. Thus to explore the mechanism of information evolution also becomes un-necessary.

T. Stonier, the American information physicist, thinks the information energy and physics energy can transform into each other, and generates a formula for them.   We can say in Europe and North America, there is no progress in the basic research of information science since 1996.   And with the time passed by, more and more scientists doubted the possibilities to establish the concept of general Information and the theory of Information. The main reason is that these scientists were limited by the Shannon's theory and Wiener's conception.   To a certain extent, Shannon's communication theory and Wiener's concept of information are interlinked, with different viewpoints and just one different character in the mathematical expression.   We should be alerted that lots of the information scientists were lost in the field of the theoretical physics, when the "Information Entropy" was introduced into basic information research.

3. Supplementing of Turing machine model

Turing machine model is the theoretical basis and methodological principle for the whole community of computer science.   It may not be transcended in the field of the symbolic computation.   But Turing machine model is simply an abstract of symbolic thought, and it needs the supplement from the "signal thinking".   We need keep in mind that when man could not think by only the symbolic thought without "signal thinking".   Animals have no symbolic thought, but they are thinking, like when hunting, the animals are calculating and planning. The thinking-model of pre-school children is really typically signal one.   In fact, to invent the words and the logics, human being has to rely on the "signal thinking". Scientists feel that originality often comes from the "signal thinking", like inspiration, intuition, insight, and so on, even the invention and discover still rely on the scientific reasoning and logistic thought.   Without the help of "signal thinking", how could we uncover the nature of the creative thinking by the symbolic and reasoning thought, which are the main methods used in the science?

Experts tell that one of the differences between human brain and computer is that human brain could not be "turn off" or "re-start up", like computer does.   But in the sleep status, the symbolic thought in brain is stopped, while the "signal thinking" is still working. Because of been squeezed by the symbolic thinking in the waken time, the "signal thinking" works even harder in the sleeping time.   And un-reasonable, un-logical dreams

occur one after another.   Since the "signal thinking" has its own logic, there should be some kind of rational in it.   Otherwise, how does the "signal thinking" could invent words, signal, and rationale?   Therefore, the fact that people get inventions and discoveries from inspirations and intuitions is conformity with its logic. This logic is not symbolic logic, it's "signal logic".   The proverb, "things that thinking in the day time, will goes into one's night dream", is the first acceptable example which can be explained by using "signal logic". Unfortunately, the study and understanding on "signal logic" is still less.

Some scholars generalized the concept of "computing", and proposed the "computes", which means that all processes in the universe are a way of "computing".   Its make sense, but also it needs to beyond the Turing machine model, or to say it a supplement to the symbolic computing model.   Since the computing of the "Computism" is generalized, it covers the arithmetic in the primary school, the infinitesimal calculus in university mathematics, and the symbolic computing in program design; and should also cover the DNA computing, the computing happens in the animal brain, the computing in a "analogue computer", and etc..   Of course, we know little about the mechanisms of the computing of "signal logic". And this will be a huge challenge to the information scientists.

4. Beyond the human "intelligence"

Professor Zong-Rong Li proposed the concept "info-energy".   But some experts say that the so called "info-energy" does not exist.   Some regard the "info-energy" as the ability to process information; and the generalized intelligence is info-energy. They think that machines have "artificial intelligence", animals have "low-level intelligence", plants and bacteria have "original intelligence", DNA has "intelligence" in molecular level, Sun and Moon have "intelligence" in inorganic level, and etc... Since there is the concept of "intelligence", the "info-energy" is not necessary.   T. Stonier, American information physicist has prompted the "intelligence spectrum of the Universe", which shows an evolutional chain of the information processing capability. In his theory, the intelligence of the inorganic approach "0", and the intelligence of the human defined as "1".   Thus all other species are falling into "0" and "1". Professor Yi-Xin Zhong, a Chinese scientist, also emphasized that intelligence in the world forms a continuously band.

As mentioned above, the Physicalism doesn't reject the concept of Intelligence. Intelligence is a capability, especially the information processing capability of human. But Physicists also said that Intelligence is essentially a bio-energy, a chemical energy, and a physical energy.   In other words, just as all the existence can be reduced to material existence; all forms of energy can be reduced to physics energy.   Since the human intelligence and the artificial intelligence of the computer are only the specific, advanced form of the physical energy, it's unnecessary or impossible to explore the unique mechanisms in the information evolution.   So, the concept of "intelligence" has its "inborn weakness": it has no status in the sense of ontology, no need of the exploring in the sense of epistemology.

Professor Zong-Rong Li's info-energy has totally different background and environments. Firstly, the info-energy is a generalized conception, it's "the energy of the information", or "the information processing ability" in the Universe. Secondly, all the info-energy, from the lowest level to human intelligence, is a kind of "fact", which reflects the history development of the Nature and human society. The generalization of intelligence is an idea, which also a historical recall that exists in human's reflection. The "fact" is the same, but the reflection will vary for individuals. Thirdly, Professor Li proposed that everything in the Universe has duality, the matter and the information, which gives the information an ontological standpoint. He believes the Universe is a unity of the matter and physical energy, and also a unity of information and info-energy. We explain the material Science by the motion law, and the downward trends of the universe by the second law of thermodynamics. Similarly, we analyze the mechanism of the information evolution by the information science and the rules of the Universe evolution by the second law of informatics. Fourthly, Professor Li said "all matter is indestructible, and the physical energy is conservative. But information is not conservative, and info-energy increase with times". Thus numbers of issues need to be answered by the informatics scientists: why and how is information not conservative? Why and how the info-energy can grow? And so on. Of cause, the philosophers have lots of questions to answer.

5. Upgrading from Trialism to the Quartism

After recognizing that there are some relationship and difference between the "info-energy" and "intelligence", understanding that the info-energy has unique characters which intelligence does have, and accepting that the dualism (matter-information) exist for the Universe, the Trialism (matter, energy and information) will inevitably replaced by the quartism (matter, physical energy, information, info-energy). Taking a vertical look at the history, we can find that the monism (matter) was substituted by the dualism (matter, and energy) happened in the period of the maturation of the physics; and it takes about half century to enter trialism (matter, energy and information). So we supposed that to accept info-energy and to enter quartism may take comparably much little time.

The acceptance of trialism was driven by the information technology, and doesn't involve the development of new philosophical idea. To accept the quartism, we need not only advance the scientific paradigm, but also accept the new system of the information philosophy. Obviously, it is very difficult. Since the reform in China, we have seen the remarkable progress of socio-economy and politics, but no big advance in philosophy. In North America and Europe, the development of the informatics is also restrained by the influence of Scientism. In the past, when speaking about "Science", the first thinking is about the "physics", which is a standard science and is armed with experimental equipments and mathematical methods. For centuries, many experts in humanity and social sciences established their own "Science" according to the model of physics. But at this condition, it's hard to have breakthrough, because the phenomena in humanity and Social sciences are informational rather than physical. We hope the establishment and dissemination of theoretical informatics could provide humanists and social scientists with

the support of scientific worldview and methodology, and help them catch up with the times.

If we recognize that physics is a form of science, but not the only scientific form, if we admit that in addition to material science there maybe a science of information phenomena and it is possible to establish a immaterial science, then we must accept the shift of "science paradigm", which means that the scientific mainstream in our age is a group of information disciplines.　Once information science mature, then the scientific status of humanities and social sciences will be self-evident. In a certain sense, the humanities and social sciences are the knowledge systems about social information and social information processing capacity, so they may be called Social Information Science. In December 2006, under the leadership of Professor Kang Ouyang, vice president of Huazhong University of Science and Technology, China's first "Social Information Science Center" has been set up, which includes a very far-sightedness.　Their basic belief is that a new discipline, social information science, will be established on the basis of theoretical informatics.

6. Solving Descartes' Mind-Body Dualism

In the exploring the source of modern worldview, R. Tanas, a historian of Western thought, said: "A polarization, which makes problems and is much effective, promotes an emergence of understanding the reality in the Western world, which draws a faithful boundary for two kinds of distinct worldview: one is an extremely orderly universe; the other is an opening and unpredictable universe."　According to Plato, the orderly universe is full of concrete things and we observe it with our eyes; and the opening universe is full of abstract things (ideas), we see them by our thinking.　The general things (Form) exist in particular things.　This theory makes scientific knowledge possible, because it is obvious that scientists "never mind" actually special things, but deal with general nature of the things, i.e., the "rules."　However, Plato gave us an unfortunate impression: "There are two different worlds, but the relationship of them is difficult to find."

With the inheritance and development of Plato's tradition, Descartes calls two different realities respectively "extensive thing" and "thinking thing".　They have different properties: thinking thing is not extended, and extensive thing can not think.　People's body and mind are completely different, diametrically opposed, and absolutely separated entities.　They are completely not dependent on each other. Descartes believes that the function of the human body can be completely attributed to the physics and our body is entirely driven by purely mechanical forces.　The function of the human mind is feeling and imagination, driven by a spiritual force.　Thus a man can think: suspect, understand, approve, deny, wish, refuse, etc.　Therefore, he said, people may be promoted by two principles, material or spiritual.　In order to explaining the impact on person's activities by the human will, he said, "man's soul has its own place in his brain ", i.e., in pineal gland, with which the soul has its interaction with the body.　However, since there is an interaction between mind and body, they must get in touch with one another.　Thus, the

mind must be "extensive", and has its size and weight. This is the so-called "Mind-Body Problem".

The essence of mind-body problem lies in: (1) "Mind" is abstract, then how does it "exist", and how to contact with the body?   (2) Mind, which is not concrete, immaterial, and without any physical energy, how can it affect the body?   The answer, given by Professor Zong-Rong Li, is very simple: psychological functions are a kind of bio-information phenomena, which obey to the relation model and interaction principles between matter and information: First, there is no information which is absolutely separated from the matter, and information is always dependent on its material "carrier"; Second, the information carrier has itself physical energy, and info-energy takes physics energy as its "loading"; and Third, information contacts matter with its carrier, and information controls matter with its loading.   Mind, which has abstract meaning, locates at people's neural networks in brain and takes flesh and blood as its carrier.   And the carrier's biological energy can be converted, amplified gradually, and effect on the muscle for controlling body's movement.   On the basis of solving mind-body problem with theoretical informatics, professor Zong-Rong Li points out that the function of mind is at both levels, symbol and signal, i.e., each part of our body is thinking in different level.   "Mind" and "body" are not only opposite but also united.   Thus a way for the integration of material and information theories and for establishment of a "unified science" is opened.

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About the Author

Ke Li is a lecturer at the Department of Pathophysiology at Wuhan University in Hubei, China. He holds a Master's degree in Clinical Medicine from Wuhan University in 2002, and is preparing for his Ph.D. degree. His academic work deals with the basic research of the cardiovascular disease. He was interested in the information science since 2000, and

shared his professional knowledge with other information scientist and worked on the informatics. (likekeli@msn.com)