The Polymorphic Intelligence

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Abstract
The aim of this paper is to reconsider the idea of human intelligence and machine intelligence as two separate entities. To do so, we defined a new concept that we call *Polymorphic Intelligence* [1]. Such a concept comes up as a possible answer to many 'false' paradigms and philosophical and conceptual orientations that for decades have pervaded many research fields, such as education, art, literature, psychology, pedagogy, science, technology and A.I. We believe, indeed, that in this exact moment of human history, it becomes necessary to clarify with a strong theoretical paradigm what is the real relationship between machines and humans. Therefore, we propose to abandon the mental scheme by which intelligence is an exclusive prerogative of the humans to embrace the idea that machines have started to express a real collaborative and/or competitive force, they are able to produce ideation, inspiration and contribute to the wealth of ideas.

Keywords:
Art, Mind Psychology, Intelligence, Darwinian Writing

Introduction

Being conscious of our own final goals is one of the most important rules to follow to achieve good results while conceiving and implementing ideas. Despite this, it is our feeling that for much too long A.I. researchers and experts have had a "wrong" target in mind when focusing on 'how to make a machine intelligent' or 'as intelligent as humans or other forms of life'. At the same time, those who study the mind have been neglecting the influence of machine intelligence over humans. It is not by chance, indeed, that the word *intelligence* itself has gained dozens of additional meanings and has had to incorporate so many extra aspects that today one could almost rename it as "*everything*". Obviously, this overall tendency is not good and it is leading to a sectored, molecular, and consequently neutral and senseless portrait of the mind at work. This is true, although intelligence for certain categories of scientists - that include Psychologists, Pedagogists, Computer Scientists, Engineers and etc. - should be the core-business of their disciplinary research and, therefore, the highest conceptual ideal to aim to, with the maximum caution and adequacy.

This might be due to the inheritance of *old* paradigms, ideas and approaches that are strangling the upcoming need for new definitions in fields such as robotics and AI as well as in literature, art, and education. Let's take as an example the *human-machine interaction* and *interaction design* concepts. These two paradigms are basically out of date since they approach the human relation with the machine with a sort of alienation and with a limited level of relational complexity, since they take for granted that machines express a well defined, limited and finite number of responses. This is not true any more.

In this perspective, the first step to take consists in rejecting the scheme that the *constructive* (and, symmetrically, destructive) intelligence is an exclusive prerogative of the humans (or, more in general, biological), to fully recognize and admit that artefacts are able to create and express collaborative and/or competitive acts. In other words, machines, with all their new artificialities based on electronics and digital devices are becoming decisive and decisional, creative and clever, and, under all circumstances, co-interpreters of the reality we live. Because of this, we think that it

is time to move to a *human-machine interrelation* concept that is to be based on a deeper level of human-machine *involvement*.

Inheritance

As said above, old ideas - originated from a few, but very popular, scientific, philosophic and artistic theoretical constructs - have been simply prejudicing and polluting the entire domain of human thought and the way we've been thinking about intelligent artefacts in the last century.

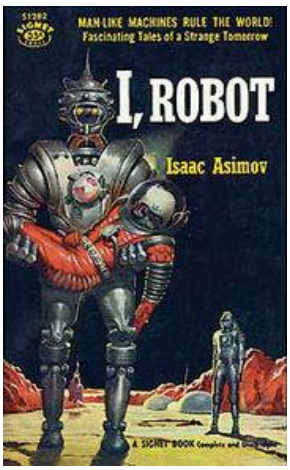

Figure 1. One of the first editions of the famous Isaac Asimov's *I, Robot* [3].

Amongst all, the most *dangerous and mining* were those theories popping out of Turing's [2], Asimov's [3], Orwell's [4] manuscripts where, paradoxically, the distance between humans and machines is thought as absolute. Their notion of machines (and therefore *machine-intelligence*) is of a somehow isolated *external device*, while the relationship they thought we could build is extrinsic, Both physically and mentally In our opinion, such an idea is to be demolished because it generates a conceptual and structural approach to machine-thinking *disintegrated* into what is to be considered the evolution of the human species. Indeed, for many years humans and machines have shared the same spaces either physical and geographical, or cerebral and virtual and, in other words, machines are an integrated part of our *Ego* or, at least, part of our own world and everyday life.

To overcome the old way of thinking artifacts it seems to be necessary to step back to old schemata, which are typical of Oriental, Indian or Native American cultures, and integrate them with most recent western psychological and philosophical theories like those postulated by G. Bateson [5] in "*Steps to an Ecology of Mind*", or by J. Gibson [6] in "*The ecological approach to visual perception*", theories that can be seen as the bases for "Ecological Psychology" [7] or "Environmental Psychology" [8]. In short, the idea that lays behind these theories is that the whole world takes part in our own computational intellectual pontentialities and brain. The world is, in other words is an important component of our sensory motor system. If so, it becomes essential for those who study the mind (as well as AI), to inherit the Bateson's [5] principle which states that the "blind man's stick is part of his sensor-motor system of his associative areas, and of his mind". Researches have to face the idea that artefacts might be an integral part of our abilities of elaboration processing, besides our perception and action.

Indeed, while modern *Psychotechnologies* [9] differentiate from the traditional ones - i.e.: motor (e.g. bicycle) and sensory (e.g. telescope) - and accordingly with the famous De Kerckhove [10] classification, including radio, television (i.e. connectivity) and computers and Internet (i.e. interconnectivity) it is to be noticed that nowadays many automations are even more complex.

Indeed, latest tools represent, more than integrative processes, pervasive ones. Even more, they are substituting human cognitive processes, even at a high level, like creativity and problem solving.

New perspectives

Now, although the fusion between natural and artificial intelligence is becoming a reality, it seems that we are not fully conscious of the changes that are taking place. Indeed, while we are aware of the fact that the agenda found in mobile phones is replacing part of the functionality of our long-term memory, we find it hard to realize how the famous "cut&paste" or "undo" or "T9text input" are changing the way we write and, therefore, think and communicate. In short, the symbolic system we are inheriting by the electronic culture is affecting our minds and is revolutionizing our entire semeiotic system.

For example, as students we used to write out our own documents - maybe copying or borrowing sentences from others every now and then. Today, our students, do a Copy&Paste of their full thesis – maybe adding something personal every now and then. And some of us started to do that, too. But that's not evil. Not necessarily so. On the contrary, it reminds us of the DNA evolution, where the outcome is the mixture of old pieces with crossovers and, sometimes, mutations. This attitude has become so popular - it is the way 90% of the writers express themselves today - that we need to define it. Let's call it *Darwinian Writing*. The *Darwinian Writing* exists and, inevitably so, being the final output of a text represents what we usually read and comprehend when we let written information go through all levels of our society. The *Darwinian Writing* is a clear example of a clear consequence of how basic A.I. (or IT if you prefer) can influence human thoughts.

Furthermore, elements like hypertexts, global searches, internet maps, GPS, wearable computers, autonomous robotics, and so on represent an increasing number of functions the biological brain is enriched with and, at the same time, delegating to machines. In other words, while modern artifacts push the brain to restructuring its functions, they also represent an increasing level of "*dependency*" the human intelligence is destining to machines. Practical examples might be seen in the recent growth of such disciplines as *Psychogeography* [11] (i.e.: how to create geographical maps linked to human emotional experiences) or tools like *Brain Training* [12] (computer based exercises that help revitalize cognitive functions).

Essentially, intelligence has doubled its evolution speed and hugely enlarged its domains. That's happening because, besides the natural genetic evolution, intelligence is also evolving in its own definition. This is due to both the power of the new technological achievements to improve our ability of self observation (and self-consciousness), and to the fact that algorithms can evolve their artificial intelligence. To take it a step further, we need to point out that our minds are influenced by the advent of "intelligent" artifacts. Indeed, as G. Rizzolati pointed out with is *Mirror Neurons* [14] theory, humans mostly learn by imitation. Computer scientists, AI and Robotics experts use that knowledge to apply to machine learning. We must become aware that by doing so we have initiated a never ending loop in which learning and teaching is somehow simultaneous (in terms of a society extended to intelligent machines).
These facts, are taking us straight to the first forms of hybridized intelligences.

To sum up, if on one hand it is very easy to predict that "the ability of future machines to directly share experiences and knowledge with each other will lead to evolution of intelligence from relatively isolated individual minds to highly interconnected structural entities" and that "the development of a network of communicating mobile and stationary devices may be seen as a natural continuation of biological and technological processes leading to a community of intentionally designed and globally interconnected structures" [13], on the other hand, what is much harder to comprehend is that the human brain is not extraneous to all of that but, on the contrary, it

gets deeply influenced by A.I. in action. Part of this is what we can call the Polymorphic Intelligence.

Polymorphic Intelligence

As far as we know, humans are the most "intelligent" organisms since their brain functions are complex and sophisticated at the very same time. Indeed, when in *Frames of Mind* [15] the psychologist and neurologist Howard Gardner tried to define intelligence he came out with seven different substructures:

1. *Linguistic intelligence* (sensitivity to spoken and written language);
2. *Logical-mathematical intelligence* (the capacity to analyze problems logically, carry out mathematical operations, and investigate issues scientifically);
3. *Musical intelligence* (encompasses the capacity to recognize, compose and perform music);
4. *Bodily-kinesthetic intelligence* (the potential of using one's whole body or parts of the body to solve problems);
5. *Spatial intelligence* (the potential to recognize and use the patterns of wide space and more confined areas);
6. *Interpersonal intelligence* (the capacity to understand the intentions, motivations and desires of other people);
7. *Intrapersonal intelligence* (the capacity to understand oneself, to appreciate one's feelings, fears and motivations).

Certainly, also thanks to such a refined biological evolution of their computational functions, it has become possible for human beings to reach a high level of social and technological evolution that, only recently, is flowing to such a stage that might be defined as the *intelligent machines age*. Amongst us few great artists (e.g. W. Shelley [16]; G. Orwell [17]; P.K. Dick [18]) envisioned that we were about to get to this point and consequently depicted a possible scenario to try to prevent the moral and the ethical decay of our societies and species. In particular, Asimov [3] who tried to define the three famous A.I. constrains:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

So, while artists were anticipating crucial philosophical goals for the future human-machine relationship, on the other side, many different scientists were defining practical objectives.

Amongst them a special mention goes to A. Touring who tried to define through the famous *Turing Test* [2] the meaning of A.I.

1. A human judge engages in a natural language conversation with two other parties, one being a human and the other being a machine; if the judge cannot reliably tell which is which, then the machine is said to pass the test.

For what came later all these conceptual paradigms were very significant for any further theoretical development and worked as lighthouses for thinking about AI.

Despite this, as it often happens in the history of ideas, what was a fundamental and inspiring landmark in the past might represent an obstacle for further evolution, and, most likely, both Asimov's and Turing's (and similar authors) principles today are still being followed too much and believed, while they actually seem to be fully outdated.

Figure 2. The *Atron* modules [21].

Things have changed because the definition of AI itself has changed. Indeed, it is clear how the Touring Test has been surmounted and AI is moving towards the idea of *Collective Intelligence* - e.g. Swarm [19], Boids [20] and etc. – as well as that robotics is moving away from the basic concept of mono-shaped body structure and the 'prison' of its canonical aspect – e.g. *Atron* [21], *RoboMusic* [27].

Even more, A.I. has started opening to such problems like interfacing humans, hence taking us to a *Polymorphic Intelligence* state where Artificial Intelligences deeply interact with biological ones. This is occurring at all levels. In virtual worlds (SecondLife [22], Gazira Babeli [23] and Marco Cadioli [24]) in real world (MipTiles [25], I-BLOCKS [26], RoboMusic [27]), and in mixed realities (Stelarc [28]; Talkers [29]; Ambient Addition [30]).

Figure 3. Stelarc [28]. *ExoSkeleton*

In other words, what is happening is that we cannot point at A.I. as the result of a single, linear artificial process but, on the opposite, the new picture tells us of a multidimensional non-linear process which is difficult to handle and, more or less, impossible to fully control. Things get even more complex when, instead of the old fashioned interactivity (i.e. the switch on activate/deactivate rule) we insatiate a run-time multi interactive dynamic (i.e. interrelation) with a single 'species' of

AI artefacts or even "worse" a multitude of them, simultaneously. Obviously enough, the outcome is a scenario where Asimov's laws don't really make sense, since machines themselves are loosely controllable (i.e. often dealing with non-linear maths and non-complete problems) and largely interconnected and therefore non directly responsible for the general system outputs.

In this perspective, we both need to renew our methodologies and move from the idea of *Human-Machine Interaction* (or *Interaction Design*) to the concept of *Human-Machine Interrelation* where the basic principles of interactivity are a bit more aleatory or, at least, less predictable and, even more important, are completely different from what we have been dealing with in the past, since the interactive procedure moves from a one way to a bidirectional intelligence flow. Indeed, what we will call here *Imitational Intelligence,* is a factor, neglected by the Howard theory [15] but indirectly consecrated by Rizzolati's recent discovery, which seems to be a crucial issue that must be taken into consideration and that will play a large role in future human-machine theories. Theories that will inevitably lead us towards a new conceptualization of the meaning of Intelligence as a domain hybridized by machine and therefore multiple, multifaceted and Polymorphic.

Conclusion

When looking at all the ideas and definitions of AI and Computer Science of the last century it becomes evident that there is something wrong regarding the philosophical approach that has been developed in the so called *machine* (or android, or cyborg, or robot) *thinking.* What seems to be missing is the idea of feedback that machine intelligence imposes upon biological intelligence, creating brand new forms of intelligence (either natural or artificial) that we define here as *Polymorphic Intelligence*. This form of intelligence might be dominant and lead both artificial and biological way of thinking. As a consequence, to look at intelligence as polymorphic might be a key point of view that will - and should - influence the way we pursuit research and education, in the next future.

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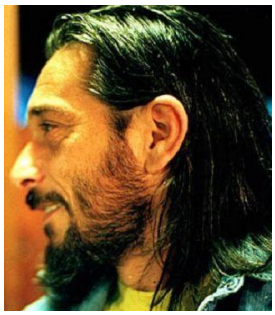
Biographical Notes



Luigi Pagliarini is an artist and a psychologist, expert in robotics and Artificial Intelligence. Currently, he is Professor of Perception Theory at the Academy of Fine Arts of Bari; Associate Professor of Robotics at the University of Southern Denmark; Director of the Pescara Electronic Artists Meeting; President of Artificialia; Art Director of Ecoteca; Member of the International Committee RoboCup Junior; Board Committee of Journal of Psychology of Art; Executive Member of EvoMusArt; Partner Consultant of Entertainment Robotics and of the Visual Emotion. He has published in international books, journals, and conference proceedings and has been rewarded with international prizes more than once. He has exhibited his work in different museums and institutions all over the world. He has worked for many Institutes and Universities as teacher or researcher and, as a consultant, with many enterprises and multinational factories. His work has often been reported on international newspapers, magazines and televisions.