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A Computational Interpretation of Intentionality

Li Quanmin

In contemporary philosophy of mind and cognitive science, intentionality is one of the central concepts that attract scholars' attention and constantly arouse controversies. Intuitively, intentionality refers to "aboutness" of a mental state or process, which means that mental content is about or representative of something. Obviously, our daily beliefs, desires and intentions are about something, and hence have intentionality indeed. Many philosophers believe that intentionality is the mark of most or even all mental states. If intentionality does exist, cognitive science, which devotes itself to interpreting mental phenomenon, must scientifically explain this feature of a mental state.

Cognitive computationalism has been, and still remains as, the mainstream in cognitive science (Piccinini, 515). According to mental computational theory, a mental state is computation-oriented in essence. Therefore, intentionality should be scientifically or physically interpreted from the perspective of computation. However, much argumentation seems to have proven that such an interpretation is impossible or unsuccessful. In fact, the inability to interpret intentionality has been always regarded as the main reason for discarding cognitive computationalism. However, though cognitive computationalism has been constantly subject to criticism from different perspectives since its emergence, the paradigm to apply computational theory to interpret the world goes beyond cognitive science and successfully extends to the frontiers in physics, life science and social sciences. Accordingly, people's understanding of the concept of computation has become more comprehensive and profound. Then we will naturally ask: Is the concept of computation applied in the argumentation against cognitive computationalism too narrow to properly grasp the essence of physical computation, which leads to the inability to apply computational theory to interpret intentionality? For me, the answer is yes. This paper tries to offer a physical interpretation to intentionality and bring forth new argumentation for

cognitive computationalism on the basis of a new interpretation of computation in philosophy of mind and cognitive science.

I. Intentionality

Although it was originally a technical term in philosophy, intentionality now has been widely applied in such domains as cognitive science, mental science and artificial intelligence and become one of the basic concepts for depicting a mental state. Etymologically, the term “intentionality” comes from Latin “interndere” (to aim at) in the Middle Age. According to the textual research of some scholars, St. Thomas Aquinas first introduced this concept to realize the Christianization of the biological theory in Aristotle (Freeman, 208 – 212). Yet, its history as a philosophical terminology may be traced back to Franz Brentano in the end of the 19th century, although it wasn’t used by Brentano himself.

In his *Psychology from an Empirical Standpoint*, Brentano firmly believes that the distinction between a mental state and a physical state lies in the fact that the former is characterized by pointing at certain object. In other words, an intentional mental state is object-oriented. Here the “object” doesn’t necessarily refer to real existence (Brentano, 68). In his argumentation of intentionality, two important connected views have aroused heated debates: first, there are no physical states or phenomena that have intentionality; second, only and all mental states have intentionality, namely, intentionality is the mark of a mental phenomenon (Crane, 229 – 233).

First of all, let’s analyze the philosophical controversy triggered by intentionality from the second view. The debate centers around two respects. First, do all mental states have intentionality? Obviously, our belief is about the world’s state and process. For example, “The earth goes around the sun” is our belief on the earth’s state. So belief has intentionality. Similarly, if we have a desire for protecting the eco-system of our earth, it concerns about the earth. So our desire also has intentionality. Therefore, intentionality is a basic feature of such mental states as beliefs and desires. In addition to beliefs and desires, which obviously contain something, we also have such mental states as bodily sensations and emotions, just like pain and anxiety, which seem to be about nothing. Therefore, some philosophers hold that only the mental states with content possess intentionality (Searle, 1983: 1). If this is true, Brentano’s second view would be incorrect.

Secondly, is it true that only mental states have intentionality? The content of

pictures, writing characters and computers is all about or represents certain objects, yet they do not belong to a mental state. They would have intentionality if “aboutness” were the proper depiction of the concept of intentionality. Yet it is not difficult for us to address this problem. That pictures and writing characters seem to be able to represent other matters is due to the third party rather than themselves: People not only create them, but also endow them with meanings. In other words, if they had intentionality, such intentionality only derives from people’s intentionality. Therefore, some scholars suggest to divide intentionality into two varieties, intrinsic (or original) and derived. Further, the former is the intrinsic property of the mentality of people (perhaps other creatures), but an artificial system (such as a computer program) or a symbol only possesses the latter (Seale, 27).

These two aspects make us believe that some of people’s mental states have intentionality and derived intentionality can be interpreted by people’s intentionality. If we associate this conclusion with the first view of Brentano, an inquiry will arise on the source of mental intentionality. Supposing that a physical phenomenon is short of intentionality that a mental phenomenon bears, and that intentionality is a real phenomenon, where does intentionality come from? An easy answer will be that intrinsic intentionality, as a basic property of real world, is self-independent and not derived from other properties. That means the existence of two kinds of basic properties that are independent of each other in the world where we live, namely, physical properties and intentional ones. However, such metaphysics of property dualism is evidently contradictory to the physical closeness of the real world and also incompatible with the achievements of modern science. To avoid the conflict with modern science, we should acquire a physical interpretation to the origin of intentionality. Jerry A. Fodor claims: “If semantics and intentionality are real properties of things, it must be in virtue of their identity with (or maybe of their supervenience on?) properties that are themselves neither intentional nor semantic. If aboutness is real, it must be really something else.” (Fodor, 97) Therefore, the core issue in understanding intentionality lies in why things that are originally not mental can have intentional mental states.

II. Approaches to Interpret Intentionality

Most of contemporary philosophers and scientists of cognition hold that intentionality can certainly be “naturalized” or reduced to something in physical state, since intentionality is real and only physical properties are primary and unreducible ones of

the things in the real world.

Following this naturalist approach, philosophers have made much exploration. An early and influential approach is the cause-effect covariant hypothesis based on a concept of information. This hypothesis holds that if the state of one thing shares a cause-effect covariant relationship with certain physical state of another thing in environment, then this thing carries some information of the concerned object and consequently results in intentionality (Stampe, 42 – 45; Dreske, 56 – 77). For example, if a willow outside the window arouses my belief state with the content that “There is a willow outside the window”, then this state carries the information of the tree so that it bears intentionality (about the willow outside the window). However, such an interpretation involves certain trouble.

Firstly, mental intentionality may refer to a virtual object (such as unicorn), or misrepresent an external object. If the above hypothesis is true, in other words, an intentional state is caused by an external object and carries the information about this external object, then we are unable to interpret the fact that a mental state can represent an object that doesn’t exist, and misrepresentation won’t occur. Secondly, what is more troublesome is that if we conclude from the cause-effect covariant relationship between two things that the state of one thing, which carries the information of the state of another thing, bears intentionality, then the states of many things in the physical world — for instance, the annual rings of a tree carrying climatic information — would be intentional. If so, the concept of intentionality does not deserve any attention.

Due to these problems, some philosophers try to reduce intentionality from another approaches. A popular way is to focus on biological function instead of cause-effect. Basically, it asserts that mental intentionality can be reduced and interpreted from biological function, while the latter can be naturally interpreted from biological evolution. Since mental phenomena are exemplified by people (or some other creatures), the interpretation of intentionality from the approach of biological function is a natural and reasonable method on the ground that a human being is also a kind of creature. However, although we may say a heart functions to provide blood circulation impetus, and a stomach is responsible for digestion in biological concepts, but a heart or a stomach is about nothing, so it is hard to confirm the intentionality of their states. From the above analysis, certain biological functions are inadequate to interpret intentionality. To address the deficiency, we can either add some essential requirements to biological functions so that they can work together to form the sufficient conditions for intentionality, or obtain some peculiar features from biological

functions and regard they are sufficient conditions generating intentionality. Now some philosophers resort to the latter, holding that what can be used to explain and describe mental phenomena, including intentionality, is not a function of tending to do something, but a purpose function. Such a purpose function is the product of natural selection while the selection process is also the design process. Therefore, the origin of mental content and intentionality is the natural design (Millikan, 17 – 51). However, whether intentionality can be reduced to biological purpose function is still open to discussion, since there is a conspicuous gap between purposeful function and mental intentionality in terms of concept.

Another influential approach is put forth and defended by Daniel C. Dennet. It holds that we can apply three different strategies to predict and interpret the behavior of a real entity in the world, namely, physical, designing and intentional standpoints. These three strategies involve different complexities and risks in predicting the behavior. To predict the behavior of an entity with a physical standpoint is the most reliable but also the most complicated and challenging. As to the behaviors of some entities, just like a human being or a chess-play computer, to predict it with an intentional standpoint is the easiest and most effective but also has the highest risk of failure (Dennet, 42 – 68). For Dennet, the adaptation of certain strategy lies in our expected result. Therefore, he is regarded as an instrumentalist by many scholars.

If Dennet is really an instrumentalist, intentionality can be taken as the result of understanding an entity as an intentional system and it seems to be unnecessary to interpret mental intentionality in a reductive way. However, if “reduction” is not understood as reducing intentionality to something beyond mentality, but as interpreting people’s intentionality as the production of intentionality that is more fundamental or simpler, then we can say it is still reductive. It is in this sense that Daniel adopts a reductive approach. Although admitting that such artificial objects as books and computers have derived intentionality, Daniel denies that people have intrinsic intentionality, asserting that the so-called “intrinsic” intentionality is essentially “derived”. Hence he claims: “The brain is an artifact, and it gets whatever intertnationality its parts have from their role in the ongoing economy of the larger system of which it is a part — or, in other words, from the intentions of its creator, Mother Nature (otherwise known as the process of evolution by natural selection)” (Dennett, 1996: 52 – 53).

Many scholars reject Dennet’s interpretation on people’s mental intentionality for various reasons. One representative objection holds that such an interpretation obscures the distinction between people’s intentionality and the derived intentionality

of things just like computers and by natural selection only we cannot “derive” mental intentionality (Nanay, 57 – 71). I argue that Dennet’s interpretation of people’s mental intentionality from the more fundamental intentionality of Mother Nature may be conducive to our understanding of people’s mental intentionality, but the intentionality itself becomes mysterious in the depth of Mother Nature. Of course, Dennet may insist on his instrumentalism, claiming that intentionality is nothing but an effective strategy with which we predict and interpret the behavior of entities. But this cannot convince us that a prediction from an intentional standpoint is in most cases successful. Nor can it explain why we often feel our mentality being in a real intentional state. Therefore, instrumentalism seems to be unacceptable.

To predict and interpret the behavior of an entity, the adaptation of different strategies is without doubt inspirational and effective, but this does not justify the standpoint of instrumentalism. As a matter of fact, if we draw upon Dennet’s strategy and the above-mentioned reduction methods, we may find an effective approach to interpret the intentionality from a computational perspective.

The basic starting point for probing into this approach lies in the hypothesis that there is only a real world, to which conceptual ways may be various. As to an entity and its behavior, we may resort to many kinds of cognitive methods. This is similar to the polybasic standpoints of Dennet. However, we believe that these different conceptual ways depict or describe the same reality, and it is the supervenience or realization relationship that functions as the bounding condition so as to ensure their mutual coordination. In this sense, it is not instrumentalism. For instance, facing a clay sculpture, we may first admit it is a being. Then it can be considered as a physical system (a pile of clay) with a certain form, or an artistic work (a sculpture). As for the relationship between these two considerations, it comes as follows: the sculpture is supervenient with, or actualized by the pile of clay. These are two ways to reach a conceptual understanding of an entity, but each of them is a description of the entity since only one entity is ontologically admitted. In the process of our understanding of the world, it is both necessary and useful to adapt various conceptual ways to grasp an entity, especially a complicated one. Just as we conceptualize a pile of clay, we may conceptualize the “brain”.¹ Firstly, we should make a claim that the “brain” is an existence. Then we may either take it as a physical system so that we can study its physical components, properties and processes within a physical framework, or regard it as a mental (or cognitive) system

1. Although mental phenomena certainly do not just involve the brain only, the “brain” here is used to refer to a mental being for convenience.

so that we are in a position to apply a conceptual framework of cognitive science (or psychology) to probe into its mental components, properties and processes. As for the relationship between the mental system and the physical one, it can be understood from a perspective of supervenience or realization. In other words, the mental system is supervenient with or actualized by the physical one.

As intentionality is a kind of mental phenomenon, and the above analysis shows that its bearer is a mental system, two basic approaches are available for us to interpret it. One is to discover the physical conditions for the realization of mental or cognitive phenomena by starting from the supervenience relationship between the mental system and the physical one. It is this approach that contemporary cognitive neuroscience adopts, whose task is to make clear the relevance (realization relationship) between mental phenomena and their neurophysiological foundation. For instance, what is the corresponding physical process in his neurological system when one perceives an external object or forms a belief? Obviously, such study is of cognitive and practical significance. By certifying the physical realization in a cognitive process, we may discover the relevance mode linking them together and then apply this mode to identify, transform or utilize certain cognitive behavior. However, as supervenience is not reduction, once the "brain" is conceptualized as a physical system, we can only describe or talk about the physical phenomena, but the mental phenomena of the mental system will disappear at the physical level (Dietrich, 9 – 11). Hence, this approach seems to be improper to interpret and understand intentionality in a reductive way.

Another approach aims at interpreting intentionality and other mental phenomena by means of direct exploration into the nature and origin of a mental system. In this case, we should first clarify what kind of system can be named as a mental system. Philosophers and cognitive scientists haven't reached a consensus yet. Generally speaking, a mental system refers to such an existence in environment that applies information in approaching a target (Dietrich, 5). This means that a mental system is an information system, in which information is its basic constituent. In certain environment, any wise creature will use the information provided by environment and adopt corresponding actions so as to achieve its aim. So it can be understood as a mental system, or mentality in short. On the contrary, a computer we use today is not a mental system since it doesn't apply information for its own purpose even though it is certainly an information system. It should be particularly emphasized that people's mentality is a system with such properties as intention and consciousness. Therefore, we have to interpret intentionality within a conceptual framework of

mentality. In other words, we must interpret the formation conditions and mechanism of intentional phenomena with the basic components, properties and structures of mentality. We can draw the conclusion that the second is a proper and natural approach to understand mental intentionality.

III. Mentality as a Computational System

Based on the above prescription and understanding, we can describe the features of a mental system. The fundamental aim of mentality is to use feed-back circuits to control or adapt to environment. To achieve this, a mental system must be equipped with an internal state comparing the information from environment with the expected target state. This means that the internal state is partially composed of environmental information and achieves reciprocal actions between mentality and environment through information conversion and feed-back circuits. If we prescribe computation as the conversion or dynamic change of information, we may certify it to be one of the four basic properties of mentality. In other words, mentality is a kind of computational system.² Furthermore, as a computational system, mentality is virtual by nature. A mental system is a real existence, but it is a virtual rather than physical existence.³ As mentioned above, we can adopt at least two ways to conceptualize a being as the "brain", i. e., to take it as a physical system or a mental one, while the latter is supervenient with or realized by the former. The virtuality is not only a property that makes mentality different from a physical system but also a fundamental condition that enables it to simulate the external object. Hence, a mental system is also a virtual machine or virtual system. Thirdly, mentality is characterized by representation. Since a mental state can carry information from environment, it can represent the state and process of the object in environment. Fourthly, mentality has intrinsic intentionality, with which mentality can represent the external object on the one hand,

2. Here, the relationship of computation and information is as follows: Information is static while computation is dynamic, and computation converts information. (Rucker, 5)

3. This trait is closely related with the concept of virtual machines widely used in the science of computer and cognition. A so-called virtual machine is a machine simulated and operating on a pervasive computer. In essence, a virtual machine is a system of computation or information, which is realized by physical machines or other virtual machines. Such a computational system is called a machine since people may emphasize that it also contains a complicated system with components and structures. These various and multiple interactive components, together with the structure they form, determine the function of the system so as to achieve particular objectives or perform specific tasks. On the other hand, people emphasize the virtuality of such machines because they are not physical machines and their structures and functions have to be realized by machines, including physical machines, at a lower level, even though they are as real as physical ones.

and adapt to or control environment by taking actions, including mental actions, based on mental states with representative content. As to mentality, intentionality in the first order apparently concerns and refers to the external object and becomes realized by means of the causal chain of information between internal states and environment.

In contrast to other kinds of mentality, people's mentality is too complicated to be described by the above-mentioned four properties. As a computational system, people's mentality performs general computation so that it can work as a general computer to simulate the computing process of other things. It is not only virtual, but also a complicated virtual system formed by different kinds of and multiple levels of virtual machines. It can represent not only objects in environment, but also different kinds of representation, including visual and abstract representation. Accordingly, it possesses both intentionality in the first order and higher-level intentionality of representation itself. Since it attempts to interpret people's intentionality, this paper has to investigate not only the properties of mentality in general, but also pay closer attention to the properties of people's mentality.

If we say people's mentality has these four proprieties, a question will immediately arise: why a computer, which is used widely today, is short of intrinsic intentionality in spite of the fact that it has derived intentionality, and, as a computational system, generality of computation, and representation and virtuality at various levels? This shows that although mentality is a computational system, not all computational systems of generality, virtuality and multi-representation can be called as mentality.

IV. Generating Conditions for Intentionality

Our next question is: what are the conditions for a computational system to turn into mentality with intrinsic intentionality? Searle's "Chinese Room" experiment is a proper starting point to this question.

Since Searle brought forth the "Chinese Room" thought experiment in 1982, philosophical and scientific debates over it have continued to present day. Searle supposes that he, as a person knows no Chinese, is locked in a room with a manual containing a Chinese word stock and an instruction set written in English. The only function of this instruction set is to regularly put a chain of Chinese characters into another. Now, Let's suppose that a group of Chinese or other people who know Chinese language are standing outside the room. They offer Searle some questions written in Chinese through a hole on the room, and Searle may send out Chinese

sentences with the help of the instruction set. As he doesn't know any Chinese characters, he is ignorant of the meanings of the Chinese sentences he sends out. However, these sentences will be meaningful to the people who know Chinese language outside the room, if Searle's answer is generated by rules. The Chinese people outside the room may judge that Searle knows Chinese language according to his behavior, but he actually doesn't know at all. For Searle, the role he plays in the thought experiment is just the role of program in a computer system. In virtue of this experiment, he argues: only by means of realizing programs, a computer cannot have an authentic understanding; an authentic understanding is meaningless unless it possesses intrinsic intentionality; people are able to understand something due to their intrinsic intentionality; therefore, realization programs are not sufficient for mentality (Searle 2001).

It is obvious that this thought experiment and its arguments not only disapprove the claim of "strong" artificial intelligence, but also seriously challenge cognitive computationalism. If his argument is true, the claim of "strong" artificial intelligence that an appropriately programmed computer literally has human's intelligence will be disillusioned, and cognitive computationalism must rationally interpret people's capacity of understanding and intentionality with a computational theory of mentality.

Since a "Chinese Room" system does not possess intrinsic intentionality due to its shortage of comprehension ability, we must ask the following question: which elements make a "Chinese Room" system different from mentality? Here is a plausible interpretation for Searle's ignorance of Chinese language in the thought experiment: language itself doesn't possess any intentional content, or it merely has derived intentionality; only when Searle's mental states and those of a person who knows Chinese language share equal content does he really possess intentionality; the essential condition for equal content is that his mental states, as those of a person who knows Chinese language, are in connection with information of objects in environment; in other words, the generation of mental intentionality not only requires rule-based computation of internal states, but also needs to represent the information from environment in a proper way. When we are in certain natural environment, environmental information entering our sense organs (e.g. our eyes) is always complicated. Therefore, to identify certain object in environment requires mentality to selectively represent information. As far as we know, the accepted information by today's computers, including Searle in the thought experiment, is formally represented in advance. In other words, they are not able to selectively represent external information.