

Could a Machine Ever Understand?

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1. Introduction

In his formulation of the Chinese Room Argument against Artificial Intelligence, Searle argues that a machine could not possess the same understanding as a human being. “Partisans of Strong AI¹ claim that in this question and answer sequence, the machine is not only simulating a human ability, but also, that the machine can literally be said to understand the story and provide answers to questions, and that what the machine and its program do explains the human ability to understand the story and answer questions about it. Both claims seem to me to be totally unsupported by Schank's² work.” (Searle, *Minds, Brains, and Programs*, pg 2) Searle does not define what he means when he speaks of understanding for either the man or the machine. It is my intention in this paper to find an epistemically meaningful definition of the word “understanding”, and then reexamine Searle's claims in order to properly assess their truthfulness.

In order to find a plausible definition of understanding, what is meant when the word “understanding” is used should be examined. Webster's offers eight different definitions of the word “understanding”. By examining the differences in these definitions, it should be possible to obtain the general meaning of the word “understand” when we speak of someone who understands. Once a general meaning of understanding is obtained, then it should be possible to extend this meaning into an epistemic definition of understanding, thus allowing understanding to be examined in relevance to human knowledge.

2. The Definition of Understanding

Webster's Dictionary gives eight definitions of “understanding” and for each definition provides some sentences that are supposed to exemplify the meaning stated in the relevant definition:

1. To perceive and comprehend the nature and significance of; grasp
2. To know thoroughly by close contact or long experience with
“That teacher understands children.”
3. To grasp or comprehend the meaning intended or expressed by some entity, or to comprehend the language, sounds, form, or symbols of some entity
“They have trouble with English, but I can understand them.”
4. To know and be tolerant or sympathetic toward

¹For Searle, Strong AI is defined as a programmed computer literally having cognitive states and thus that the program explains human cognition.

²In the 1970s and 80s, Roger Schank was a major innovator in the fields of case based reasoning and dynamic memory. Schank argued that memory was stored in the form of meaningful stories instead of as symbols manipulated by rules. In Schank's view problem solving progresses through using examples stored in memory.

- “I can understand your point of view even though I disagree with it.”
5. To learn indirectly, as by hearsay
“I understand his departure was unexpected.”
 6. To infer
“Am I to understand you are staying the night?”
 7. To accept
“It is understood that the fee will be fifty dollars.”
 8. To supply or add mentally

As we examine the definitions in order, there is a change in what is meant in the usage of the word “understanding.” In the first three definitions, there is a sense that the meaning includes some sort of intimate relationship between the subject who possesses the understanding and the object of that understanding. Moving from definitions four through eight, there is more of a sense that the meaning of “understanding” is related to having a justified belief about a state of affairs, which seems a far weaker form of grasping than what is implied from the first three definitions. Examining the two sets of definitions and then comparing should highlight this difference.

In the case of examining the definitions that indicate that understanding consists of some sort of intimate epistemic relationship between the subject who possesses the understanding and the object of that understanding, the first definition says it all. In fact, that first definition can be applied to the second and third definitions to show that the three definitions in fact have common ground. When the sentence, “That teacher understands children,” is examined, both the second and first definitions of understanding are true. That is, teachers obviously come to know their students thoroughly through years of experience in teaching them, however, it could also be said that the teacher perceives and comprehends the nature of the children, as per the first definition. In addition, the third sentence, “They have trouble with English, but I can understand them,” does, as per the third definition, implies that the subject of the sentence, to whom we'd ascribe the understanding in this case, does in fact grasp the meaning intended by the speaker, and the subject of the sentence perceives and comprehends the meaning of what the person is saying as per the first definition. It can be seen that the sort of understanding defined by definitions two and three has something in common with the sort of understanding defined in the first definition then.

In definitions four through eight, it appears that this intimate relationship between the person to whom we'd ascribe the understanding, and that which we'd claim they understand does not exist. The fourth definition, illustrated by the sentence, “I can understand your point of view, even though I disagree with it,” implies more of a sort of tolerance on the part of the speaker more so than a deep grasp of the nature or significance of the other person's argument. The speaker may grasp the other person's argument, but it is not necessarily the case that they grasp the nature of that argument as the other person perceives it, or the significance of it to them. This does not seem to be quite as strong epistemically as the version of understanding I wish to consider.

In the illustration of the fifth and the sixth definitions, the intimacy between the subject and that which we'd claim that they understand becomes even more tenuous. “I

understand that his departure was unexpected,” and “Am I to understand that you are staying the night?” both seem to be some sort of knowledge of a particular state of affairs instead of the grasp on the nature and significance of the issue that we have mandated.

Using the fifth definition as an example, the speaker knows that the departure of the person in question was unexpected, however the speaker does not seem to grasp the significance of the issue, or grasp the nature of it, and this does not seem to be the sort of epistemic understanding that we are seeking.

The seventh definition involves the acceptance of something as fact, as is outlined in the sentence, “It is understood that the fee will be fifty dollars.” This statement implies that there is a sort of agreement on a particular subject, or an acceptance of that agreement. At best, this is a knowledge that there is an agreement, and at worst this is an implication that there may be an agreement. As above, this sort of understanding falls short of the sort of epistemic understanding we are looking for.

The eighth definition presents a sort of enigma, as it seems as if it could fall into either camp. What is the subject supplying or adding mentally? It would seem as if that which is being supplied is reasoning or logic to some sort of unspoken logical string or argument. However, from where is this reasoning or logic to supply or add coming from? In this sense, it may imply some sort of relationship between the subject and the object of understanding in line with the first definition. So in a way, it could be used to highlight either interpretation of the definition of understanding.

For the purposes of this paper, I am more interested in exploring the former sense of understanding, that is, to perceive and comprehend the nature and significance of something. This seems to require two things epistemically. First, it requires some sort of intimate epistemic relationship between the agent in the object so that the agent can perceive the object's nature. Second, it requires a sort of knowledge that allows for a comprehension of this nature. Such a definition of understanding provides something more essential and interesting to our notion of the term “understanding”, and is thus more interesting to explore than what underlies the latter four definitions of the term.

3. Understanding as Knowledge by Acquaintance

To try and examine what the epistemic contents of this form of understanding may be, I will examine what the first three cases have in common. How is it that the teacher in the second definition grasps the nature of children, or that the speaker in the third definition can understand the person whose grasp of the English language is poor, or how is it that anyone can come to grasp the nature or significance of something as the first definition outlines? I think the reply would be that one gains such a grasp of something through spending time with it, becoming acquainted with it so to speak. A part of understanding then appears to be knowledge by or through acquaintance.³

³For the purposes of this paper, I assume that sentient beings can have knowledge, and that knowledge can be properly defined as a justified true belief. When one says that a person, S, knows a proposition P, what they mean is that S believes P, S is justified in believing P, and that P is true. This applies to propositional knowledge, or knowledge that. I do not think that mere propositional knowledge is the same thing as understanding.

In his paper “Knowledge by Acquaintance and Knowledge by Description”, Russel says, “I say that I am acquainted with an object when I have a direct cognitive relation to that object, i.e. when I am directly aware of the object itself.” (Russel, Knowledge by Acquaintance, pg 202) Using this definition of acquaintance, “knowledge by acquaintance” is that sort of knowledge we have of those things to which we have direct cognitive access. Examples of this sort of knowledge would be knowledge of one's own beliefs, pains, and thoughts, or the knowledge of your friends, or of a particular baseball. This can be generalized as follows: knowledge by acquaintance is the sort of knowledge that someone has when they have direct experience with the object in question. For instance, if we were to say that I have knowledge by acquaintance of my tea cup, what we would be saying is that I have some sort of direct experience with the tea cup.

Typically, knowledge by acquaintance is considered to be opposed by knowledge by description. As Russel puts it, knowledge by acquaintance of an object is that sort of knowledge, “that brings the object itself before the mind,” (Russel, Knowledge by Acquaintance, pg 223) and knowledge by description of that object is “when we know that it is *the* object having some property or properties with which we are acquainted.” (Russel, Knowledge by Acquaintance, pg 223) An example is a person being told that an apple is something roughly round, red, and sweet tasting that grows on trees in temperate climates, assuming our subject was aware of what each of these properties was. In the example, we would say that the person knows what an apple is, because if we were to ask them what an apple is, they would probably be able to provide a satisfactory answer. However, this person may not be able to identify an apple when shown one, as they've never had any experience with an apple outside of its description to them.

One could argue however, that how we come to understand particular physical laws or properties of math is done through knowledge by description. That is, we have the law or property described to us, and then we come to understand it. I do not think this is the case either. Using the Doppler Effect as an example, I have it described to me as the property of waves that they become longer in wavelength the farther they travel to get to you. Then the questions to ask are, do I perceive and comprehend the nature of the object? I would argue no on both counts. First, while I may be able to tell you what the Doppler Effect is if you were to ask me based on the description I was given of it, until I've actually experienced the Doppler Effect, it would seem that I lack a perception into the nature of the object in question. However, one may argue, and I must cede, that while I do not have that necessary intimate connection to the Doppler Effect itself, I could have an intimate connection to the concept of the Doppler effect. That is to say, I perceive the nature of the theoretical law, but I do not perceive the nature of the actual effect. In either case, there still seems to be something lacking in the definition of understanding, as even if I do perceive the nature of the object, unless I can comprehend that nature, through something such as knowing how and why the Doppler Effect works, it seems that my understanding of the Doppler Effect would be incomplete.

Looking at knowledge by description, it becomes apparent that it is insufficient for understanding. If one is merely given a description of something, while we would grant to them that they would know what that something is, we would most assuredly not grant

them that they understand that something. That is, a description of something doesn't provide an intimate connection to the object of the description, but only to the description of that object itself. While this may apply to objects such as concepts, it is not robust enough to extend out onto the full range of objects. Even in the cases of these theoretical objects however, it is insufficient for understanding, as it does not provide a comprehension of the nature of the object of the description.

In contrast to the above, knowledge by acquaintance seems to provide for that perception of the nature of any sort of object, but it still seems to be lacking in the area of comprehending the nature of an object. A pair of examples help illustrate this.

Returning to the Doppler Effect example, it can be claimed that knowledge by acquaintance can be had of such conceptual objects through description. This is because knowledge by acquaintance is a direct cognitive relationship between the agent having cognition about the object, and the object itself. In this case, the object is merely an idea, and in having it described, one forms the idea in their own mind, thus obtaining a direct cognitive relationship with it, and thus obtaining knowledge by acquaintance of it. It then seems, that in the specific case of dealing with objects that are purely conceptual knowledge by acquaintance can be obtained through knowledge by description. It therefore is the case that knowledge by acquaintance grants the perception of the nature of the object it is knowledge by acquaintance of. However, it is still the case that a comprehension of the nature of the object is lacking.

Moving away from conceptual objects, a case involving an actual object needs to be examined. In this example, I shall simply use a catapult. Through whatever means necessary (examining it, firing it, or even being fired from it), our subject has acquired knowledge by acquaintance of this catapult. The subject therefore has a direct cognitive relationship with this catapult, allowing him the intimate relationship with the object that allows him to perceive the nature of it. However, as it is with the Doppler Effect example, the subject is lacking a comprehension as to the nature of the object. It is the case that knowledge by acquaintance of an object, alone, is insufficient for the understanding of an object.

4. Understanding as Operational Knowledge

Since knowledge by acquaintance alone is insufficient for understanding, what is it that is lacking to acquire understanding? As concluded in both examples outlined above, knowledge by acquaintance only allows the agent claiming understanding an intimate cognitive connection with the object, but not the comprehension of the nature of the object. What is being sought then is some form of knowledge that grants such a grasp on the nature of the object. What we are referring to when we refer to the nature of an object are those particular elements of that object that cause it to be that object. That is, if an agent knew how a particular object does what it is meant to do, we could say that it grasped the nature of that object. I will call this sort of knowledge operational knowledge, or knowledge relating as to how an object operates.

In the Doppler Effect example, such operational knowledge would involve knowing how it is the case that the particulars involved in the conceptual Doppler Effect cause it to

work, (Presumably requiring our agent to know or understand other parts of math and physics) which would most likely be knowing the theory of the Doppler Effect, the mathematical equation behind it, and how the particulars of both operate in how they produce their effect. If one separates off the operational knowledge by itself and examines it, it does in fact seem that the agent in question grasps the nature of the Doppler Effect, but operational knowledge alone grants only this. Without the perception of the nature of the Doppler Effect, the agent cannot be said to understand it.

In the Catapult example, operational knowledge would involve knowing how it is the catapult is winched, aimed, fired, and does all things a catapult does. (Again, presumably requiring our agent to know or understand certain underpinnings of the catapult) Again in this case, as it was in the Doppler Effect example, if one were to separate off the operational knowledge by itself, it would only grant a comprehension as to the nature of the catapult, which as was shown above, is insufficient for understanding.

5. Understanding as Knowledge by Acquaintance and Operational Knowledge

It now seems that we have two forms of knowledge involved in understanding, knowledge by acquaintance and operational knowledge. As we concluded above, knowledge by acquaintance is insufficient for understanding, it would seem that operational knowledge alone is also insufficient for understanding. This is because the sense of understanding I am using is defined as both the perception of the nature of an object, and the comprehension of the nature of an object. As knowledge by acquaintance provides for the perception but not the comprehension, and knowledge by operational knowledge provides for the comprehension and not the perception, the defined notion of understanding is neither of these sorts of knowledge by themselves. However, if an agent had both knowledge by acquaintance of an object and operational knowledge of an object, then they would have both the perception and the comprehension of the nature of that object. Such a conjunction would be sufficient for understanding of this sense.

6. Searle's Chinese Room

Given such a definition of understanding, we can now proceed to analyze Searle's assertion that machines are not capable of understanding, which is to say, by my epistemic definition of understanding, Searle's assertion can be read as saying that machines are not capable of possessing both knowledge by acquaintance and operational knowledge. Before I begin, there are a couple of pertinent points to address.

First, Searle describes the Chinese Room example as a room containing a person with an instruction booklet and a slot in the wall through which characters in English are passed in and characters in Chinese are passed out. The person inside uses his rule book to translate the English characters into the corresponding Chinese characters, which are then passed back out of the room. The person with his rulebook represents a computer program. The English and Chinese characters are the input and output to and from the program, respectively. As such, the computer the person represents could be seen as “translating” the English into Chinese.

Searle gives a reason as to why he feels machines cannot understand. Referring to the machine making “symbol manipulations” between English and Chinese using its given rules, Searle sums his point up neatly. “Because the formal symbol manipulations by themselves don't have any intentionality; they are quite meaningless; they aren't even symbol manipulations, since the symbols don't symbolize anything. In the linguistic jargon, they have only a syntax but no semantics.” (Searle, *Minds, Brains, and Programs*, pg 8) What Searle is really saying here is that just because some entity can manipulate symbols (in this case, the English and Chinese characters) does not grant that entity intentionality⁴. That is, the machine does not know that what it constructs out of the symbols corresponds to things in the world, and because of this, the machine is in fact manipulating meaningless signs when it translates the English to the Chinese.

In the following, I will attempt to respond to Searle's claims that the Chinese Room refutes Strong AI. If one holds the type of program used in the Chinese Room constant, then I must cede Searle will be correct in his assessment. However, I feel this is more a valid point on the over-exuberance of researchers in the AI field declaring they had made Strong AI, and the weakness of the Turing Test⁵.

While Searle states that he formulates the Chinese Room Argument with the work of Roger Schank specifically in mind, he also states, “The same arguments would apply to Winograd's SHRDLU, Weizenbaum's ELIZA, and indeed any Turing Machine⁶ simulation of human mental phenomena.” (Searle, *Minds, Brains, and Programs*, pg 2) Searle, in my interpretation of this quote, is saying that the Chinese Room argument refutes all sorts of Strong AI. Therefore, putting a different sort of program in place of the original should make no difference. As such, I will attempt to show that a properly designed machine can have the faculties necessary for the epistemic definition of understanding laid out above.

To further elaborate on the program used in the Chinese Room Example, it is entirely static, that is to say, it's programmed with a series of unchanging prior rules. In fact, in essence all it really is an electronic English to Chinese dictionary. As alluded to above, I question whether or not placing a program of more contemporary design in place of this program would refute Searle's assertions about what the Chinese Room argument accomplishes.

The particular reason why to use a more contemporary system in place of the original static sort of system in the Chinese Room is that the static system lacks the faculties necessary to obtain operational knowledge of the rules it uses. I do not attack the static system's capability to have knowledge by acquaintance of the rules it uses as it could easily be argued that while it is performing operations using those rules, it is having a mental state of sorts about those rules. However, as it has no access to information

⁴Intentionality is the power of minds to be about, to represent, or to stand for, things, properties and states of affairs. (Stanford Encyclopedia of Philosophy, <http://plato.stanford.edu/entries/intentionality/>)

⁵The Turing Test is test in which a judge communicates through a blind text-only channel with a person and a machine attempting to simulate human response. At one time it was believed that if a machine could pass the Turing Test, then that machine was intelligent in some fashion.

⁶The concept of a Turing Machine was defined by Alan Turing as a hypothetical computational device that is capable of storing information and performing instructions.

related to what makes those rules work (it is a static system, the rules are hard coded in when it is created), it has no means of having operational knowledge of them, and as such, cannot have understanding.

The particular type of system I will use for this example is a Semiotic System⁷. While the Semiotic System has many interesting intricacies, the two key ones that apply this particular discourse are the system's method of obtaining input, and its ability to learn. Its method of obtaining input is to take input directly from data it obtains from its external world. When it learns, it does so by either learning new rules of how to interpret that input based on previous input or by learning new rules with which to perform the prior learning. For example, take a very naïve Semiotic System in a virtual world that has the basic rules of logic built into it, rules on how to move in the virtual world, and a very basic rule stating “damage to the self is bad.” During the course of the System's execution, it moves off of a “cliff”, and the resulting “fall” causes damage to the system. The System's next move may then be to write itself a new rule equating moving off a cliff with damage to the self, and thus, equating moving off a cliff with something bad.

Putting such a system into the Chinese Room, I think its arguable that the Semiotic System mentioned above has some minute level of understanding. I say minute because while Searle may be correct that the system doesn't understand what the story its being given corresponds to in our world, I think it understands the relationships between the English and Chinese symbols from the translations it is performing in its world. To put it in terms defined in the previous sections, the Semiotic System in the Chinese Room will have knowledge by acquaintance of the rules of translation and operational knowledge of these rules. I will argue for the knowledge by acquaintance of the rules of translation on the basis that because the Semiotic System can generate new rules based on the input that it is given, it has a direct cognitive relationship to the rules that it generates. I will argue for the operational knowledge of the rules of translation on the basis that as the Semiotic System has a set of rules it uses to generate new rules of translation, it has knowledge of how it is the rules of translation operate.

As outlined in section three, knowledge by acquaintance is a knowledge of some object to which someone has a direct cognitive relationship with. This then seems to require that the agent in question has a mental state of some sort about the object in question. So, when I state that the Semiotic System has knowledge by acquaintance of the rules of translation, I am in essence saying that the Semiotic System has a mental state of some sort about those rules of translation. The question of whether or not this is the case is a difficult one at best as the phrase “mental state” is open to much interpretation. However, I wouldn't be making this argument if I didn't think that the Semiotic System did not in fact have a mental state of some sort. When the Semiotic System generates a new rule, it must go through a set of operations which involve examining the rules it has for rule construction, and then building a new rule based on the data input its generating the rule about. For example, if the machine was being told that

⁷A complete review of important literature about the concept of a Semiotic System can be found in the paper Fuzzy Logic Semiotic Systems, located at: epoxy.mrs.umn.edu/~mansellw/FuzzyLogicSemioticSystem.pdf, or otherwise available upon request to the author.

the Chinese equivalent of the English word “horse” was “ma”, it would reference its rules for rule construction, find the rule of equivalence, (I’m presuming that a Semiotic System designed for translation purposes would have this rule at the very least) and construct a rule equating the English symbol for “horse” with the Chinese symbol for “ma”. As this rule is an object being processed actively by the Semiotic System, the system is having a mental state of sorts about the rule. By our definition then, the Semiotic System has knowledge by acquaintance of the rule equating the symbol for “horse” and the symbol for “ma”.

As outlined in section four, operational knowledge is that sort of knowledge that relates to how the object in question operates. Using the example of the equivocation rule above, an example of the operational knowledge in this case would be knowing how it is the equivocation works. I argue that the Semiotic System has such knowledge on the basis that it has access to the information required to construct such rules. To further examine the example of the equivocation rule, the Semiotic System during the process in which it creates the rule, accesses rule creation rules, one of which identifies equivocation as the sort of relationship between “horse” and “ma” it wants to create a rule for. It seems to be the case then, that at some level, the Semiotic System has knowledge of what equivocation is, and how it works. Thus, it has operational knowledge of equivalence, and more specifically, the equivalence of “horse” and “ma”.

The above two arguments show that the Semiotic System has the capability of possessing knowledge by acquaintance and operational knowledge of the rules it generates. As it is concluded in section five, having both knowledge by acquaintance and operational knowledge of a particular object is at least sufficient for having understanding of that particular object. Therefore, it is the case that the Semiotic System possesses an understanding of the rules it uses to translate English symbols into Chinese symbols.

Searle also argues that the system in the Chinese Room has no intentionality when it does its job. When the Searle uses intentionality it appears to mean the connection of the object of a statement or thought to something real in the world. So when it is said that the system has no intentionality, what is meant is that the system's responses to the data aren't connected to something “real” in the world. This can shown to be a flawed argument.

By Searle's definition of Strong AI's, the AI only needs to simulate those mental faculties that humans have. Either the world that Searle refers to is an objective sort of world, or it is a subjective sort of world. That is to say, either the world is that which truly is around us, or it is that which we perceive around us. If it is the case that the world Searle refers to is the objective world, then it does not seem that humans have the intentionality that Searle requires of the Strong AI. For a human to have intentionality in an objective world, when a human being forms a statement or thought of an object, there would have to be a connection to that objective object. However, when a human does these things, it seems that what the connection is formed to is their perception of that object. Furthermore, at best it is extremely difficult to make any sort of argument that these subjective perceptions correspond perfectly to the objects of those perceptions in the world. It then appears that in an objective world, humans don't have the intentionality

that Searle wants, and if humans don't have this intentionality, Strong AI wouldn't need to have it either.

The case of perception leads straight into the situation that arises if the world is subjective. If it is the case that the world is subjective to us, then the world are those things which we perceive. If this is the case, then anything that can perceive in some sense has intentionality. Examining the machine of the Chinese Room, its world is essentially just the symbols it receives as input and the symbols it outputs and the rules it has for them. The machine's form of perception is feeding in and feeding out the binary language representing its inputs and outputs. When the system makes a statement such as, "The English symbol for 'horse' is equivalent to the Chinese symbol for 'ma'", it is making statements about something it has perceived in the world, and thus, it has intentionality.

In light of the above conclusions about the possibility of understanding and intentionality for a machine, one may raise the objection that the semiotic system seems not to understand nearly to the level of a human, or to have intentionality on the same level as a human. This is a factual statement. The semiotic system, at best, has but extremely limited variations of these two faculties. Despite this, I do not find such an objection compelling. In the end, the purpose of all of this is to argue that the Chinese Room Argument does not disprove the possibility of there being Strong AI, and if the faculties that Searle claims cannot be simulated in fact can be simulated to even the smallest degree, there remains the possibility of Strong AI being created in the future.

In the introduction to this paper, two claims of Searle's were introduced. The first being that instances of Strong AI could not be said to literally understand the stories they are given as input, and that as such they could not provide real answers to questions about those stories. The second being that instances of Strong AI explain the human ability to understand the stories and answer questions. I have two serious reservations about the first claim. The first being a concern that we're not actually feeding the system in the Chinese Room a story, but instead a string of symbols. The second being that it is unfair to expect the system in the Chinese Room to be able to understand the story if the story is not educated as what the symbols in the story refer to. However, assuming Searle's first claim stands, then no, the Semiotic System in the Chinese Room cannot be said to literally understand the story it is given, and as such, cannot answer questions about it. The second claim however, seems at least partially refuted as examining the simplistic sort of understanding that the Semiotic System has of what it "perceives" can give us insight into how the complete sort of understanding that we as humans have about we perceive. Furthermore, the way the Semiotic System builds rules and uses those rules to respond to the inputs its given, can in turn give we as humans insight into some of the more simplistic ways that we respond to questions about stories.

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