The Logician and the Biologist

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Abstract: Modern theories of intelligence have been constructed in an intellectual environment characterized by the results of on-going work by computational theorists on *artificial* intelligence and by philosophers and cognitive psychologists on the nature of *human* intelligence. One result of this work is that the line of demarcation between what is human and what is a machine (an artefact) is often blurred or even erased. Were one to seek an alternative general research program aimed at understanding human intelligence especially, then key elements of Aristotle's theory laid out in the first two books of *De Anima* would be a good place to start.

Key words: *Aristotle, computation, functionalism, intelligence, psuché, Turing*

> *"Don't think you can outsmart Aristotle!"*
> *(Krister Segerberg)*

Introduction

Ray Kurzweil is a computer scientist, inventor and futurist. His books deal with spirituality, artificial intelligence, and a heavy load of prediction. *The Singularity is Near: When Humans Transcend Biology* (Kurzweil, 2006, the movie version was released in 2010 … really) is probably his most popular work. There he argued that technology is progressing exponentially, so that sometime in the future, perhaps at the end of this century, humanity will reach a point (the Singularity) where humans will "transcend biology." He predicts that:

future machines will be human, even if they are not biological. This will be the next step in evolution [...] Most of the intelligence of our civilization will be nonbiological [...] our understanding of the term ['human'] will move beyond its biological origins. (Kurzweil, 2005, p. 40)

Moreover:

In the aftermath of the Singularity, intelligence, derived from its biological origins in human brains and its technological origins in human ingenuity, will begin to saturate the matter and energy in its midst. It will achieve this by reorganizing matter and energy to provide an optimal level of computation [...] to spread out from its origin on Earth. [...] [T]he "dumb" matter and mechanism of the universe will be transformed into exquisitely sublime forms of intelligence [...] This is the ultimate destiny of the Singularity and of the universe. (Kurzweil 2005, p. 35)

I do not know if many philosophers would be so eager to embrace such a future—assuming the concept of such a future even makes sense. Here is what D.W. Hamlyn wrote in 1953: "Our ways of accounting for intelligent behavior must be very different from the ways in which we would account for the movements of machines." Four centuries ago Baruch Spinoza (1632–1677) was clear in his claim that philosophers have to get the biology right before pronouncing on the non-biological. He wrote:

[N]obody as yet knows the structure of the body so accurately as to explain all its functions, not to mention that in the animal world we find much that surpasses human sagacity. [...] It follows from this that when men say that this or that activity of the body has its origin in the mind, which has mastery over the body, they do not know what they are saying. (Spinoza 1985 [1677], Part III, Postulate 2, Note)

It may very well often be the case that from the fact that two things are able to perform the same function we can conclude that they are, in some non-trivial sense, the same sort of thing. When it comes to intelligent people and intelligent machines (whether material or abstract), there are many who urge that very inference. I have some doubts about this, many of which are prompted by some very old—even ancient—ideas. So let us take a brief look at how the issue is addressed by those who, though not as extreme as Kurzwell, support, in some form, the conclusion that the categorical distinction between humans and machines might be denied.

The Turing test

There are many questions that contemporary philosophers of mind worry about. Among the most fundamental are: What are persons? Are they material or immaterial, or some combination? How do we know that a thing is a person? What criteria do we use in judging something to be a person? So the philosophy of mind is in part ontological and in part epistemological. The most popular theories today tend to take persons to be material (though, as we will see, a whiff of dualism still lingers even there). They also tend to take our main criterion for judging a thing to be a person to be behavioral in some way. As Daniel Dennett (1981) has said, we recognize a thing by its effects—we judge a thing to be an intelligent person when we see its behavior as intentional. He calls this the "intentional stance". This naturally raises a kind of chicken-egg problem: Do we take a thing to be a person because we take its actions to be intentional *or* do we take a thing's actions to be intentional because we take it to be a person? But I will pass this by.

In 1950 Alan Turing (1912–1954), mathematician, logician, code-breaker, did *not* ask the question 'Can a machine think?' in spite of the title given to his essay (Turing, 1950) when it was anthologized six years later by James Newman (1956). Turing's question was: Could a machine of the future cause us to believe (deceive us into believing) that it was intelligent? By the "future" he meant a half-century later, i.e., the year 2000. As everyone knows, he formulated a test (now called the Turing test, but which he called the Imitation Game) to decide the issue. Briefly, the idea here is that a player is given the task of deciding which of two hidden things is a person and which is a computing machine. The player asks, in writing, various questions, which are answered, in writing, by the person or machine. The machine can be said to pass the test if players are convinced it is the person at least half the time. As I said, Turing believed that by our day computing technology will have advanced to the stage where some machines will often pass the test and, presaging Kurzweil's claim, our concept of intelligence will broaden to accommodate both humans and advanced computing machines. Suffice it to say, this has not happened yet. Elaborated versions of Turing's test are being applied still, and so far only humans have passed the test.

Remember, Turing called his test the Imitation Game. Now an imitation is, in an important sense, a fake, an illusion. Turing's machine does not have to *be* intelligent—it only has to fake us into *believing* that it is. But Turing thought that once this was done we would begin to conceive of such machines as intelligent, we would take the fake for the genuine article; appearance would

be reality! Still, most of us today can keep the two distinct. We have little problem deploying concepts such as *person* and *intelligence* without having them broadened as Turing and Kurzweil imagined, and we still take computers as tools, mere aids to our intelligence. That is *most* of us—but not all. The field of Artificial Intelligence (AI) is populated by many who believe that it is possible to build a machine that can pass Turing's test, and thus deceive us into taking it to be intelligent. A common assumption among these enthusiasts is that since a machine can do what we cannot it must be displaying some intelligence not due to its maker. This is nonsense, of course. A paper airplane can fly, but that is no proof that it, rather than its maker, should get the credit. Of course, there is an important distinction (noted by one reviewer) between the *source* of a capacity (the computer programmer, the paper airplane maker) and the *exercise* of that capacity (displaying intelligence, flying). If the Turing test is passed, it was passed by the programmer; the program (the abstract machine) may be given attention and scrutiny but the programmer will, quite justifiably deserve the praise for his or her exercise of intelligence.

Consider John Searle's Chinese Room (Searle, 1980). His scenario asks if a thing (viz., the system consisting of the room, dictionary, paper, non-Chinese speaking person, etc.) can deceive us into believing that it can translate Chinese, do what normally requires human intelligence. The Chinese Room amounts to a version of the Turing test. And the answer to the question of whether a Chinese Room can deceive us into thinking that *it* can translate Chinese is: No. Any intelligence, namely, the capacity to translate, attributed to the room, to the "system", rightly belongs to the original dictionary writer or writers, just as any intelligence that might be attributed to a Turing machine is rightly attributed to its maker, the programmer.

One version of the Imitation Game has the player trying to decide which of two hidden persons is a man and which a woman. In this version it might very well happen that the man fools the player, but the fact remains that he is a man. Likewise, the Turing machine might fool a player (actually, the player might be fooled) into believing it is a person, but the fact remains that it is a machine. AI enthusiasts accept this for the man-woman case but cannot seem to do the same for the machine-person case. To be fair to AI, however, we need to keep in mind Searle's distinction between two types of AI: *strong* AI holds that computers *are* (or will be) minds, intelligent; *weak* AI holds only that computers are useful tools for the study of minds. Needless to say, the use of "mind" here raises many difficult questions. I will deal with some of these later.

While many AI researchers have been aiming to make a machine that is more like us (or at least that can fool us into believing that it is intelligent like us), there are a number of philosophers who have been bent on showing that *we* are more like machines (at least when we exhibit intelligence (think, reason) by calculating, computing, applying an algorithm); and this is just what computing machines do. Such an idea is a central part of certain theories in the philosophy of mind called functionalism.

Functionalism

By its very nature a model is only an approximation. It shares certain salient features with the thing that is modeled, but it cannot share all features. A paper airplane is a model of an airplane, but the jet I flew on last month is not a model (it is an example, an instance) of an airplane. Models fall short of their targets in many ways. The model of an atom as a mini solar system is not accurate in many ways. But it is nonetheless quite useful in most situations. Formal logics are not languages (though we often call them so). They model natural language by ignoring non-logical features of natural language and emphasizing logical ones. The idea that a computer is a model of the human brain (the program, software, modeling human cogitation) is now extremely popular among many philosophers. However, there are those who go beyond this, holding that the human brain *just is* a program-running computer. This idea comes from the twin notions that computing is a function that, in theory, is multiply realizable, able to be carried out using a wide variety of computing machines, hardware (electronic, mechanical, biological, etc.) and that human cognition, human intelligence, is computational. This computationalist-functionalist model enjoys wide-spread support among analytic philosophers.

As a philosophy of mind, functionalism is complex. There are a number of subtly distinct versions, and each is a kind of amalgamation of such older theories as Humean associationism, Rylean behaviorism, and Cartesian dualism. Consider a standard behaviorist model of the mind. The mind is a "black box" into which there are inputs (perceptions, say) and out of which there are outputs (behavior). A given mental state can be attributed to the black box (e.g., a person) just in case the black box is *disposed* to produce a certain range of outputs given a certain kind of input. In general, functionalism takes the black box, the mind, to be a Turing-like machine that, depending on the input, is in a series of functional

states that eventually yield the output. Some versions of functionalism take the inputs, outputs, and functional states to be neurological, others take them to be physical, still others leave them unspecified. Some so-called "connectionist" versions say that there is a chain of causal connections from input to output; other connectionists say these are semantic (associationist) connections. A popular line of development in computer design now is Parallel Distributed Processing (PDP), which takes a connectionist approach and aims, in some cases, to build into its model certain kinds of biological constraints.

There is something Cartesian about functionalism as well. About fifty years ago Hilary Putnam began arguing that we are very much like a machine. The machine he had in mind was a modified Turing machine. Like any Turing machine, which is capable of being in a finite number of states and able to "read" information, a Putnam machine is, additionally, sensitive to its environment, able to calculate probabilities of relevant states of itself and its environment, and is constrained by rules of utility. Any computing machine is in a particular functional state if and only if its embodiment (whatever that might be) is in a corresponding physical state. The machine can be said to "know" it is in a given state *directly*—it has privileged access to its own functional states, but it knows the corresponding state of its physical embodiment only *indirectly*. Thus, there is a kind of Mind/Body Problem not only for persons but for Turing machines as well. Moreover, there is for Turing machines also the Problem of Other Minds. One Turing machine might know directly that it is in a given functional state (e.g., computing), but a second machine can only know indirectly that the first is in that state. It must observe the first machine and then conjoin that with theoretical knowledge about functional states and their observable physical correlates. So Putnam argued that, since problems of mind also plague Turing machines, the existence (even any possible solution) of such problems either (1) will not shed any light on humans as unique beings, or (2) will show that both humans and machines have *minds*! Therefore, what a human or machine is *made of* tells us nothing about minds—only functionality does. Mind is a functional program; the brain is just one of many possible hardwares for running that program. Putnam called this 'compositional plasticity.'

Of course, if the problems of mind (the Mind/Body and the Other Minds problems) turn out to be merely pseudo-problems, then they are problems neither for humans nor machines. Machines have functions, we have functions. *We* give the machines that we build those functions. The machines are our tools. Hammers do not drive nails, we do. Calculators do not calculate, we do.

Machines do not think, we do. And while we do apply algorithms, some of our thinking is, after all, calculation, not all of it is. We are living organisms. It is a very old story.

De Anima: A and B

So now I want to rehearse some of that old story. Along the way I will try to make some critical observations, but I will say right now that, as stories of how we can best understand what we are, the old one is preferable to the new ones.

The first two books of *De Anima* (I would like to pretend that Aristotle did not actually write parts of Book 3) make use of a number of ideas elaborated in other works (especially *Metaphysics*, *Physics*, and the biological treatises such as *Parts of Animals*, *Generation of Animals*, and *Generation and Corruption*). *De Anima* is a *scientific* account of living substances. Since what marks off living substances from others is the fact that the form of a living substance is its *psuché*, its psyche, its soul, we can read *De Anima* as an essay in scientific psychology (or *psuch*-ology, as some say). So we need to get clear about what kind of science Aristotle's psychology is. A deep and pervasive underlying assumption of the *Metaphysics* is that the universe is both structured (hierarchically) and intelligible. That is why it is possible for us to give an account of what there is, of *ousia*, being. Any *theoretical* science is the attempt to give a systematic account. Metaphysics (viz., ontology), the highest, broadest, most divine such science for Aristotle, gives an account of what is substance, what has being in the highest sense (being-qua-being). While all the objects of any scientific study are knowable, those of metaphysics are also, *inter alia*, imperceptible and unchanging. Mathematics accounts for what is unchanging but perceptible. Physics is the study of *natural* substances, things that are both changing and perceptible. Some of these things have an external principle of change, an external efficient cause. These are artefacts. Others, natural substances, have their principle of change internally. And among these some are living. For these living substances, these *organisms*, the internal principle of change, the efficient cause, is their nature, their formal cause, that by virtue of which they have life, their *psuché*. Biology is the study of such organisms and their parts. Thus, biology is a part of physics (it still is). Psychology is the study of *psuché*, what accounts for the life of organisms. So psychology is a part of biology (it still is for some psychologists) (see *De An.* 402a4-6, 10-22, and 403a27-29).

The theoretical sciences constitute just one of the hierarchies found in Aristotle. For example, subjects and predicates form an infinite logico-ontological hierarchy, with predicates at one level being subjects at the next higher level. Two other kinds of hierarchies are important in Aristotle's psychology and biology. The form-matter hierarchy treats the form at one level as the matter at the next. For example, brick is the form of mud and straw, and also the matter of the wall (which, in turn, is the matter of the house); and water is the matter of the eye, which, in turn, is the matter of sight. More particularly, the matter of a given organism is its non-uniform, heterogeneous parts, its organs. In turn, the matter of these is *their* uniform, homogeneous parts, e.g., flesh, bone, blood. And the matter of these is the elements, air, earth, fire, water (see *Gen. An.* 715a1012 and *Parts of An.* 647b24-25). Finally, there is, of course, the nutritive, perceptive, rational hierarchy, with its attendant hierarchy of capacities, such as ingestion, touch, sensation, appetition, imagination, reason.

While it is important to understand these hierarchies, it is equally important to understand that each one also constitutes a kind of unity. Aristotle is insistent that *psuché* and body (*soma*), like the form and matter of any substance, constitute a unit, a unified whole, a living organism. Each involves and constrains the other (*De An.* 403a6-7, 413a2-4). This is because each organism is a *combination*, not just a mere *composit* (see *Gen. and Cor.* 328a6 and *Met.*1041b7-32). While a composit is simply a collection, a combination is a structured, unified whole of its parts. Consider your car. All of the parts of a car could be found in a car-parts shop. Suppose such a shop has one each of all the car-parts corresponding to the parts of your car. It still does not have a car. Car-parts need not be parts of cars. While every part of a car is a car-part, not every car-part is a part of a car. For Aristotle, what makes my dog more than just a composite of dog-parts, organs, blood, flesh, bone, etc., is his form, his *psuché*, which is the principle by which he lives, is knowable by me, is what he is, is a unified, *organized*, organism (see *De An.* 410a1-2).

There is more. For Aristotle, the connection between *psuché* and body is far from accidental. The living body is ensouled and the soul is embodied. But not just any chunk of matter will do. There must be a "community of nature" between the two (*De An.* 407b14-26). The *psuché* is enmattered, but not just in *any* matter (*hulé*). It is enmattered in a body (*soma*). More accurately, it is em*bodied*. And it is not just any body, but a body of a certain kind (*De An.* 414a17-24 and *Parts of An.* 642a10-13). Since form, actuality, is prior (in every sense) to matter, potentiality, it follows that the *psuché* is prior to the body that it actually ensouls.

The body is ensouled by the *psuché* it has because it is potentially ensouled, actualized, by that very *psuché* (*De An.* 414a26-29).

Psuché accounts not only for the unity of the whole living organism, it accounts as well for the unity of the body. We have seen that the body constitutes a structured, organized, hierarchy of (homogeneous and heterogeneous) parts. The *psuché* is constituted by all of the organism's organic capacities (literally psychic powers). And in *Generation of Animals* Aristotle says, "Every capacity has a certain corresponding organ" (765b35). The *psuché* unifies the organs to form a living organism. The organs that constitute the body (e.g., the digestive system, the eyes) have capacities (to digest, to see) that, in the presence of the appropriate objects (food, color) are activated. Just as the organs are organs of the parts of the *psuché* (e.g., the eyes are the organs of sight, a psychic power), natural bodies are the organs of *psuché* as a whole (*De An.* 415b18). *Psuché* is a self-unifying, structured, hierarchy of psychic powers, organic capacities (except for thought, of course). This unity is seen in the intricate interdependencies that hold among the various parts, capacities, psychic powers. For example, my dog's locomotion depends on his nutrition, and his nutrition depends on his sight, appetition, and locomotion.

It is important to remember that Aristotle denied that any particular substance, any *this*, could be bare. Every substance has a form that makes it this (*Met.* 1033b20-21). Consequently, every living organism has a *psuché*. Moreover, only a natural substance, a particular this can change. This means that neither matter nor form are subject to change, and, therefore, neither *psuché* nor body can properly be said to change. At *De Anima* 408b1-14 Aristotle admits that we sometimes talk as if the *psuché* could be pained, angry, learn, etc. But he tells us that it is more correct to say that it is the person, the whole organism, that does these things by virtue of its *psuché*. Aristotle was no mere materialist. Matter *per se*, *hulé*, is never what is ensouled. Bodies that are potentially living are what are ensouled. Bodies that are potentially alive are those that are actually alive, ensouled (again, actuality is always prior to potentiality). That is why psychology, for Aristotle, is a part of biology not just of physics. But this also guarantees that for him no immaterial thing can be ensouled either. For *psuché* must be enmattered. Nor, of course, was Aristotle (at least in *De Anima* A and B) a dualist. (Recently, H. Smit has provided a convincing demonstration of the integration of Aristotle's theory with post-Darwinian biology, see Smit, 2018.)

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Aristotle the Biologist

The best way to appreciate Aristotle's contribution to scientific psychology, to a biologically based account of the *psuché*, is to understand just how different his theory is from virtually all post-Cartesian philosophies of mind.

Long ago, in a galaxy far, far away, I used to teach a course called "Philosophy of Mind." I soon realized that if I were to include Aristotle in the course, I would have to change the title (which I did, to "Philosophical Psychology," over objections from the Psych department!). For the fact is that while Descartes and his successors worried about *mind* (*mens*), Aristotle was happily innocent of such a concept. Aristotle was after a *scientific* account of living substances; Descartes was after an epistemology, a theory of knowledge, that would guarantee certainty in at least some areas. We might say that while Aristotle was a biologist-ontologist, Descartes was a physicist-epistemologist. Descartes, equating body and matter, took matter to be essentially extended. Matter might be living or not, but this had nothing to do with its extended nature. Physics (viz., mechanics) was the study of matter (body), extended substance. Aristotle thought that different kinds of material objects (artefacts, plants, animals, persons) have different natures (souls, in the case of living organisms). In contrast, Descartes thought only extention is natural to body. More importantly, where Aristotle had seen *psuché* as at once the actualizing and unifying principle of a living organism, Descartes argued that soul was ambiguous. In one sense it was the Aristotelian principle of life, but in another, and, for Descartes correct, sense it was the principle by which he, Descartes, thinks. Thus, in his reply to the fifth set of objections (see Cottingham, 1996), he replaced the soul (*psuché*), an old-fashioned biological notion, with mind (*mens*). And life and mind have nothing to do with one another. Aristotle says he is a rational animal; Descartes says (in *Med.* 2), "I am a thing which thinks." Where Aristotle saw himself as a living animal, Descartes saw himself as an eternal, immaterial mind, a thinking substance.

It was the challenge of skepticism that drove Descartes here. He sought to protect knowledge from that challenge by finding for it an incorrigible foundation. Knowledge could hardly stand on the foundation of sense experience, which is notoriously fallible. But there are experiences that are not fallible. In dreams, Descartes' perceptions are illusory, but what is not illusory, what is infallible, what is incorrigible is his *seeming to see* those dream objects. While *seeing* might be a biological phenomenon, even a matter of *psuché*, attributable only to animals and us, *seeming to see* is a kind of thinking, *prima facie* mental. Descartes

got his epistemology by paying an ontological price: the splitting of persons into extended bodies and thinking minds. Aristotle's unifying, structuring *psuché* was abandoned and post-Cartesian philosophers of mind have continued to pay Descartes' price.

K. V. Wilkes (1992) outlined a number of advantages that Aristotle's theory of *psuché* has over Descartes' theory of *mens*. Some of these are: Aristotle's theory unifies the study of humans and other living organisms, an impossibility for Descartes. Aristotle can account for the gradual development of an organism (e.g., tree, person) from its more primitive states (e.g., seed, infant), while from a Cartesin perspective any developmental psychology is senseless. Further, for Aristotle each thing has its highest end or good (*eudaimonia* for persons). Our highest good is "living and doing well," especially socially (for "man is a political animal"). By contrast, for Descartes the thinking I is locked into a private theater of ideas, where any belief that there are other persons is either a lucky guess or the conclusion of a notoriously bad inference. Moreover, where Aristotle recognized that any person exhibits a variety of psychic capacities, and different kinds of organisms have different versions of these (compare my dog's sense of smell and mine), Descartes took persons, à la thinking substances, minds, as having just one capacity: to "see" the objects that are its content, all of which, from the idea of the self to the ideas of God, anger, fear, perceptions, etc., are homogeneous, just ideas. Finally, Descartes saddled his heirs with the concept of consciousness (the subsequent history of which is a horror). Aristotle, like all the Greeks, including even the "psychological" dramatists such as Sophocles and Euripides, was happily free of such a notion.

In spite of all this, rumor still has it that some philosophers interpret Aristotle's account of *psuché* as a version of functionalism. The idea here is that he is clearly not a dualist nor any kind of identity theorist (both are views he considers and rejects), but he does hold that the form of a living organism *could* be instantiated in a variety of matters, even though, in fact, it is only instantiated in living bodies (see the famous passage in *Met.* Z.11–viz., 1036a30-1036b6, 1036b24-31). Philosophers like Putnam hold that Aristotle can be read as claiming that the *psuché* is nothing more than a Turing machine, so that any psychological state might, in principle, be instantiated by different kinds of physical states. Moreover, such philosophers are fond, so rumor again has it, of saying that Aristotle's talk of *capacities* in *De Anima* amply shows how he understood *psuché* in terms of functions. Psychological states are not bodily (or, more specifically, brain (though Aristotle might have said heart)) states, they are abstract causes of certain outputs

in an information-processing system. Or so these philosophers say. Well, Aristotle did, after all, talk of the *psuché* as the "cause and principle" (*aitia kai archê*) of the living body (*De An.* 415b8). But consider this. Modern functionalists have an approach to the study of persons modeled on their understanding of Turing-like machines. On this model program, function, software is prior (in every way?) to hardware. Yet Aristotle allowed that there is no such priority in the study of organisms. For example, one might follow the "student of nature" in accounting for anger in terms of heat, blood, etc. (a focus on "hardware"), or one might follow the "dialectician," making the account in terms of passions and motives (a focus on "software"). The "genuine scientist" will, of course, combine the two accounts (*De An.* 403a29-403b9).

Finally, one might have doubts about how far Aristotle would be willing to allow for multiple realizability, compositional plasticity, when reminded that he held that *psuché* and body are mutually interdependent, each constraining the other in various ways (and again see passages such as *De An.* 407b14-19, 20-26, 410a1-2, 414a17-24, etc.). In contrast, functionalists take mental states as simply functional sates of some (natural or artificial) machine that can yield some new state. But the fact that different functional states (e.g., a psychological state and a Turing machine state) can both yield new equivalent states (e.g., a chess move) does not establish the equivalence of the initial states. More generally, and contrary to Dennett's suggestion, the hopes of Turing and Kurzweil, and the enthusiasm of the AI guys, identity of effects is no guarantee of equivalence of the actors. Indeed, at the very least, functional equivalence is never sufficient to establish structural isomorphism (let alone identity). An artificial heart is still not a heart.

The biologist Richard Dawkins (1989) characterizes a living organism as a "survival machine" (where a machine is simply a complex, unified, structured, organism) for a successful replicator (DNA), a gene. Aristotle might have characterized a living organism as a survival machine for a successful life-form, *psuché*. It is just what you would expect from a biologist.

Acknowledgements

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