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TURING AND COMPUTATIONALISM

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Due to his significant role in the development of computer technology and the discipline of artificial intelligence, Alan Turing has supposedly subscribed to the theory of mind that has been greatly inspired by the power of the said technology which has eventually become the dominant framework for current researches in artificial intelligence and cognitive science, namely, computationalism *or the* computational theory of mind. *In this essay, I challenge this supposition. In particular, I will try to show that there is no evidence in Turing's two seminal works that supports such a supposition. His 1936 paper is all about the notion of* computation *or* computability *as it applies to mathematical functions and not to the nature or workings of intelligence. On the other hand, while his 1950 work is about intelligence, it is, however, particularly concerned with the problem of whether intelligence can be attributed to computing machines and not of whether computationality can be attributed to human intelligence or to intelligence in general.*

INTRODUCTION

As Alan Turing [1912-1954] played a significant role in the development of computer technology and the discipline of artificial intelligence (henceforth AI), it is natural to suppose that he subscribed to the theory of mind that has been greatly inspired by the power of the said technology and that has eventually become the dominant framework for current researches in AI and cognitive science, namely *computationalism* or the *computational theory of mind*. Such a supposition can be gleaned, for instance, from the following remark by Herbert Simon—a pioneer of AI and a vigorous promoter and staunch defender of computationalism—in his essay "Machine as mind" (1995, 676):

> The materials of thought are symbols—patterns, which can be replicated in a great variety of materials (including neurons and chips), thereby enabling physical symbol systems fashioned of these materials to think. Turing was perhaps the first to have this insight in clear form, forty years ago.

Simon clearly speaks here of the standard view of *classical computationalism* that human thinking is a kind of computing defined as a process of symbol manipulation, which, according to him, was pioneered by Turing. <50)

This supposition can likewise be gleaned from the arguments of some critics of computationalism, in particular the anti-computationalist arguments of John Searle and Roger Penrose. Searle's Chinese Room argument (1980, 417-57) is a classic anticomputationalist argument that basically disputes the alleged computationalist conclusions drawn from the Turing test (referring to the imitation game introduced by Turing in his 1950 paper). Searle, in gist, argues that passing the Turing test is not a guarantee that a computing machine, which passes such as test, is "genuinely" intelligent—which, in Searle's light, means that the machine is aware of what the symbols it manipulates represent in the world (see Mabaquiao 2012, 65-67; 2008, 229-30 for an elaboration of this argument).

For his part, Penrose claims that no machine can ever simulate human intelligence and thus pass, even in principle, the Turing test. Penrose (1994, 64-65) bases his claim on Kurt Gödel's *incompleteness theorem*, which, in general, states that any formal system is bound to contain some propositions whose truth is not derivable from the rules of the system. Penrose, following Lukas (1961), infers from this theorem that the human mind is not a formal system and as such can never be a computer. For unlike computers, humans can transcend the rules of a formal system to recognize the truth of statements not derivable from the system. Given this, it would then be impossible for a formal system such as the computer to simulate the human mind. Speaking of the computationalist view as "*A,*" Searle's as "*B*," and his own as "*C,*" Penrose (1994, 14-15) distinguishes these views as follows:

> The acceptance of this kind of argument, which basically is what is referred to as a Turing test, is in essence what distinguishes *A* from *B*. According to *A*, any computer-controlled robot which, after sustained questioning, convincingly behaves as though it possesses consciousness, must be considered actually to be conscious—whereas according to *B*, a robot could perfectly well behave exactly as a conscious person might behave without itself actually possessing any of this mental quality. Both *A* and *B* would allow that a computer-controlled robot could convincingly behave as a conscious person does, but viewpoint *C*, on the other hand, would not even admit that a fully effective simulation of a conscious person could ever be achieved merely by a computer-controlled robot.

Accordingly, while Searle disputes the sufficiency of the Turing test as a basis for attributing (genuine) intelligence to a computing machine, Penrose disputes the conceivability of a computing machine passing such a test (see Mabaquiao 2011, 77-80; 2012, 170-72). Nonetheless, Penrose, like Searle, focuses on the Turing test in making a case against computationalism. And this only proves that both Searle and

Penrose acknowledge the supposed critical role of the Turing test in establishing the view of computationalism.

In this essay, I challenge the supposition that Turing supports or advances the view of computationalism. In particular, I will show that there is no evidence in Turing's two seminal works—"On computable numbers with an application to the Entscheidungsproblem" (1936) and "Computing machinery and intelligence" (1950)—that supports such a supposition. While his 1936 paper is all about the notion of *computation* or *computability* as it applies to mathematical functions and not to the nature of intelligence, his 1950 work—though about intelligence—is, however, particularly concerned with the problem of whether intelligence can be <51) attributed to computing machines and not of whether computationality can be attributed to human intelligence or intelligence in general. I divide my discussion into three. I introduce in the first the central theses of computationalism. I discuss in the second Turing's investigation of the meaning of computation. I tackle in the third Turing's analysis of the legitimacy of attributing intelligence to computing machines.

COMPUTATIONALISM: THE CENTRAL THESES

In their joint article, "Foundations of cognitive science," Herbert Simon and Craig Kaplan (1990, 2) define cognitive science as "the study of intelligence and its computational processes in humans (and animals), in computers, and in the abstract." This definition identifies the levels on which a computationalist investigation of the nature of intelligence is to be carried out, namely on the *abstract, human* (and animal), and *machine* levels. Based on these levels, we can accordingly divide the central claims of computationalism into *a general thesis*, which concerns the abstract level of intelligence, and *two subtheses*, which concern the human and machine levels of intelligence.

The general thesis claims that thinking or cognition is a type of computational process or, as Zenon Pylyshyn (1990, 51) puts it, *a species of computing*. Cognition, here defined abstractly, does not exclusively pertain to the intelligence of a particular type of entities for it can in principle be instantiated by the intelligence of various types of entities. We can refer to this general thesis more specifically as the *thesis of cognitive computationality*. Now as the two *subtheses* concern the human and machine instantiations of this general thesis, we can respectively call them the *thesis of human computationality* and the *thesis of machine intelligence*. The thesis of human computationality claims that *human cognition* is a computational process; whereas the thesis of machine intelligence claims that machines capable of computationally simulating human cognitive processes are themselves intelligent. As the machines capable of doing this simulation are computers, the thesis of machine intelligence can thus be simplified as the claim that computers are intelligent.

While computationalism considers humans and machines as entities in which the general thesis of computationalism are instantiated, it must be noted that the same thesis can in principle be instantiated in any other conceivable type of entities that can be considered intelligent, examples of which are animals and aliens or extraterrestrials. For if it is true that cognition is a species of computing on the abstract level, then any conceivable entity that can be considered intelligent must be an entity whose intelligence is a species of computing. The general thesis thus guarantees that the intelligence of humans and machines are of the same kind, that is, of the same computational kind.

The difference between human intelligence and machine intelligence is here regarded simply as a matter of degree or, more specifically, as a difference in degree of complexity or sophistication. This means that the intelligence of humans is seen simply as a more complex or sophisticated type of intelligence than the one allegedly possessed by computers. Being so, the possible gap between human intelligence and machine intelligence is a contingent matter and thus in principle can be bridged. Furthermore, it is even conceivable that in the future machine intelligence will be able to surpass human intelligence [see Chalmers's (2010) paper on singularity]. We are here, of course, referring not to the speed and accuracy by which humans and machines process information—for in these departments modern digital computers obviously outdo humans—but to the other aspects of intelligence where machines are still too slow compared to humans. Some of these aspects are identified in the <52) following remarks byJames McClelland, David Rumelhart, and Geoffrey Hinton (1995, 305) in their joint article, "The appeal of parallel distributed processing":

> What makes people smarter than machines? They certainly are not quicker and more precise. Yet people are far better at perceiving objects in natural scenes and noting their relations, at understanding language and retrieving contextually appropriate information from memory, at making plans and carrying out contextually appropriate actions, and at a wide range of other natural cognitive tasks. People are far better at learning to do these things more accurately and fluently through processing experience.

Computationalism has also been called *strong AI*. This is due to the distinction made by Searle (1980) between *strong AI* and *weak AI*. According to Searle, weak AI is the view that makes the neutral (and philosophically uncontroversial) claim that the computer is a powerful tool for understanding how the mind works, while strong AI is the view that makes the bold (and philosophically controversial) claim that the human mind is a kind of computer or, more specifically, a kind of computer program implemented or run by the brain hardware. Strong AI thus looks at the mind-brain relation as a type of software-hardware relation, which is popularly put as "the mind is to software as the brain is to hardware." Roger Schank and Peter Childers (1984, 43), two of strong AI's staunch defenders, put straightforwardly in their book, *The cognitive computer*, the thesis of strong AI as follows: "Our cognitive apparatus has two main components: the actual brain itself (the hardware, really) and the knowledge or information it contains (the software)."

Not only is computationalism the dominant framework in current AI researches pertaining to the construction of intelligent machines, it is likewise the dominant framework in current researches in the emergent discipline whose main project is to naturalize the mind or to assimilate it into the scientific worldview, namely, *cognitive science*. Jay Freidenberg and Gordon Silverman (2006, 2) define cognitive science as "the scientific interdisciplinary study of the mind." It is scientific in that its primary methodology is the scientific method; and it is interdisciplinary in that it draws from the findings of a number of different disciplines whose common interest is the study of the mind. These disciplines are comprised of philosophy, artificial intelligence, linguistics, psychology, neuroscience, and anthropology (see Gardner 1985, 6-7). But though it aims to be interdisciplinary in its approach, cognitive science, in its very framework, remains to be computational. Freidenberg and Silverman (2006, 2-3) explain:

> In order to really understand what cognitive science is all about we need to know what its theoretical perspective on the mind is. This perspective centers on the idea of computation, which may alternatively be called information processing. Cognitive scientists view the mind as an information processor.

Speaking of how cognitive scientists understand the nature of the mind, Gardner (1985, 6) basically makes the same point:

> …there is the faith that central to any understanding of the human mind is the electronic computer. Not only are computers indispensable for carrying out studies of various sorts, but, more crucially, the computer also serves as the most viable model of how the human mind functions. <53)

Consequently, this limits what cognitive science draws from the findings of the other disciplines—only to those that will help advance the computational conception of the mind.

THE NATURE OF COMPUTATION

There are two key concepts in the theses of computationalism, namely *computation* and *intelligence*. To fully understand the claims of computationalism, one needs a good grasp of what these two concepts mean, or, better yet, how these concepts are understood within the perspective of computationalism. Incidentally, these are also the two concepts that preoccupied Turing in his two seminal works—the 1936 and 1950 papers—and his investigations in this regard have apparently laid the grounds from which computationalism developed. Be that as it may, it is, however, a different thing to say that Turing endorses or supports the view of computationalism.

In his 1936 paper, "On computable numbers with an application to the Entscheidungsproblem," Turing clarifies the notion of *computation* or *computability* as a way of responding to a foundational problem in mathematics posed by the great mathematician David Hilbert. Hilbert's problem, which has come to be known as the *decision problem*, asks whether there is an effective or mechanical procedure by means of which we can determine whether or not any given mathematical problem is solvable (or whether any given mathematical function is computable). Turing's ingenious strategy is to clarify the concept of computation not in the context of "human computers" (i.e., humans doing computations) but in the context of "computing machines" (i.e., machines doing computations). In this way, the scientifically intractable psychological considerations—mainly referring to the subjective qualities of conscious states—are put aside; and thus the investigation becomes a purely objective and mechanical undertaking.

In the course of specifying the basic features that a machine must have, as well as the basic operations that it must be capable of performing, in order to perform computations and thus be regarded as computing, Turing conceives of an abstract computing machine which has come to be known as the *Turing machine.* The Turing machine specifies the basic features of any possible computing machine; and for this reason, it serves as the theoretical forerunner of the modern digital computer. It becomes, as it were, the blueprint for constructing actual computers. Consequently, with his concept of the Turing machine, Turing then defines computation or computability in terms of the actions of a Turing machine. Accordingly, a computation is whatever can be implemented in a Turing machine; and corollary to this, a mathematical function is computable (or a mathematical problem is solvable) if such a function can be implemented in a Turing machine. This way of defining computation and computability has eventually come to be known as the *Church-Turing Thesis,* after the logician Alonzo Church (1937, 42-43) has recognized the superior intelligibility of the Turing machine as a scheme for defining computability over other similar schemes. Such other schemes included Church's own, namely the *lambda calculus,* while another was Emil Post's (see Penrose 1994, 20-21). And the said result of the schemes was a negative response to Hilbert's problem: that there is no effective or mechanical procedure by which one can determine the computability of any given mathematical function. Furthermore, Turing's scheme, presumably <54) because of its superior intelligibility, also became the basis of the ordinary conception of computation as an "effective procedure" or as a finite set of step-by-step procedures to arrive at a desired result (see Tim Crane 1995, 88).

Now, in light of the Church-Turing Thesis, to say that thinking is a species of computing is to say that thinking is an operation of a Turing machine, for anything that is a species of computing is an operation of a Turing machine. This was the basis of Putnam when he remarked, in the course of advancing his *machine functionalism* [(which was a precursor of computationalism (see Mabaquiao 2012, 32-35)]—that "human minds are instantiations of Turing machines" (see Putnam 1991, 199-200). Saying that human minds are instantiations of Turing machines is, of course, just another way of saying that human minds are computers. But all this would follow only if we grant, at the beginning, that thinking is indeed a species of computing. But Turing's 1936 paper has nothing to say about the nature of thinking. What will follow from Turing's ideas in this paper is that whenever we perform computations what we do are explainable in terms of the operations of a Turing machine, and not that whenever we think we perform computations. In the case of humans, computing, of course, is a kind of thinking, but this does not imply that computing is all there is to human thinking. We can say, in this regard, that computing is a species of thinking, but not the other way around—that thinking is a species of computing.

In sum, Turing's 1936 paper, in the course of answering Hilbert's foundational question about mathematics, clarified the meaning of computation (and computability) and in the process contributed to the development of the computer. Turing's clarification of the concept of computation, however, was never intended by Turing to describe the nature or essence of human thinking and to advance the view that thinking is a species of computing. The claim that the human mind is an instantiation of a Turing machine already grants such a view.

ATTRIBUTION OF INTELLIGENCE

In his 1950 paper, Turing tackles another problem still related to computing but this time on the question of whether computing machines can be considered intelligent. And the manner by which he tackles this problem, through an imitation game now famously known as the *Turing test*, paves the way for the development of AI as a discipline (as a branch of computer science that studies the nature of intelligence with the objective of constructing intelligent machines). It is said that some early AI programs, such as Joseph Weizenbaum's ELIZA created in 1966 and Kenneth Colby's PARRY created in 1972, were made with the objective of passing the Turing test. If Turing's 1936 paper is a landmark in the history of digital computers and computer science, his 1950 paper is a landmark in the history of AI. As Herbert Simon and Craig Kaplan (1990, 2) write: "Since at least 1950 [we might take Turing's (1950) essay as a convenient starting point] that branch of computer science called ‘artificial intelligence’ has been studying the intelligence exhibited by machines” (see also French 2000, 215-16).

The question in his 1950 paper is whether computing machines is intelligent, and not whether human intelligence or intelligence in general is computational. But could a test for machine intelligence not also serve as a test for the computationality of intelligence? To properly deal with this question, we need to examine Turing’s conception of intelligence as assumed in his test and how such a conception of intelligence correlates with the <55) computationalist own conception. But first let us examine our commonsense notions of intelligence.

Two views on the nature of intelligence

We normally believe that human intelligence has both functional and conscious aspects. Its functional aspect generally consists in the ability to perform certain functions or to carry out certain tasks, which include answering questions, following rules, and solving problems. It is in light of this aspect that we say, for instance, that a student is intelligent in the area of mathematics if he or she can actually solve mathematical problems or perform mathematical operations. Its conscious aspect, on the other hand, generally consists in the experience of certain mental states and processes, such as understanding and reasoning, as one performs certain functions or carries out certain tasks. And it is in light of this aspect that we say, for instance, that someone who gives the correct answer to a certain problem but does not understand how such an answer is arrived at is not really intelligent or does not really perform an intelligent action.

The kind of intelligence assumed in computationalism, however, is a general one in that it concerns both humans and machines. What is said to be a species of computing is intelligence not just as it is possessed by humans but as it can possibly be possessed by machines as well. The question that arises here is whether intelligence, understood in this sense, should also be construed as having both functional and conscious features. Machines can obviously share the functional aspect of human intelligence; it is, however, quite contentious whether they can also share the conscious aspect of human intelligence. Be that as it may, the fundamentality of the conscious aspect of intelligence is here put into question. And consequently, the question that we need to contend with is: *Is functionality sufficient to define the nature of intelligence?*

I shall call the affirmative reply to this question the *purely functional view*, while the negative reply the *conscious view*. The purely functional view thus states that functionality is adequate to explain the nature of intelligence, while the conscious view states otherwise. For the purely functional view, an entity is intelligent if it has the required functionality regardless of whether or not such an entity is conscious;

but for the conscious view, such an entity can only be intelligent if, in addition to having the required functionality, it is also conscious. The "conscious view" should not be confused with what can be called the "purely conscious view." The purely conscious view states that consciousness adequately defines the nature of intelligence, but the conscious view only asserts that consciousness is as fundamental as functionality in defining the nature of intelligence. The purely conscious view can be attributed to the idealists (who regard reality as fundamentally mental or spiritual) and substance dualists (who regard mental reality as independent of physical reality). While this view may have been influential in the past, it is, however, no longer in contention in contemporary philosophy of mind where the main motivation is the naturalization of the mind. Consequently, we shall limit our discussion to the purely functional and conscious views.

Most of the strong advocates of the purely functional view are AI scientists who subscribe to computationalism. AI pioneers Simon and Newell, for instance, clearly assume this view in their *physical symbol system hypothesis*, which regards intelligence only in terms of action and behavior. In their award-winning essay, <56) "Computer science as empirical inquiry: Symbols and search," they (1976, 116) explain that "[a] physical symbol system has the necessary and sufficient means for general intelligent action," and by "general intelligent action," they "indicate the same scope of intelligence as we see in human action: that in any real situation behavior appropriate to the ends of the system and adaptive to the demands of the environment can occur, within some limits of speed and complexity." Simon (1989, 1-2), along with another fellow AI scientist, Kaplan, in another essay, "Foundations of cognitive science," further states that "people are behaving intelligently when they choose courses of action that are relevant to achieving their goals, when they reply coherently and appropriately to questions that are put to them, when they solve problems of lesser or greater difficulty, or when they create or design something useful or beautiful or novel…" It is, however, Roger Schank and Peter Childers (1984, 51), in their book *The cognitive computer*, who may have provided the most direct expression of the purely functional view; thus: "When we ask *What is intelligence?* we are really only asking *What does an entity, human or machine, have to do or say for us to call it intelligent?"*

On the other hand, most proponents of the conscious view are critics of computationalism, such as Penrose and Searle. Perhaps the clearest expressions of the conscious view come from the highly accomplished mathematician and physicist Penrose. In his book, *The emperor's new mind: Concerning computers, minds, and the laws of physics*, Penrose (1989, 525-26) writes:

> There is also the question of what one means by the term 'intelligence'. This, after all, is what the AI people are concerned with, rather than the perhaps more nebulous issue of 'consciousness'…. In my own way of

> looking at things, the question of intelligence is a subsidiary one to that of consciousness. I do not think that I would believe that true intelligence could be actually present unless accompanied by consciousness.

In his other book, *Shadows of the mind: A search for the missing science of consciousness*, Penrose (1994, 38-39) argues that one cannot talk of intelligence and not talk of consciousness at the same time. For according to Penrose, if "(a) 'intelligence' *requires* 'understanding' and (b) 'understanding' *requires* 'awareness'," then intelligence requires awareness. Thus, for Penrose, to say that something can be intelligent without being conscious in some way is to misuse the word "intelligence" or to deviate from its original meaning.

Searle generally shares with Penrose's view of intelligence. Searle, however, is more specific in explaining that there is only understanding, and hence intelligence, if there is awareness of what our mental states represent in the world. The intentionality or directedness of our mental states (the cognitive or intentional ones) necessarily requires awareness of the objects or states of affairs that these mental states are about. Searle (1980) thus contends in his Chinese Room argument that machines can never be genuinely intelligent since they can never have an awareness of what the symbols that they manipulate refer to in the world. These machines individuate and manipulate these symbols simply on the basis of their syntax and not of their semantics as well. <57)

Intelligence and the Turing test

Turing begins his 1950 paper by exploring how the question "Can machines think?" can best be dealt with. One usual strategy is to define the key terms involved in the question, namely "machine" and "think." But as definitions should reflect the various ordinary usages of the terms being defined, this strategy will just turn the question ("Can machines think?") as something that is answerable via a statistical survey, which Turing finds absurd. Turing then proposes a strategy where the original formulation of the question is to be replaced with one that is closely related to the original formulation but which avoids its possible ambiguities. Turing's proposed reformulation of the question involves what he calls an "imitation game," which we now know as the Turing test. The test basically determines whether a machine can successfully imitate the intelligent behavior of a human to deserve the attribution of intelligence. The main idea is that if the human is regarded as intelligent in virtue of his or her behavior, then a machine exhibiting the same behavior should, by force of consistency, be regarded as intelligent as well.

One simplified version of this test is as follows. Imagine a human interrogator communicating with two respondents: one is human while the other is a machine. A wall physically separates the interrogator and the two respondents; and the interrogator communicates with the respondents only through text messages using computers. Let us say that there are two computer terminals, one for each respondent; and the interrogator, though he knows that he is communicating with a human and a machine, does not know in which terminal he is communicating with the human and with the machine. According to the test, if after a series of questions and answers the interrogator could not tell solely on the basis of the respondents' answers which of these respondents is the human and which is the machine, the machine is said to have passed the test, and is consequently considered to be intelligent.

Is Turing through his test proposing a definition of intelligence? A widely held view is that he is, and the type of definition he is proposing is an *operational* one wherein intelligence is defined in terms of performing certain tasks or activities—which is nothing but what we have called the purely functional view of intelligence. Robert French (2000, 116), for instance, in his article "The Turing test: the first 50 years," writes that one of the seminal contributions of Turing was that "he provided an elegant operational definition of thinking that, in many ways, set the entire field of artificial intelligence (AI) in motion." Some scholars, however, dispute this view. Preeminent Turing scholar Jack Copeland (2000, 522), for instance, writes: "Twenty-five years later, the lesson has still not been learned that there is no definition to be found in Turing's paper of 1950. Commentator after commentator states that Turing's intention was to offer a definition of 'thinking' or 'intelligence'."

Copeland and others who share his view make a valid point here. There is a big difference between saying that functionality is the basis for intelligence attribution and saying that functionality is all there is to intelligence. There is in fact no logical inconsistency in holding that functionality is the only basis for intelligence attribution while maintaining that consciousness is also essential for intelligence. Turing is just concerned with intelligence attribution; he is not after a definition of intelligence. This is in fact clearly expressed by Turing (1950, 433) himself at the very beginning of his 1950 essay: <58)

> I propose to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms "machine" and "think"…Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

Based on these remarks, Turing will simply be contradicting himself if he intends his replacement of the said question by another one as a way of offering a certain definition of intelligence. But is it not the case that the attribution of intelligence somehow presupposes a certain definition of intelligence? Yes, but the specification of such a definition is not necessary to settle the issue of whether intelligence can legitimately be attributed to machines. The point can perhaps be simply put as follows: *Regardless of what we really or ultimately mean by intelligence there are undoubtedly some concrete ways by means of which we attribute intelligence to our fellow humans.* The activity of answering questions must surely be one of these ways. What Turing simply does is to make this particular activity, with some modifications, as a test to determine whether intelligence can be legitimately attributed to machines.

Turing's reply (1950, 445-47) to the Argument from Consciousness further sheds light on this point—that he is not after a definition of intelligence. The argument maintains that intelligence can be attributed to machines only if machines can have conscious states such as emotions and sensations. Turing's reply is that we have no way of knowing whether machines are conscious or not when exhibiting intelligent behaviors, but this is no different from the fact that we also have no way of knowing whether other persons have conscious states when exhibiting intelligent behaviors. Turing further notes that if consciousness will be used as the criterion for intelligence attribution the result is the absurd position of *solipsism* (the view that only I, the speaker, have conscious states and thus the only intelligent being in the world). Turing, however, qualifies that he does not deny the mysteries about consciousness; what he rather thinks is that such mysteries have nothing to do with the attribution of intelligence to machines. Turing (1950, 447) continues:

> This argument appears to be a denial of the validity of our test. According to the most extreme form of this view the only way by which one could be sure that machine thinks is to be the machine and to feel oneself thinking… In short then, I think that most of those who support the argument from consciousness could be persuaded to abandon it rather than be forced into the solipsist position. They will then probably be willing to accept our test. I do not wish to give the impression that I think there is no mystery about consciousness. There is, for instance, something of a paradox connected with any attempt to localise it. But I do not think these mysteries necessarily need to be solved before we can answer the question with which we are concerned in this paper.

Now, if Turing were concerned with defining intelligence he would have acknowledged the need to deal with the nature, or mystery, of consciousness whose reality he obviously does not deny. As Turing is not offering any definition of intelligence, it is safe to conclude that it does not really matter to him whether intelligence is defined in purely functional terms or in terms of consciousness as well. The most that can be said here is that his test advances a *functional criterion for intelligence attribution*, which does not necessarily imply or assume a purely functional definition of intelligence. <59)

Furthermore, the Turing test, on closer inspection, is not a test for intelligence exclusive to computing machines. And if so, the computational nature of the machine that passes the test has nothing to do with the attribution of intelligence to it. This point is actually emphasized by Turing himself when he replies to one of the objections that he tackles in his 1950 paper, namely, the Argument from Continuity in the Nervous System. According to this objection, since the nervous system is not a discrete system while the computer is, then there cannot be a computer simulation of the nervous system. To this objection Turing (1950, 451) replies: "It is true that a discrete-state machine must be different from a continuous machine. But if we adhere to the conditions of the imitation game, the interrogator will not be able to take any advantage of this difference." Simply, the point of Turing is that the said objection is irrelevant to the issue at hand. Turing drives the point home when he clarifies that the computational nature of the computer is irrelevant to the attribution of intelligence to it since it is possible to conceive of another machine (e.g., the "differential analyser") that works differently from a computer but can likewise pass the test. Turing (1950, 451-52) writes:

> The situation can be made clearer if we consider some other simpler continuous machine. A differential analyser will do very well. (A differential analyser is a certain kind of machine not of the discrete-state type used for some kinds of calculation.)...It would not be possible for a digital computer to predict exactly what answers the differential analyser would give to a problem, but it would be quite capable of giving the right sort of answer...Under these circumstances it would be very difficult for the interrogator to distinguish the differential analyser from the digital computer.

Finally, some scholars (see Whitby 1996, and Ford and Hayes 2002) have pointed out that while the Turing test did provide the impetus for researches in AI, such a test is no longer relevant and will even be an obstacle to the future development of AI. More particularly, while the project of constructing machine intelligence did start out by pursuing machine imitation of human intelligence, such a project, according to these scholars, would have to transcend, if not abandon, such a pursuit if it were to make real progress. The analogy used was mechanical flight: the construction of flying machines was inspired by bird flight and started out by imitating how birds fly (like the flapping of wings), but real progress came when some early designers of these machines (the Wright brothers) started thinking of how machines would be able to fly without imitating how birds fly.

I think this is a very important insight and it indirectly supports our own thoughts about the Turing test. Based on the given analogy, what will make this test irrelevant and an obstacle to the AI project will be the requirement that for machines to be truly intelligent they should be intelligent in *exactly* the same way that humans are intelligent. But the Turing test has no such requirement. As we have shown, it is enough for Turing that machines imitate the functionality of human intelligence to deserve the ascription of intelligence. And how such functionality is made possible by some inner processes, be they of the conscious, computational, or noncomputational type, is simply irrelevant for such an ascription. The Turing test that these scholars talk about can only refer, therefore, to a certain conception of this test which we have precisely put into question: that this test endorses a certain theory of mind (or definition of intelligence) which some scholars have taken to be that of computationalism. <60)

CONCLUSION

Being widely regarded as the father of computer technology, Turing's contributions to the development of this technology are well placed. It is, however, contentious whether Turing subscribed to the theory of mind inspired by this technology—computationalism. I have shown that while Turing greatly contributed to the clarification of the two key concepts that define the theses of computationalism, namely, the concepts of *computation* and *intelligence*, his investigations on these concepts were not intended to establish, nor did they support, the view that regards thinking as a species of computing.

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