Chapter 3
From the Linguistic Turn to the Cognitive Turn and Back Again

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Abstract The developments in the field of artificial intelligence are pointing out to complex nature of intelligence. The aim of this chapter is to show that to achieve a deeper understanding of intelligence, which is also the main task of Walter Pitts and Warren McCulloch, we need artificial intelligence, but we need psychology, neuroscience, and we also need philosophy. The complex nature of intelligence points to the need for turning back to evolution of understanding of intelligence that we find in definitions with which we operate and to history of the term itself. Moreover, it seems that the history of attempts to define intelligence indicate that its essence is scattered throughout many fields. However, the turn to the history of the meanings of the term itself can unravel the essence of intelligence. For this, we need philosophy. Perhaps we can say that we can grasp the essence of intelligence from mingling between the linguistic and the cognitive. For this, we need AI, psychology, neuroscience, and philosophy.

3.1 Introduction

The nature of intelligence is complex and therefore the meaning of the term "intelligence" is hard to grasp. This has implications for psychology, neuroscience, and Artificial Intelligence (AI). To achieve their own goals, these disciplines need not only to define but, moreover, to understand intelligence. There are many ways of defining this phenomenon. If any discipline in history has shown this, it is AI. Namely, as AI is developing we understand that intelligence is more than we thought or more than we supposed in our definitions. However, our definitions certainly are the starting points of our inquiries and points we return to. Furthermore, sometimes, as in case of intelligence, the so-called evolution of our understanding of a phenomenon is seen in variety of definitions. This variety is uncovering to us that the nature of the

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phenomenon is complex and its essence is hard to grasp. However, if we turn to the term itself we see that from the metamorphosis of its meaning we can come closer to grasping the essence of intelligence and deepen our understanding of it. For this we need AI, psychology, neuroscience, and philosophy.

There were not many disciplines throughout history that challenged our understanding of intelligence as AI did. Hence, the developments in the AI field are pointing to complex nature of intelligence, and to the need of an adequate philosophy. In this sense, we can say that today is an interesting moment for psychology, neuroscience, and AI, which are called to turn back to philosophy for a deeper insight into the meaning of the term they operate with. In addition, this is an interesting moment for philosophy, which is called to turn to psychology, neuroscience, and AI to broader its understanding of intelligence. Even though there is no agreed-upon definition of intelligence, either in psychology or in philosophy, dispute about intelligence is still vivid. Moreover, the concept of intelligence is evolving and migrating from field to field. The history of this evolution, in the sense of attempts of defining the intelligence and in the sense of metamorphosis of the concept, is uncovering that the essence is scattered through many fields. To better understand intelligence and to come closer to the grasp of its essence, the main tasks Walter Pitts and Warren McCulloch wanted to achieve, we need to turn to philosophy. The aim of this chapter is to suggest how to grasp the essence of intelligence by turning to the history of the term "intelligence". Some parts of this history are and some are not well known outside of the context of philosophy. Hence, we will turn to these parts in order to come closer to our objective. This turn we will call "the turn for the missing pieces of the meaning". We will not open philosophical discussions on the nature of intelligence, or on the nature of definitions or relations between meanings and essence. Rather we will indicate why philosophy is essential for the developments in the field of AI, psychology, neuroscience, etc., and why it is essential for better understanding of intelligence. Furthermore, we will not offer a new theory of intelligence, or a new definition. However, we will show that throughout the history of attempts to define intelligence and through the history of metamorphosis of the term, we can indicate the essence of intelligence that has implications for the field of artificial intelligence.

3.2 Turning Back for Missing Pieces of the Meaning, or: Why Philosophy Matters?

Sometimes, to get the point, we need to reverse the story. We need to turn back for missing pieces of the meaning. Therefore, we start from the father of computing who marked the first step of the birth of artificial intelligence [19, p. 2]. Alan Turing started his famous paper *Computing Machinery and Intelligence* with the proposal to consider the question: Can machines think? He stated that to answer this question, he needed definitions of the meaning of the terms "machine" and "think" but concluded that "the definitions might be framed so as to reflect so far as possible the normal use

of the words, but this attitude is dangerous" [23, p. 433]. Instead of the definitions of the terms, he proposed the "imitation game," and the today well-known concept of the "Turing test" was born. Thus, when John McCarthy coined the term "artificial intelligence" (1955) [13, p. 2], he did not just create the term for the new field of AI, he reopened the question and the problem Turing faced. In his book *Defending AI Research* McCarthy commented the so-called *Lighthill Report*.[1] One of the basic ideas of the *Lighthill Report* is that "the general structure of the intellectual world is far from understood, and it is often quite difficult to decide how to represent effectively the information available about a quite limited domain of action even when we are quite willing to treat a particular problem in an ad hoc way" [16, p. 28]. Lighthill concluded that AI has not contributed to applications in psychology and physiology. McCarthy stated that Lighthill ignored the possibility that AI has goals of its own and showed that AI has contributed to other subjects. For McCarthy, *Lighthill Report* is giving up on science. For him, AI is promising, but "a very difficult scientific study, and understanding intelligence well enough to reach human performance in all domains may take a long time between 5 years and 500 years. There are fundamental conceptual problems yet to be identified and solved, so we can't say how long it will take" [16, pp. 29, 36]. From Turing's words quoted at the beginning of this section, we can conclude that he would agree with McCarty regarding the fundamental conceptual problems.

Furthermore, commenting on John Haugeland's book *Artificial Intelligence: The Very Idea*, McCarthy said that Haugeland got many things wrong but that he was right about two things. The first is the polarization between the scoffers and the boosters of AI regarding the self-assurance of both sides about the main philosophical issue. Second, he is right about the abstractness of the AI approach to intelligence. For, as McCarthy says, "we consider it inessential whether the intelligence is implemented by electronics or by neurochemical mechanisms or even by a person manipulating pieces of paper according to rules he can follow but whose purpose he doesn't understand" [16, p. 40]. Moreover, for McCarthy, the book contents show that many issues raised by philosophers from Aristotle, Hobbes, and Descartes to Leibniz and Hume are alive today, but in an entirely different technological context. Even so, "it's hard to trace any influence of this philosophy on present AI thought or even to argue that reading Hobbes would be helpful. What people are trying to do today is almost entirely determined by their experience with modern computing facilities rather than by old arguments however inspired" [16, p. 41]. We do not know what Turing would say on this comment, although his famous paper was published in *Mind*. However, we think that Turing was right that the main problem is the definition, but, unlike McCarty, we think that to solve this problem we need philosophy. To understand intelligence well enough to try to reach human performance demands interdisciplinary and complementary approach to a phenomenon.

Now, just as thinking was the epitome of intelligence and logic considered as something connected with the laws of thinking, and just as it was, therefore, natural

[1] Name used for the paper "Artificial Intelligence: A General Survey" by James Lighthill, published in Artificial Intelligence: a paper symposium in 1973. It is the proposal to end support for AI research

that AI started out with logic [19, p. 12], it is even more natural than AI, as any other science, needs philosophy for solving fundamental conceptual problems. Perhaps it is "inessential whether the intelligence is implemented by electronics or by neuro-chemical mechanisms or even by a person manipulating pieces of paper according to rules he can follow but whose purpose he doesn't understand" [16, p. 40], but it is essential to know what intelligence is. The first fundamental problem concerns the concept "intelligence" and we should consider its nature more closely. How do we define intelligence and can the meanings of the term "intelligence" indicate an essence of intelligence?

Without doubt, in routine scientific practice, it is not easy to trace philosophical influence on the discipline with which we are engaged. However, we should be aware that philosophy is mother of the sciences on the one side and on the other side that for routine scientific practice we need concepts. Concepts are main connections between human activities, culture, scientific disciplines and philosophy, and it is the task of philosophy to discuss and understand the nature of these connections. Moreover, concepts are necessary tools for every science, starting points of every scientific inquiry. We can generalize from the history of philosophy and say that "a discipline remains philosophical as long as its concepts are unclarified and its methods are controversial. Some may say that no scientific concepts are ever fully clarified, and that no scientific methods are ever totally uncontroversial. If that is true, all that follows is that there is always a philosophical element left in every science" [14, p. 4].[2]

However, concepts we use have a history; we can say that their meanings evolve and that they migrate between disciplines. There are many patterns according to which concepts we use evolve

> […] but usually they become more and more general. However, this process is not a linear one. It can have many side-branches and diverse ramifications. The objective of science is to explain each specific phenomenon, but to explain a phenomenon in science means to put it in a more general conceptual scheme. Moreover, in this generalization process old concepts are not eliminated but engulfed by new ones as their "special cases". We could risk the statement that the generalization of conceptual schemes determines an "arrow of time" of scientific progress. During every such metamorphosis they changed their meanings by adapting themselves to a new environment. The history of ideas is full of instances of these processes. But it would be naive to think that they belong only to the past [12, pp. 247–248].

Psychologist Robert J. Sternberg said that as anyone who has seriously studied the history of any country knows, there is not one history of a country but many histories. Similarly, he said, there is no one history of the field of intelligence, but many histories that depend on who is doing the telling [21, pp. 3–4]. The same applies to the concept of intelligence. The nature of intelligence is still a big question, and Sternberg, in his book *Metaphors of Mind. Conceptions of the Nature of Intelligence* [20], said that metaphors, and there are many metaphors of intelligence, serve as the foundations for theories of intelligence. Again, we do not have an answer to the

[2]For the studies about the conceptual parallels between philosophy and cognitive science see [17]. For the philosophical introduction to AI see [4, pp. 4–10], and for the philosophy of AI see [3].

question what intelligence is nor agreed definition of intelligence. It depends on who is doing the telling.

Therefore, we need to turn back to history on two levels. First, we need to turn back to history of the metamorphosis of understanding of nature of intelligence that we see in definitions we use. Second, we need to turn back to history of the term itself. To neglect the history is to give up on a part of the meaning and to reduce our understanding of a phenomenon. We might say that science helps us to understand a phenomenon in some new way, but science starts with the definition of the concept it uses. From the concept, using definitions, we turn to inquiry and from inquiry we turn back to the concept. However, to know the history of the concept and the meanings of a term itself is to know the phenomenon deeper. This means to come closer to the essence that is scattered throughout many fields. For this, we need philosophy. We cannot open the philosophical discussions on these questions but we can indicate that reading of some philosophical texts on this subject would be very useful, but to have philosophy of an adequate depth it would be precious. In this sense, since AI uses definition of intelligence to turn to its own inquiry, it would be very useful for the goals of AI to have an appropriately deep philosophy. The inquiries of AI researchers, particularly in the field of deep learning, help us to understand intelligence better, which is good for psychology, neuroscience and philosophy. Sometimes in this turn from the linguistic to the cognitive and back we find forgotten or hidden pieces of meaning. Perhaps we can say that we can grasp the essence from mingling between the linguistic and the cognitive. Certainly, we are achieving better understanding of intelligence. This would surely be something that Walter Pitts and Warren McCulloch, with whose seminal paper, *A Logical Calculus of Ideas Immanent in Nervous Activity*, the neural network history begins, would have wanted [19, pp. 3–5]. Our first turn is the turn to the question of what intelligence is or to the attempts at defining intelligence.

3.3 The Definition, or What Is Intelligence?

Throughout human history intelligence was understood in various ways, as the capacity for abstract thought, understanding, communication, planning, learning, reasoning, and problem-solving. Today "intelligence" is the term we apply in human but also in non-human context and, consequently, it is studied in the context of human species and in animals and plants [11, p. 7]. The term evolves definitions multiply and epistemologies change. The term "intelligence" is widely used but the question what intelligence is still puzzles the minds of many philosophers, scientists, and psychologists.

Since intelligence is inquired first and foremost in human context, we naturally turn to psychology for the answer to the question what intelligence is. However, we find that in psychology there is no agreed-upon definition of intelligence. Moreover, as Strenberg notes: "although all fields of psychology are perceived through ideological lenses, few fields seem to have lenses with so many colors and, some might

argue, with so many different distorting imperfections as do the lenses through which are seen the field of intelligence" [21, p. 4]. The reason for this lies in the fact that intelligence is the construct on which psychologists base their models, but at the same time, the fundamental question is how to conceive intelligence.

In psychology, there are two well-known attempts to define intelligence. The first is based on the famous study of experts' definitions of intelligence. It was done by the editors of the *Journal of Educational Psychology* in 1921 (*Intelligence and its measurement*) and known as *The 1921 Symposium*. Experts were asked to address two issues. First, what they conceived intelligence to be and how it could be best measured by group tests? Second, what would be the next most crucial research step? Fourteen experts gave their views on the nature of intelligence. They offered 11 definitions. Thorndike said that intelligence is the power of good responses from the point of view of truth or facts. Terman said that it is the ability to carry on abstract thinking. Freeman said that it is sensory capacity, capacity for perceptual recognition, quickness, range or flexibility of association, facility and imagination, span of attention, quickness or alertness in response. Colvin saw it as something learned or ability to learn to adjust oneself to the environment, and Pintner as the ability to adapt oneself adequately to relatively new situations in life. Henmon defined intelligence as the capacity for knowledge and knowledge possessed, while Peterson saw it as a biological mechanism by which the effects of a complexity of stimuli are brought together and given a somewhat unified effect in behavior. Thurstone defined intelligence as the capacity to inhibit an instinctive adjustment, the capacity to redefine the inhibited instinctive adjustment in the light of imaginably experienced trial and error, and the capacity to realize the modified instinctive adjustment in overt behavior to the advantage of the individual as a social animal. While Woodrow thought it is the capacity to acquire capacity. For Dearborn intelligence was the capacity to learn or to profit by experience and for Haggerty it was sensation, perception, association, memory, imagination, discrimination, judgment, and reasoning. Other contributors to the symposium did not provide clear definitions of intelligence [21, p. 6].

Another well-known attempt to define intelligence was done in 1986 by two leading figures in psychological research on intelligence. Douglas K. Detterman and Robert J. Sternberg tried to update the 1921 symposium. They

> Solicited two dozen brief essays by experts in the field of intelligence, who were asked to respond to the very same questions that were posed to the experts in the 1921 symposium. The idea was to address the issues raised in a way that might reflect any progress that had been made from the beginning to the ending of this century [15, p. 19].

The two dozen answers were published the same year in book titled *What Is Intelligence? Contemporary Viewpoint on Its Nature and Definition*. Sternberg and Berg made the comparison of the 1921 and 1986 attempts to define intelligence and came to three insights. First, attributes such as adaptation to the environment, basic mental processes, higher order thinking (e.g., reasoning, problem-solving, and decision-making) were noticeable in both symposia. Therefore, they concluded that there was at least some general agreement across the two symposia regarding the nature of intelligence. Second, central themes occurred in both symposia, but main

question was: Is intelligence one thing or is it multiple things, and how broadly should intelligence be defined? Third, despite the similarities, difference was metacognition, conceived of as both knowledge about and control of cognition. It played a prominent role in the 1986 symposium, but almost no role at all in 1921. The 1986 symposium also placed a greater emphasis on the role of knowledge and the interaction of mental processes with this knowledge [21, p. 7]. Their general conclusion was:

> The field of intelligence has evolved from one that concentrated primarily upon psychometric issues in 1921 to one that concentrates primarily upon information processing, cultural context, and their interrelationships in 1986. Prediction of behavior now seems to be somewhat less important than the understanding of that behavior, which needs to precede prediction. On the one hand, few if any issues about the nature of intelligence have been truly resolved. On the other hand, investigators of intelligence seem to have come a rather long way toward understanding the cognitive and cultural bases for the test scores since 1921 [22, p. 162].

Based on the gathered definitions of intelligence on two symposia Sternberg offered an integrative framework for understanding the conceptions of intelligence. The proposed framework branches understanding of intelligence in three contexts. First, *individual* context that includes: (A) Biological level: 1. across organisms (between species (evolution), within species (genetics) and between-within interaction); 2. within organism (structure, process, and structure-process interaction); 3. across-within interaction. (B) Molar level: 1. cognitive (metacognition (processes, knowledge, and process-knowledge interaction), cognition (processes (selective attention, learning, reasoning, problem-solving, decision-making), knowledge and process-knowledge interaction) and metacognition-cognition interaction); 2. Motivational (level (magnitude) of energy, direction (disposition) of energy, and level-direction interaction). (C) Behavioral level: 1. academic (domain-general, domain-specific, and general-specific interaction); 2. social (within-person, between-persons, and within-between interaction); 3. Practical (Occupational, Everyday Living, Occupational Everyday Living Interaction); (D) Biological-molar-behavioral interaction. Second, *environmental* context that includes: (A) Level of culture/society and (B) Level of niche within culture/society which booth branch on: 1. demands; 2. values and 3. demands-values interaction. (C) Level × sublevel interaction. Third, *individual-environment interaction* [22, pp. 4–5].

Charles Spearman (1904) proposed well-known g or general factor of intelligence (the stock of energy in the nervous system) and s or specific factor of intelligence (the structure of some particular area of group of neurons). "The general mental acts and is constant for the individual. It consists of the energy which is at the disposal of the whole brain. The specific factor is the structure of some particular area or group of neurons in the brain" [8, p. 260]. However, this did not solve the problem of the definition of intelligence; it only confirmed complexity of its nature [8, p. 260]. Therefore, Sternberg's framework is a good outline of the complex nature of intelligence. This complexity certainly indicates why we lack agreed-on definition of intelligence. In addition, with developments in AI, this complexity is a good confirmation of need for philosophical insights in ways of defining a phenomenon and for understanding of intelligence. Without doubt, for these requests it would be useful to read philosophers as Plato, Aristotle, Locke, Frege, Rusell, etc. that were

discussing nature of definitions in their texts. Furthermore, the complex nature of intelligence indicates why Sternberg concluded that the basis for its understanding is metaphor. In that sense, it would be useful to study philosophical discussions on metaphors, analogy or links between words and objects, and in that sense Plato, Aquinas, Frege, Kripke, and Quine can be useful.

Some psychologists recognize this philosophical background. Jagannath P. Das starts his inquiry of the history of the definition of intelligence with the indication that we can trace attempts to define intelligence back to Aristotle, who divided mental functions into the cognitive (cybernetic) that are essentially thought processes and the orectic (dynamic) that comprise emotional and moral aspects.[3] Further, he says that similar dichotomy can be found in the Hindu system of logic where "Purusa, literally, the male energy, is thought which acts as a catalyst for Prakriti, the female energy, which is emotion and action. The former is passive, the latter is active" [6, p. 1]. Then he notices that we can recognize the same distinction today and concludes that "currently, we separate intelligence from personality or the cognitive from the affective domain, although such separation is recognized to be impossible at a practical level" [6, p. 1]. Das points out well that contemporary attempts to define intelligence have philosophical background and this background needs to be studied if we want to gain better understanding of intelligence.

Has intelligence evolved and how much, as we read in the 2015 Goldstein, Princiotta and Naglieri *Handbook of Intelligence: Evolutionary Theory, Historical Perspective, and Current Concepts*, depends on its definition, but our understanding of intelligence certainly has evolved and will grow as different disciplines put their forces together. We still do not have complete understanding of intelligence nor agreed-on definition of it, but the term is alive. Maybe as Lanz said the term "intelligence" stirs up more trouble than it can help to soothe [15, p. 21], but we think that from the meaning of the term we can derive the essence of intelligence. We can say that we are turning to the history of the term "intelligence". Some parts of this history are not well known outside of the context of philosophy.

3.4 The Term "Intelligence"

Expert in the field of intelligence themselves are aware that behind the definitions of intelligence and behind the concept with which they operate there is a philosophical thought and a philosophical term. Both is evident from their texts devoted to the nature and the concept of intelligence. Therefore, for example, Goldstein turns back to the meaning of the term "intelligence". He notes that the roots of the term "intelligence" are in the Latin verb *intelligere* and that in turn has roots in *interlegere*, and that the "form of this verb, *intellectus*, was the medieval technical term for someone with a good understanding" [11, p. 3]. This was the translation of the Greek term "nous".

[3] It is true that we can find this kind of distinction, although the term "cybernetic" is not quite appropriate. The distinction between the cognitive and the affective can be attributed to Plato.

> Nous, however, was strongly linked to the metaphysical, cosmological theories of teleological scholasticism, including theories of the immortality of the soul and the concept of the active intellect. Its entire approach to the study of nature, however, was rejected by modern philosophers, including Francis Bacon, Thomas Hobbes, John Locke, and David Hume, all of whom preferred the word "understanding" in their English philosophical works. […] The term intelligence, therefore, has become less common in the English language philosophy but has been widely adopted in contemporary psychology, absent the scholastic theories which it once implied [11, p. 3].

Goldstein well notices that contemporary uses of the term have lost some of the pieces of the meaning of the term itself. But these missing pieces can be important for our understanding of intelligence and have implications for the fields that operate with the concept of intelligence. Therefore, we turn back for those missing pieces of the meaning. Once more, we will reverse the story.

The term "intelligence" has its roots, as Goldstein noticed, in Latin, which through the forms of the term "intellect," that is translation of Greek term "nous," connects English, Latin, and Greek language. However, as Goldstein indicated something is missing from English usage of the term "intelligence," but it is not only some scholastic theory. Namely, in Latin language the term "intellectus" is noun use of past participle of "intelligere" that was translation of the Greek term "nous". The Latin term was probably translated from Aristotle, but in philosophy it was introduced by Anxagoras from its pre-philosophical usage. It should be noted that English language does not have a convenient verb for translation and it cannot cover the various activities of the intellect, as the Latin *intelligere*. As Kenny writes

> To correspond to the Latin verb one is sometimes obliged to resort to circumlocutions, rendering *actu intelligere*, for example, as "exercise intellectual activity". An alternative would be to use the English word "understanding", in what is now a rather old-fashioned sense, to correspond to the name of the faculty, *intellectus*, and to use the verb "understand" to correspond to the verb *intelligere*. In favor of this is the fact that the English word "understand" can be used very widely to report, at one extreme, profound grasp of scientific theory ("only seven people have ever really understood special relativity") and, at the other, possession of fragments of gossip ("I understand there is to be a Cabinet reshuffle before autumn"). But "understand" is, on balance, an unsatisfactory translation for *intelligere* because it always suggests something dispositional rather than episodic, an ability rather than the exercise of the ability; whereas *intelligere* covers both latent understanding and current conscious thought [14, p. 41].

What intelligere covers is beast seen at Thomas Aquinas.[4] As Jason T. Eberl[5] outlines, in Aquinas we notice that the intellect should be understood as an essential capacity (not singular capacity, and not more than one intellect for each person, but one intellect that engages in various types of operations) of a human soul. Since

[4] One of the most influential scholastics and philosopher who is direct connection to early Christian philosophers and Greek philosophical thought, just as Aristotle is connection to thought of Presocratics. He is important to us not only because in his texts he gives an overview of the history of arguments of thinkers before and in his age on questions he dealt with, but because he was systematic, logically clear, and the Latin he used was precise the Latin used on first Universities.

[5] In this passage, we will use Eberl overview of Aquinas questions 79, 84–89 from *Summa theologiae* but for the start of deeper study we recommend questions [1, Sth. I. q. 75–89].

Aquinas is accepting Aristotle's hylomorphic understanding of the soul, he does not identify the soul as Plato with the intellect, nor does he use the term, like post-Cartesians, to refer to the "mind" or "consciousness". In that sense, the non-rational animals are conscious and capable of certain degree of cognitive activity, they have minds, but they do not have *intellectus*. But Aristotle and Thomas make the further distinction between *intellectus possibilis* and *intellectus agens* that are two functions of intellect. The possible intellect is like *tabula rasa*, but it has a cognitive architecture that makes it possible to comprehend the intelligible forms it receives. It is analogue to Chomsky's thesis that human beings are born with an innate language-learning ability (capacity to learn). However, the intellect abstracts the intelligible form from its sense-perception of individual human beings and this abstraction is accomplished by active (agent) intellect (a creative intellectual light; an ability that belongs to the individual thinker). There is no intellectual cognition without objects perceived through senses (phantasm). Furthermore, the intellect uses the received intelligible forms and acquires additional knowledge through reasoning (something the intellect does). In confronting a particular object, intellect has three primary operations. First, the intellects comprehension of intelligible form is done by abstraction (conceptual striping away), and in this sense intellection differs from sensation as *seeing as* from *seeing*. For instance, intellection consists in apprehending this person *as human*, as opposed to perceiving *this person*. However, all human seeing intrinsically involves *seeing as*. Second, the intellect can "compound and divide" comprehended concepts, and gain deeper understanding (comprehend essential properties and formulate propositions) or create fictional objects. Finally, the intellect can reason, that is, engage in syllogistic inferences. The reasoning takes various forms, which depends on object and purpose. In this sense, Aquinas distinguishes higher from lower reason, that is, reasoning about eternal objects with the goal to attain wisdom, and reasoning about temporal objects. These forms of reasoning form speculative reasoning that aims at discovering what is the case, while practical reasoning aims at determining what ought to be done (moral reasoning). Now, since the human intellect has the innate structure, both the speculative and the practical reasoning include first principles. The first principles of practical reasoning are background everyday premises, like the principle of non-contradiction. The most fundamental principle in practical reasoning is "good is to be done and pursued, and evil is to be avoided" and the main feature of cognitive architecture required for moral reasoning is *synderesis*.[6] that is fundamental disposition of the intellect to reason practically. This conscious application of first principles for Aquinas is conscience. Finally, the intellective soul knows itself, but by means of its activity of intellectual abstraction, that is the self-consciousness or self-knowledge is by-product of intellectual cognition [7, pp. 100–109]. The self-awareness is "an intimate internal experience of myself as an existing individual, concretely present to myself in my acts" [5, p. 73].

Therefore, *intelligere* covers all characteristics of *intellectus* that is translated by the English term "intellect". The intellect "is the capacity for understanding and

[6]For detailed overview of human acting on moral principles see whole book and for the indicated term [24, pp. 110–101, 205].

thought, for the kind of thinking which differentiates humans from animals; the kind of thinking which finds expression especially in language, that is in the meaningful use of words and the assignment of truth-values to sentences" [14, p. 41]. However, as we have seen, for Aquinas the hylomorphic character of human nature is reflected in the mode of human cognition. The gap between immaterial intellect and material realities, Aquinas bridges the gap between immaterial intellect and material realities with a complex psychological process of dematerialization that is accomplished by a hierarchy of cognitive powers, each grasping a different aspect of experienced reality [5, p. 10]. Human intellect is naturally directed toward the "essences that are in material objects, and it depends on the senses for access to such objects. Thus the senses are not the obstacle, but the vehicle, for human intellectual cognition" [5, p. 9]. The operation of intellectual thinking occurs when the possible intellect is "informed" by the intelligible form illuminated by the active intellect. In this moment, my possible intellect is actually formally united with the essence in that individual object. This is the moment of understanding. Our intellectual attention is turned toward the objects of perceptions (phantasms), so that sense and intellect are unified in my *seeing* as *seeing as*. "This 'turn' secures a unified experience of the world in which sense and intellect cooperate, in consonance with the hylomorphic soulbody unity that is the human individual" [5, p. 22].

However, those characteristics of *intelligere* are not only products of mediaeval philosophical theory of mind and Aquinas discussion with philosophical ancestors. Aquinas "intelligere" is the precise translation of the Greek term "nous". *Intelligere* was carrying the essence of the meaning that was present in the first usage of the term "nous" in pre-philosophical period. The analysis of the meaning and etymology of the term "nous" used in pre-philosophical period was made by K. von Fritz and it supports this kind of reasoning. Since there is no accepted etymology of the term "nous," von Fritz started his analysis with the discussion of Homer. He pointed out that Joachim Boehme distinguished three main meanings of the term "nous": "(1) 'Seele als Träger seelischer Erlebnisse', which may perhaps be translated as 'the soul as an organ of experiences'; (2) 'Verstand', which can be either 'mind' or 'intellect' or 'intelligence' or 'understanding'; (3) 'Plan', which is 'plan' or 'planning'" [9, pp. 80–81]. Furthermore, von Fritz stated that in order to clarify these distinctions Bruno Snell "pointed out that in the first case *nous* means an organ, in the second and third case the function of this organ but with the further difference that in the second case it means the function as such while in the third case it means the function at a given moment. The second meaning, then, would correspond to the present tense of a verb, the third to an aorist" [9, p. 81]. The detailed analysis led von Fritz to conclude that Schwyzer's proposal of etymology is far more correct and the term is probably derived from a root meaning "to sniff" or "to smell".

It is quite true, writes von Fritz,

> that in Homer *noein* appears more often connected with the sense of vision than with any other sense. But this need not always have been the case. The most fundamental and most original meaning of *noein* in Homer seemed to have been "to realize or to understand a situation." The most primitive case in which a situation becomes important is that in which there is

> danger or where there is an enemy nearby. The most primitive function of the *nous*therefore would have been to sense danger and to distinguish between friend and enemy [9, p. 93].

Further, von Fritz presupposes

> that in a very early stage of human development the sense of smell played a preponderant part in this function. One has only to point to the fact that even in our present day language we still speak of "smelling a danger." With the development of a higher civilization the sense of smell would naturally have been more and more replaced by the sense of vision. But the understanding of a situation remained nevertheless distinguished from the vision or even recognition of an indifferent object. It is not impossible that the emergence of this new concept of a purely mental function was greatly favored by the fact that the original connection of this function with the sense of smell receded more and more into the background, as the sense of vision became more preponderant in importance, and finally was completely forgotten [9, p. 93].

It is interesting to look back on Aquinas understanding of intellect and notice that for Aquinas "verbs like *percipere* and *experiri* serve as general verbs of cognition (like *intelligere* or *cognoscere*) to denote sensory or intellectual operations or some cognitive operation in general, but they carry an additional connotation of the objects intimate presence to the intellect" [5, p. 73].

At the beginning of further inquiry of the uses of the term by Presocratic philosophers von Fritz summarizes derivative meanings of the terms "nous" and "noein" that can be found already at Homer. Therefore, the term "nous": (1) sometimes implies the notion of a specific reaction of a person to a specific situation and can be thought as a specific attitude; (2) can be thought as planning (to escape from dangerous situation or to deal with the situation); a volitional element enters into the concept; (3) can be thought as something that remains in the purely intellectual field; the realization of the meaning of a situation or the deeper insight into its real nature; (4) penetrates beyond the surface appearance and discovers the real truth about the matter ("intuitive element"); (5) "makes far-off things present" (designate the imagination by which we can visualize situations and objects which are physically or temporally distant); and (6) indicates a certain amount of reasoning (can engage in syllogistic inferences) [10, pp. 223–225]. Therefore, from this, it seems that mentioned derivative meanings of the Greek terms are present in Aquinas understanding of *intelligere* from which term "intelligence" arrives. Moreover, it seems that those terms uncover the essence of intelligence. This essence, however, has clear implications for contemporary inquiries of intelligence, especially for the AI field.

3.5 The Essence of Intelligence and AI

From this short insight in the history of evolution of our understanding of intelligence and attempts of its defining, we can conclude that we can distinguish various types of definitions and that they, as philosophical discussions indicate, are of different types and have different purposes. However, this also indicates that the essence of intelligence is scattered throughout many fields or disciplines. This has direct implications

for all the sciences. This is what Turing noticed and therefore proposed the "imitation game" that would correlate to IQ test that postulate parameters of intelligence without the answer on the question what intelligence is, or which of the definitions, in philosophical sense, would be real definition of intelligence. In that sense, we could say that intelligence remains a mystery. Nevertheless, indicated framework of understanding and studying of intelligence indicate that there is something that all definitions have in common. That is intelligence itself, which can be understood as g factor, Holy Grail as Margaret Boden called it, that AI cannot grasp. It seems that in spite of great developments in the field of AI that human level of AI is not within sight [2, p. 56]. As Sternberg's framework and developments in the field of AI indicate, it seems that intelligence includes more than logical reasoning. Language, creativity and emotions are challenges for the AI field, but intentionality, making moral decisions, intuition, and dreaming are also waiting around the corner to be challenged.

Writing on intentionality, John R. Sarle says that "anyone who tries seriously to follow out the treads the Network will eventually reach a bedrock of mental capacities that do not themselves consist in Intentional states (representations), but nonetheless form the preconditions for the functioning of Intentional states" [18, p. 143]. This background is hard to demonstrate, but he thinks that is pre-intentional: a set of nonrepresentional mental capacities that enable all representing to take place [18, p. 143]. It seems from this that the intelligence can be seen as some kind of background behind all of this challenges. But, Boden asked: what if AI equals human performance?

> Would they have real intelligence, real understanding, real creativity? Would they have selves, moral standing, free choice? Would they be conscious? And without consciousness, could they have any of those other properties? These arent scientific questions, but philosophical ones. […] We need careful arguments, not just unexamined intuitions. But such arguments show that there are no unchallengeable answers to these questions. Thats because the concepts involved are themselves highly controversial. Only if they were all satisfactorily understood could we be confident that the hypothetical AGI would, or wouldnt, really be intelligent. In short: no one knows for sure. Some might say it doesnt matter: what the AGIs will actually do is whats important. However, our answers could affect how we relate to them […] [2, p. 119].

We tried to show that for the clarification of the question of intelligence we need AI, psychology, neuroscience, but also philosophy. However, just like Boden, we do not have unequivocal answers, but are suggesting that some answers are more reasonable than others [2, p. 120].

Therefore and furthermore, we think that the essence of this background can be grasped from mingling between the linguistic and the cognitive and that it is recognizable in the meanings of the term. This essence is sometimes over the history of metamorphosis and migration of the concept overlooked, forgotten, but implications of this essence remain present in today's challenges of AI. Therefore, to grasp the essence of intelligence we have turned back for the missing pieces of the meaning, to the history of the term itself. The look in this history has shown that English language cannot cover the various abilities of intellect expressed by the Latin *intellectus* and

intelligere. However, a deeper insight in the mediaeval understanding of those terms in Aquinas philosophy of mind has shown that this understanding is not the product of certain philosophy but an attempt to uncover the essence of this mysterious background that we call intelligence. Moreover, the analysis of the Greek term "nous" and its etymological root shows that this essence was present in pre-philosophical uses of the term. We have indicated several characteristics of the term "intelligence" in Latin and Greek usage. From these characteristics, the meanings, it seems that the essence of intelligence includes dispositions for knowing the truth, for abstract and logical thinking and for language learning, but also includes senses, emotions, moral behavior, creativity, self-knowledge, intuition, and intentionality. Moreover, it seems that the essence of intelligence is not reachable out of specifically human cognitive structure. The implication for AI is clear: intelligence cannot be artificial. However, AI field of inquiry, especially deep learning, is very useful and worthy field of study because it, as Boden noticed, can illuminate the nature of real minds [2, p. 120]. That is something that Walter Pitts and Warren McCulloch would be satisfied with.

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