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ARTICLE

Cognitive Limits of AI: A Key to Enhancing AI

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ABSTRACT

The correlation between the human hand and the mind is a well-documented phenomenon in the fields of philosophy, anthropology and neuroscience. However, the intellectual potential of the hand and embodiment as a whole remains underestimated in the domain of cyber technology. This philosophical paper examines the gap between hand-centred knowledge and machine understanding, to explore whether there are margins of cognitive enhancement for machines through the improvement of their sensing capabilities. The author begins with a historical introduction to the relationship between hand and mind in classical and contemporary philosophy. The ensuing discourse will focus on elucidating the function of hands as activators of knowledge, thereby addressing the dual question of how hands and machines acquire knowledge. Finally, it will be considered the prospective use of porous materials, which embody the latest frontiers of digital technology, to advance the cognitive development of artificial intelligence. It will be argued that this represents a commitment to future research in cybernetics, with particular reference to the use of analogies with the properties of the hand (e.g. flexibility, touch and sensing). The concept of machine quasi-knowledge is introduced as an analogy to human understanding. The final discussion will focus on the claim that such a category has the capacity to serve as a zero degree for the formulation of a theory of personhood, including that of digital machines endowed with artificial intelligence.

Keywords: Hands; Mind; Knowledge; AI; Machine Learning,;Porous Materials; Enlarged Sensitivity; Quasi-knowledge

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1. Introduction

Viewing the hand as an organ of the mind is not a new idea (Radman, 2013) [1]. Conversely, the correlation between haptic capabilities and understanding can be traced back to the classical philosophical tradition. In the third century BC, Anaxagoras advanced the theory that humans are the most sapient of living beings, a position he substantiated by asserting that humans possess hands. Aristotle subsequently retracted this statement, contending that human beings (anthropoi) possess hands because they are the most intelligent creatures (De partibus animalium, IV, 10, 687 a 8-11) [2].

While the contribution of Greek civilization to the subject is well documented among scholars, it is arguably less well known that the intellectual understanding of interconnection was in fact developed by the Ancient Egyptians long before the Greeks began to use the term 'philosophy'. In hieroglyphic language, the concept of action is symbolized by the sign of an eye (irt), which corresponds to the verb "to do" (iri). In consideration of the medium-direct relationship between the object drawn and the semantic area to which it refers, as established by hieroglyphic signs, the presence of a hand drawn, which is closer to the idea of operating, one would have expected (Fisogni 2019 [3], 2022 [4]). The sign of the eye is indicative of the Egyptians' awareness of the correlation between sensory and tactile experience and the intellectual process of abstraction that occurs through concrete experience. This understanding was not derived from rational thought, but rather from intuitive comprehension of the connection between these domains. Indeed, the term "eye" is employed metaphorically to denote the cognitive faculties that are enabled by experience. The absence of theorisation in the context of the relationship between the hands and the mind, as evidenced in Greek civilization, did not result in Egyptians delineating the terms of such a relationship. However, the intuitively clear nature of this relationship is noteworthy.

The ancient Egyptian concept of the connection between the hand and the eye, as a representation of the mind, provided a valuable insight into the brain as part of an enactive system. This concept has only recently been theorized. As Gallagher et al. emphasize:

«In evolutionary terms, the brain does what it does and is the way that it is, across some scale of variations, because it is part of a living body with hands that can reach and grasp in certain limited ways, eyes structured to focus, an autonomic system, an upright posture, etc. coping with specific kinds of environments, and with other people. Changes to any of the bodily, environmental, or intersubjective conditions elicit responses from the system as a whole. On this view, rather than representing or computing information, the brain is better conceived as participating in the action» (Gallagher et al. 2013: 421) [5].

The correlation between action and cognition has yielded insights into the neural mechanisms underlying visual perception. Recent studies have identified a hand-centered framework within the visual system that elucidates the neural processes through which visual signals are transformed into motor commands that guide hand movements towards objects and activity (Goodale 2011 [6], Cazzato et al. 2012 [7], Corbetta et al. 2008 [8], Craighero et al. 2002 [9]).

2. How Hands Act

The assertion that manual dexterity plays a role in cognitive processing is substantiated by numerous perspectives, a few of which will be outlined in this section. From a phenomenological standpoint, this organ fulfills a mediating function between the individuals and their experience of the world through the process of manipulation. Specifically, two distinct sets of actions are performed: firstly, data are transmitted to the brain, and secondly, changes are brought about in the environment. The human subject is able to identify objects through touching, shaping and manipulating due to the sensitivity of the skin's cellular texture. As postulated by Stuart (2013) [10], each of these operations involves the transmission of messages to the brain via specific receptors. This facilitates the establishment of a robust relationship between tactile prehension, apprehension and comprehension.

In this context, the concept of peripersonal space (PPS) (Rizzolatti et al., 1997 [11]; Brozzoli et al., 2012 [12]) can be introduced. The term refers to the area immediately surrounding the body and more proximate to the hands, where the individual can reach and interact with objects. Such a territory is regarded as "an essential component of bodily self-consciousness" (Rabellino et al. 2020: 1 [13]).

Moreover, PPS is a fundamental concept in the fields of neuroscience and psychology, as it facilitates comprehension of the process through which self-consciousness is developed through environmental perception and interaction. As will be discussed in the final section of this paper, PPS may be regarded as a potentially beneficial tool, to a certain extent, for augmenting digital machines' self-awareness.

This space is characterized by its dynamism and capacity for rapid transformation, manifesting, for instance, in the experience of driving a car or engaging with another individual. To illustrate this phenomenon, consider the following example: when standing on a subway carriage, one may find themselves holding on to a socket in order to avoid falling. In such a scenario, the peripersonal space would encompass not only the immediate vicinity, but also the individuals standing adjacent to the subject, the space adjacent to the metro carriage's door, the ceiling of the carriage, and the individuals moving in front of or next to the subject. PPS can be defined as a zone of respect, wherein other systems (i.e. people, objects, and environmental dynamics) intersect.

Consequently, the space surrounding the individual is subject to constant monitoring by the brain. This enables the individual to navigate and interact with their surroundings. This spatial, dynamic, emotional domain, which is both systemic and fluid, is subject to constant change and adaptation. It can be regarded as an extension of the body, with the hands playing a pivotal role. Research conducted on the subject of dummy hands and peripersonal spaces has contributed to a focus on hand-centered representations of objects in PPS (Makin et al., 2008 [14]). Research on immersive virtual reality, however, demonstrates how visual-proprioceptive discrepancy shapes the hand-centered PPS (Fossataro et al., 2020 [15]).

Among the most promising investigations in the field, there is the one about the implications for psychological trauma-related disorders in a social world (Rabellino et al. 2020 [13], Bogdanova et. al. 2021 [16]). A further direction of enquiry concerns the role of rubber hands as neural correlates of embodiment in individuals with amputation (Castro et al. 2023 [17]).

An additional cognitive feature of the human hand is the double attitude, which is typical of human persons, to touch and to be touched, as the result of bodily perceptions related to embodiment. From a Merleau-Ponty perspective, the body assumes a pivotal role in the cognitive relationship with the world of life. In order to facilitate a more profound comprehension of this foundational issue, it would be advantageous to make reference to Merleau-Ponty's seminal work, Phenomenology of Perception (1962: 106 [18]).

Merleau-Ponty's central idea is that the human body possesses a unique characteristic, distinguishing it from external objects, through its capacity to generate "double sensations" during the act of touch. This faculty to experience the sensation of being touched whilst concurrently engaging in tactile stimulation is posited as a manifestation of bodily "reflection", a phenomenon that is deemed to be absent in inanimate entities.

The logical progression commences with the introduction of the concept of "double sensation", defined as the body's ability to experience physical contact. The prime example given is that of touching one hand with the other. It is subsequently elucidated that the two hands cannot concomitantly function as both the toucher and the touched. The act of pressing them together does not entail the occurrence of two separate sensations in juxtaposition; rather, it is an ambiguous dynamic in which the roles of "touching" and "touched" are subject to alternation. The pivotal observation is that, in this transition between roles, it is possible to identify the hand that was touched as the same hand that will shortly be in contact. The aforementioned identification process establishes a distinctive association with one's own body.

Merleau-Ponty's reasoning suggests that the capacity to experience "double sensations" reveals a fundamental property of the human body. This property is a form of self-consciousness or self-perception that distinguishes it from passive objects in the external world.

Merleau-Ponty's philosophy posits that the tactile experience of the body is not merely a passive reception of stimuli, but rather an active and dynamic process that engenders a unique form of bodily self-awareness.

It is evident that the dual motion under discussion can be experienced at any moment of our lives; however, the significance of the dynamic between touch and being touched in shaping our knowledge is not generally realized. The phenomenon of inter-subjectivity is facilitated by this dynamic, which provides the fundamental tool for experiencing it. The classical principle of non-contradiction (PNC), which forms the basis of Western thought, is predicated on the concept of enactive hand capacities. Indeed, to posit the claim advanced by Aristotle that: As posited by Metaph IV 3 1005b19–20 [19], the notion that something can be and not be in the same respect at the same time is an impossibility. This is subject to the appropriate qualifications. The concept can be realised through the understanding that something exists outside of the subject who knows. The experience of the world of life is preceded by the use of the senses and manipulation, and this is prior to any conceptualization.

It is important to note that another relevant type of knowledge linked to the hands is frequently accompanied by gestures and belongs to the domain of paralinguistic features in indexicality (Peirce 1958 [20]; Atkin 2005 [21]). For instance, consider the common adverbs of place that indicate a location relative to the speaker. The use of a pointing hand gesture to indicate specific locations, such as "here" or "there," serves to eliminate ambiguity and emphasize verbal communication.

The myriad ways in which hands know, of which some essential features have been given, are made possible by embodiment. The phenomenon functions as a transcendental condition for the purpose of facilitating the acquisition of knowledge by means of the senses. The endowment of a human subject with a body is predicated on the notion of receptivity, which is contingent on the properties of the skin, which in turn are determined by the cellular structure. It is vital to note the significance of a complex tissue that is comprised of pores or minute apertures that accommodate hair follicles. The porosity of this tissue is of paramount importance in regard to the functions it performs.

Porosity performs four primary functions: firstly, it acts as a barrier that protects the body from environmental threats; secondly, it facilitates the release of specific substances (gases, liquids, and oils) from glands through the pores. Skin is comprised of elastic fibres and collagen, and thus possesses the capacity to absorb water, humidity, chemicals, pharmaceuticals and cosmetics. In conclusion, the function of the pores is to regulate temperature through the process of perspiration.

At this point of the discussion, some final remarks should be taken in account:

- there is a hand-brain connections that embodied experience highlights
- hands are cognitive sources
- hands function in virtue of the skin's porous texture.

3. Machine and Artificial Intelligence

The integration of artificial intelligence into our daily lives has been a gradual process that has spanned several decades, with significant advancements occurring in the latter half of the 20th century. The pervasiveness of artificial intelligence (AI) in various domains of human activity is evident when considering the technologies that have been applied to a wide range of everyday activities, including household appliances, personal computers, automated fare collection systems, video games, and more. However, it is only in 2022, with the emergence of ChatGPT, that the hypothesis formulated in 1950 by Turing, a seminal figure in the field of computer science, appears to be materializing. Turing's hypothesis posited that an apparatus might be considered intelligent if it demonstrated behavior that was indistinguishable from that exhibited by a human.

The advent of Generative Artificial Intelligence represents a paradigm shift in this regard, as digital machines are now capable of not only interacting with human users but also exhibiting creative reasoning methods reminiscent of human thought processes. In 1957, Herbert Simon advanced the hypothesis that within a decade, it would be feasible to create a machine with the capacity to play chess, thereby demonstrating strategic capabilities comparable to those of a human subject.

A period of almost forty years elapsed before the aforementioned prediction was realized: in 1996, the Deep Blue computer, designed by IBM with the specific intention of playing chess, defeated the then-chess champion Garry Kasparov. Nevertheless, Google has succeeded in raising the bar to an even higher level. In the context of the DeepMind project, the AlphaZero algorithm was developed, representing an evolution of AlphaGo. This algorithmic system was capable of independently acquiring the ability to play chess, achieving this within a mere four hours of training, commencing from the fundamental principles of the game.

Subsequent to this, it achieved a superior performance against the reigning top-ranked chess computer, Stockfish, without relinquishing a single game out of one hundred. AlphaZero has achieved a breakthrough in the cognitive potential of machines by leveraging its capacity to calculate 80,000 possible positions per second. Concurrent with the development of artificial intelligence, two primary theoretical strands have emerged, which can be primarily attributed to Herbert Simon and Hubert Dreyfus. The former was among the major proponents of the development of machine thought, while the latter outlined insurmountable limits to the cognitive autonomy of machines.

Dreyfus's primary argument for the insurmountable limitations of computers in their specific mode of understanding is related to the concept of embodiment. This is due to the fact that humans are physically embodied, and thus all processual aspects of cognition are inherently linked to the bodily approach to the world of life. It is imperative to note that the physical nature of the machine is not permitted to come into contact with an object, thereby preventing identification. For Dreyfus, the body fulfils three functions that are absent in machines. In summary, the initial section pertains to the inner horizon of understanding, comprising "predetermined anticipation of partially indeterminate data." The subsequent section addresses "the global character of this anticipation, which determines the meaning of the details it assimilates and is determined by them." The final section of the thesis focuses on the transferability of this anticipation from one sense modality and one organ of action to another. (Dreyfus, 1972: 167 [22]). When these characteristics are distilled into their fundamental aspects, it becomes evident that the bodily experience, far from being confined to the concrete, transcends it by affording an opportunity to apprehend that which eludes the senses. It is evident that this constitutes a metaphysical experience, which can be achieved through the faculty of perception.

In order to illustrate this point, an example will be provided. The definition of a garment is an object made from a specific textile material for a particular purpose. In the wardrobe of my father, I observe a jacket that signifies more than a mere object; it evokes memories that are inextricably intertwined with the fabric of my family's existence. The act of observing or manipulating such a textile must be considered as more than the mere handling of a fabric. It is imperative that the item be handled with the utmost care.

4. How Machines Function

In contrast to the acquisition of knowledge by human hands through direct contact, manipulation and grasping, machines learn by applying pre-programmed algorithms. Digital machines receive input through a variety of devices, including keyboards, mice, and sensors, which are then converted into binary code. The central processing unit (CPU) can be regarded as the brain of the machine, responsible for processing binary data using a set of instructions or a program. The CPU performs arithmetic and logical operations to manipulate the data stored in memory devices, such as RAM (random-access memory) for short-term use and hard drives or SSDs (solid-state drives) for long-term storage. All data is stored in binary form. Subsequent to processing, the machine converts the binary data back into a human-readable form and displays it through output devices, including monitors, printers, or speakers.

The extent to which machines are able to enhance their understanding and cognitive abilities is contingent upon the efficacy of the algorithms that underpin their operations. These algorithms process vast amounts of data in order to identify patterns and make decisions, thereby exhibiting a process analogous to the manner in which humans acquire knowledge through experience. Three distinct processes can be identified: machine learning, deep learning and reinforcement learning.

Machine learning is a subset of artificial intelligence in which computers are capable of acquiring knowledge from data without the necessity of being explicitly programmed through the application of algorithms and statistical models. The employment of machine learning techniques has been demonstrated to facilitate the construction of predictive models and the implementation of data-driven decision-making processes.

Deep learning can be defined as a specific instance of machine learning that employs neural networks for the purpose of data-driven learning. Deep learning algorithms are particularly well-suited to the analysis of large, complex datasets, and have been applied to a variety of tasks, including image and speech recognition, natural language processing, and machine translation.

The employment of deep neural networks, comprising multiple layers, facilitates the execution of sophisticated tasks, including image and speech recognition.

In the domain of artificial intelligence, reinforcement learning constitutes a subcategory of machine learning that focuses on the development of algorithms that enable agents to interact with their environment in a manner that optimizes the value of a specific reward, or reward function. The employment of machine learning in training computer programs to play games and control robots is a notable application, and the potential for its application to a diverse array of real-world problems is significant. In the context of reinforcement learning, the learner's decision-making process is characterized by a cycle of trial and error, a principle that finds a notable parallel in the human learning experience.

The prevailing trends in the field of enhancing the cognitive capabilities of machines are focused on the development of computational artificial neural networks (ANNs), which are modelled on biological neuron models comprising multiple interconnected nodes, referred to as "neurons". However, in contrast to biological neurons, artificial neural networks (ANNs) utilize statistical methodologies to discern patterns between inputs and outputs (Bihl et al., 2023: 899 [23]).

5. Enlarged Sensitivity of Digital Machines

Despite the considerable disparities between the manner in which human subjects and machines perceive and interact with the digital environment, there is considerable potential for enhanced emotional engagement and sensitivity between the two. This assertion is substantiated by the encouraging advancements witnessed within the domain of digital technology. As Orduño-Osuna et al. emphasize: As technology continues to evolve, the fusion of human emotion and artificial intelligence promises to reshape our understanding of emotions (Orduño-Osuna et al., 2024: 2 [24]).

The following discussion will introduce the concept of enlarged sensitivity, derived from the interconnection of humans and machines within the frame of the Onlife world (Fisogni, 2023 [25]). It is important to note that this form of sensitivity does not coincide with the machine's capacity to discern human emotions (Baia et al., 2022 [26]; Balamurani et al., 2022 [27]). Furthermore, it does not pertain to the capability of digital devices to experience emotional states autonomously, a concept that, at present, remains within the realm of science fiction literature. However, both fields remain pertinent in the context of cutting-edge research.

The interplay between human emotions and digital devices, a concept termed "Onlife" by Floridi (2014 [28]), can be categorized into two macro-systems. The phenomenon under discussion is characterized by a conscious approach to oneself and one's environment, which results in a felt sensory experience. This experience is predicated on the assumption of an agent that is sensitive, conscious, and willing. It is an insurmountable challenge for machines to generate such a sophisticated experience, with the exception of digital interactions. Indeed, the digital can be activated by a human subject in virtue of the human touch. The machine has been programmed to detect changes in skin pressure, which represents the initial stage in the process of achieving heightened sensitivity.

The ability to discern a multitude of emotional nuances through tactile detection is a hallmark of the agent. In summary, the commencement of a refined process of learning takes place upon the activation of the sensing platform of the machine by human skin. The cognitive capacity of the machine, otherwise termed 'digital intelligence', is stimulated to interpret, recognise and organise the emotional input of the agent. In contrast, the human subject directs their actions towards the responses of the machine, while concurrently ascertaining certain characteristics of the device itself. The agent is able to regulate its touch in order to enhance the interaction, thereby entering the digital domain and intuitively grasping the dynamics of this realm. It is evident that the processes in question are not comparable with those of the offline world. The concept of sensing undergoes an expansion rather than a transformation, encompassing both the real and the digital domains.

Each touch, by becoming a prolonged extension of the person, gives rise to a number of emotional inputs and outputs. In contrast to programmed emotional frameworks, which facilitate the recognition of consumer sentiments, human/smart-device interactions involve the stimulation and orientation of emotional responses by the screen. The environment itself becomes a subject in the strict sense through interaction with the digital environment, insofar as it activates the response of an intelligent individual. It is imperative to emphasize that a novel environment is engendered in the interaction between human and smart machine. The supposition that such a transformation has occurred is a prerequisite for the infusion of technology with emotional intelligence.

The notion that machines possess a psychic component is pertinent to their cognitive development. The concept of enlarged sensitivity is introduced with an emphasis on the dependence of machines on human sensitivity, which results in the development of a mixed environment, both in terms of sensing and sensory knowledge. A subsequent step in this research would be to examine whether there is also a sensitivity in machines that is to some extent analogous to human sensitivity. It is imperative to consider the analogous dimension when investigating the potential for the digital screen to possess sentience.

6. Cognitive Potential of The Touch in Machines

As has been previously argued, the role of the manual is of great consequence for human understanding, because it enables the human person to acquaint themselves with the processes of the world of life through the use of the hands. This faculty is associated with the sensitivity of the skin, particularly with regard to touch. During the global pandemic, when people were prohibited from touching each other in public spaces for several months, a notable loss of interpersonal knowledge was detected.

The screen is to a digital machine what the skin is to a human being. In the transition from the human to the digital environment, it becomes evident that the screen's capacity to function as a conduit between machine and world is limited. It is erroneous to equate touch displays with human hands, as they lack the porosity that characterizes the texture of skin. Derived from the branch of physics concerned with the study of heat and related phenomena, the term signifies the capacity of a medium to allow the flow of external fluids from one point to another. The human hand is characterized by its cellular structure, which renders it permeable. The capacity for porosity is integral to the hydration of the skin, whilst the pores facilitate the removal of sebum, sweat, and toxins. As demonstrated in the study by Oftadeh et al. (2023 [29]), there is a demonstrable correlation between the biophysical properties of the human body and the activity of the brain. This correlation is evidenced by the poroelastic behavior and water permeability of human skin.

The capacity for emotional responses is contingent upon this touch-related faculty. The pertinence of this concept is becoming increasingly evident in the digital domain, where the sense of touch is being employed in e-commerce, digital marketing and on digital intimacy platforms.

It is evident that porosity and permeability are not the primary characteristics of touch displays manufactured by ITO or graphene. The utilization of these materials is constrained by their inherent limitations, chief among which is their inflexibility. There is a consensus among scholars that the integration of novel materials, particularly polymers, has the potential to enhance the flexibility of touch displays. Zhang and Diesendruck (2024 [30]) described a novel touch-sensitive digital display, fabricated from block copolymer materials. The rapid advancements in the field of research concerning porous materials are truly remarkable.

It is evident that porous materials hold considerable promise for utilisation in digital displays. The engineering of porous materials is of crucial importance in the development of flexible and foldable displays, due to the flexibility that this material type allows.

Furthermore, the inherent porosity of these materials confers a notable advantage in terms of their lightweight nature, a quality that is particularly advantageous for the design of portable electronic devices. A reduction in the weight of the display has the potential to enhance the overall user experience by facilitating the transportation and manipulation of the device. The incorporation of such materials into displays has been demonstrated to enhance their optical properties, thereby improving their overall performance. For instance, they can be employed in the development of more efficient light-emitting layers, which may result in brighter and more energy-efficient displays. The porous structure facilitates enhanced thermal management, enabling more effective heat dissipation. This can extend the operational lifetime of the display and enhance its dependability. The incorporation of porous materials has been demonstrated to enhance the mechanical robustness of displays, thereby conferring greater durability and resilience to physical stress. This is of particular importance in the case of devices that are frequently handled or subjected to bending and twisting.

The properties of these materials render them a pivotal area of research and development in the domain of digital displays, offering the potential for more innovative and versatile electronic devices.

In a similar manner, flexible displays, such as those manufactured using organic light-emitting diodes (OLEDs), possess the capability to undergo bending and folding. This property facilitates the development of innovative designs in smartphones, tablets and other devices. Modern touchscreens have been developed to detect multiple points of contact, and this function is analogous to the way in which a human hand can sense touch. In a manner analogous to the flexibility of the human hand, flexible displays constructed from materials such as organic light-emitting diodes (OLEDs) can be deformed into various shapes through bending and folding. The process under discussion has been demonstrated to facilitate the creation of innovative designs in smartphones, tablets and other electronic devices.

A question arises at this point of the paper.

The question that is posed here is whether it is pertinent to inquire whether a digital display can be analogous to human hands. Despite the fundamental distinctions in structure and function between digital displays and human hands, it is noteworthy that digital displays can emulate certain characteristics of human hands. The advent of novel, advanced materials that enhance the cognitive and performative capabilities of displays indicates a potential paradigm shift in machine sensitivity, towards increasingly sophisticated, expanded sensitivity.

The latest generation of touchscreens has been developed to detect pressure and gestures, thus emulating the sensitivity and dexterity of the human hand. It has been demonstrated that some digital displays incorporate haptic feedback, which provides a tactile response to touch. This can simulate the sensation of pressing a button or feeling a texture, thereby rendering the interaction more intuitive and analogous to the tactile feedback of a human hand. In a manner analogous to the human hand's capacity for precise movement, digital displays can provide precise control through stylus input or advanced touch gestures. This is particularly beneficial in applications such as digital art and design. Whilst digital displays have been developed to incorporate these features in order to emulate certain aspects of a human hand, they still lack the full range of motion, sensory capabilities and biological functions of an actual hand. Nevertheless, technological advancements continue to facilitate the development of more intuitive and responsive interfaces.

7. Results

The interconnection of the mind, the hands and the environment engenders a non-reproducible and unique phenomenon. It is evident that manual dexterity and tactility, in addition to embodiment, serve as the primary conduits through which inputs from the life-world are acquired. However, it is important to note that the hands are not to be considered a 'receptive' organ. It has been demonstrated that they act as a sensory activator.

These characteristics, which proved so instrumental in the development of human knowledge, are entirely absent in machines, despite the existence of an analog dimension within the digital environment. The concept under discussion is predicated on the notion of a mixed environment, wherein the tactility of the screen is juxtaposed with the physical contact of the user.

8. Discussion

Human knowledge, by virtue of these continuous interconnections and systemic interactions (Agazzi, 2019 [31]), gives life to an emergent property of extraordinary power that affects, modifies and transforms reality. As posited by Urbani Ulivi (2019 [32]), this II type systemic property is mind.

This suggests that the mind cannot be superimposed on either the brain or the hands, but rather benefits from both, and can only function in relation to the environmental world, embodiment and neural activity. Machines have the capacity to discern patterns and relationships within vast quantities of data through the utilization of algorithms, thereby facilitating the ordering and reorganizing of such data. Machines are devoid of embodiment, and most crucially, the manual capacity that enables humans to establish systemic relationships and emergent properties (such as the mind). One potential avenue for advancement in this regard can be observed in the utilization of porous materials for display purposes, which may facilitate two key objectives: flexibility and the transfer of input from the external environment to the machine. The integration of a digital screen into the machine's learning process is advantageous. It is hypothesized that enhancing the tactile sensitivity of the digital screen will facilitate the machine's acquisition of a more sophisticated interaction with the environment. This capability is not fully addressed by deep learning or re-information learning, the most advanced forms of machine learning.

The absence of tactility and manual dexterity in machines signifies a condition that transcends the emotional domain and aligns with the cognitive domain. The sense organs, of which the hands are the haptic terminals, facilitate the process of abstraction, which represents the pinnacle of human understanding. Nevertheless, it is the faculty of sensation that engenders self-awareness, or the transcendental condition for self-consciousness.

It is imperative to acknowledge the pivotal juncture at which we stand in our rendezvous to elucidate the constraints imposed by artificial intelligence.

The present moment marks a pivotal juncture in the discourse surrounding the limitations of artificial intelligence (AI). Notwithstanding the deployment of highly sophisticated algorithms, the machine's central processing unit is devoid of the essential instrument of reflective knowledge. In order to establish the fundamental requirements for conscious experience to be possible, it is necessary to posit the following hypothesis: that 'one must feel to be in a body'. This phenomenon is not exclusive to humans, but is also observed to a certain extent in highly evolved animals, including mammals. It is evident that both human beings and animals are characterized by two fundamental situations: The first condition is to be in a body, and the second is to be exposed to impact, contact and a set of experiences of interaction with otherness. In relation to these conditions, the subject takes a position. When comparing the animal to the human individual, it becomes evident that the latter possesses hands, which afford the individual a fine and complex tactility divorced from the basic instincts of survival, feeding and reproduction. It may therefore be posited that, in addition to experiencing the sensation of being in a body, the human being, as an active center of feeling and cognition, has the capacity to introspect. The utilization of digital machines is inherently impeded by their inability to replicate the sensitive conditions (i.e., embodiment and manual dexterity) that are conducive to more articulate, flexible, and creative modes of thought, and can only function in relation to the environmental world, embodiment and neural activity. Machines have the capacity to discern patterns and relationships within vast quantities of data through the utilization of algorithms, thereby facilitating the ordering and reorganizing of such data. Machines are devoid of embodiment, and most crucially, the manual capacity that enables humans to establish systemic relationships and emergent properties (such as the mind). One potential avenue for advancement in this regard can be observed in the utilization of porous materials for display purposes, which may facilitate two key objectives: flexibility and the transfer of input from the external environment to the machine. The integration of a digital screen into the machine's learning process is advantageous. It is hypothesized that enhancing the tactile sensitivity of the digital screen will facilitate the machine's acquisition of a more sophisticated interaction with the environment. This capability is not fully addressed by deep learning or re-information learning, the most advanced forms of machine learning.

Nevertheless, it is evident that machines are capable of thought when they are programmed for simple or more complex cognitive operations. From this standpoint, the enhancement of their cognitive abilities must be considered. It is now possible to reflect upon the notion of quasi-knowledge (Minati and Pessa, 2018 [33]).

9. Future Perspectives of Research

The concept of quasi-knowledge emerges in the context of digital machines when a specific degree of cognitive ability is ascribed to them, whether through data input or data processing. In this domain, the concept of quasi-machine knowledge is salient for two primary reasons. Firstly, the term 'knowledge' is predominantly associated with the human individual. Secondly, knowledge is contingent on human action. Despite the evident and considerable disparity between the two forms of knowledge, the focus of our reasoning should be directed towards the realm of machine cognition, given its unique and often enigmatic nature.

From a philosophical standpoint, the augmentation of machines' unique cognitive abilities does not necessitate the creation of super-intelligent devices that function as autonomous entities, distinct from the Onlife world. Instead, it entails the establishment of conditions that can enhance the inter connectivity between the two levels of knowledge (sensitive and abstract). This enhancement is given by the systemic interaction among machine, environment, and human user. This suggests at least three possible perspectives aimed at:

1) Improving the sensory dimension of machines, which will increase their receptive capacity for environmental inputs. nputs are defined as any data or information that is entered into or received by the system, which in this context refers to inputs that are not introduced through programming, but rather acquired through the screen itself. This skill can be regarded as a progression in relation to computer vision techniques, which facilitate the development of a certain degree of environmental understanding within the computer. Turuk et al. (2023 [34]) recognize that, despite technological "advances", emotions remain a necessary ingredient for natural interaction.

2) Secondly, enhancing the capacity to discern one's peripersonal space is imperative to facilitate a zero-degree systemic process between the machine's sensitivity, its interaction with the environment, and its interaction with the human user-subject. The imminent integration of a novel generation of sensors is anticipated to further augment this domain. For Sahana e al. «Smart sensing technology has the capacity to utilize artificial intelligence (AI) and machine learning (ML) techniques with a view to enhancing the process of information acquisition. As asserted in the 2023 publication (p. 240) [35], the integration of artificial intelligence (AI) and machine learning (ML) methodologies within smart sensors has the potential to enhance data collection processes and substantially minimize the volume of data exchanged within network systems.

3) Thirdly, there is the question of enhancing the degree of quasi-personality exhibited by machines. Nevertheless, the improvement of the machine is moving in the direction of a closer analogy with the physiology of the human brain: this is the case of artificial neural networks (ANNs), "a family of techniques that are commonly used to recognize and interpret patterns in large amounts of data, which are used in prediction, clustering, classification and identification of other previously unknown data patterns" (Bihl et al. 2023: 899 [23]).

As discussed above, the porous screen has capabilities that bring the machine closer to human qualities, including flexibility and porosity, which facilitate interaction with the environment. They can be seen as a substitute for manuality in machines.

The advantage of porous materials is that they facilitate the establishment of a peripersonal space, even for machines, analogous to that of sentient beings. Although it is implausible that digital machines will acquire a reflexive capacity comparable to that of humans, it is conceivable that a quasi-sensitivity to the environment could develop through receptive processes facilitated by porous materials. Such experience would be conceptualized as a distinct capability of the machine, not to be equated with traditional machine learning.

In light of the above characteristics, what kind of knowledge would one have about emotionally enhanced digital devices endowed with a peculiar self-awareness, enhanced sensitivity, and the ability to be in touch with their peripersonal space? The expected result is a quasi-subtractive and quasi-abstract knowledge, because such a systemically enhanced machine would select the inputs most congenial to the materials of which its screen - its quasi-embodiment - is made.

This would represent a substantial advancement in the field of machine learning, as it would progress towards human abstraction, a process that functions effectively through subtraction, while preserving a certain distance from it. Abstraction can be defined as a process of subtraction. The act of recognizing an object is predicated on a series of perceptual processes, including observation, evaluation, measurement, weighing, and finally, holding the object in one's hand. The notion that the object itself does not enter the mind, for example in the form of an apple or a chair, is one that has been thoroughly explored. Rather, it is the idea that has formed in the mind through a series of evaluations that are connected, in an immediate way, to sensory experience or by recalling such experiences.

As previously stated, machines become knowledgeable through a process of addition, whereby data, programs, and commands are entered. However, it is also true that the machine's knowledge is derived, to some extent, through subtractive processes such as data cleaning, through which irrelevant or redundant data are removed to improve the quality of the dataset. In certain instances, specific features may be eliminated from a model to reduce complexity and enhance performance. This subtractive approach has been demonstrated to facilitate the creation of more efficient and effective models. In the context of neural networks, pruning entails the elimination of superfluous connections or nodes with the objective of optimising the model's efficiency and augmenting its performance.

The enhancement of machines' environmental perception is contingent on the cultivation of both subtractive and additive knowledge, thereby privileging the analogue of human abstraction. The interaction between abstract concepts and concrete experience is the crucible in which abduction, the pinnacle of cognitive ability in humans, is forged. The phenomenon of abduction, in its capacity as a cognitive process, has been demonstrated to be associated with creativity. This association can be understood as a result of the mental operation that underpins the formation of an explanatory hypothesis. Abduction is defined as the sole logical operation that introduces a new idea (Peirce, 1932 [36]). This approach presupposes the existence of an additional fact or law that is distinct from the observed fact or law in question. This enables the possibility of an inverse inferential ascent, whereby the effect is hypothesized to derive from the cause (Urbani & Ulivi, 2016 [37]).

The ancient Egyptians are deserving of recognition for their insight into the manual dimension of knowledge, a quality that is especially evident in the process of abduction. To illustrate this point, one may consider the process of medical diagnosis, which is predicated on the analysis of sensitive data, such as the patient's symptoms. This line of reasoning should prompt us to ascribe greater value to the manual and tactile aspects of highly sophisticated knowledge. While this may be regarded as a limitation for machines, it also offers promising avenues for research and development. Interdisciplinary research in cognitive sciences is progressing in this direction, particularly in the work of Magnani, who distinguishes between a "model-based" and a "manipulative" form of abduction (Magnani, 2023: 805 [38]).

This paper posits the notion of a quasi-knowledge system for digital machines. It explores the inherent limitations of machines, and the potential for evolutionary change that can be derived from materials and the degree of systemic interaction with the human being and the environment. The paper hypothesises that this could have interesting repercussions in the area of the personality of the machines themselves. To date, the concept of personality in relation to AI has been developed within the legal sphere, where questions are being asked about the possibility of 'intelligent' digital machines having legal personality (Novelli, Floridi and Saror, 2024 [39]; Brown, 2021 [40]; Bryson, Diamantis and Grant, 2017 [41]; Allgrove, 2004 [42]). Another level of concern pertains to the intersection between AI and the human brain, as an outcome of the insertion of the machine or its components into the brain context. In this case, provided that the theoretical perspectives are feasible in practice and the ethical limits they pose have been overcome, it could be posited that a human person's capabilities are 'reinforced' by the device.

In contrast, the concept of quasi-knowledge establishes a notion of quasi-personality situated between the human condition and that of the machine. The concept under discussion is founded upon the machine's capacity to exhibit a degree of self-awareness, constrained to the extent of its sentient capabilities as manifested in its interactions with a peripersonal space, from which it derives inputs and responds accordingly. In the domain of generative artificial intelligence, the evolution of this technology has been marked by the development of deep learning and data programming modalities. The potential for this evolution, as outlined here, is towards continuous sensory enrichment. Despite the absence of physical hands for modelling, transformation and understanding the world of life, digital machines can be assigned a quasi-human status while maintaining a clear separation from the human.

10. Conclusions

The article has outlined themes of considerable theoretical scope that are distinctly systemic in nature. This is because the manner in which a machine acquires knowledge is perceived as inextricably linked to human knowledge. This phenomenon is not contingent upon the observation that machines are processed in a manner reminiscent of human cognitive strategies. Rather, it is a consequence of the interconnectedness between the domains of human knowledge and machine knowledge in the Onlife world, a state that facilitates the cross-fertilisation of ideas between these two domains. From this standpoint, it is not only desirable for technological research to proceed in close relation to philosophical, linguistic and psychological research, but also for the categories of machine thinking to be increasingly refined. In a similar vein, the development of manual dexterity, which represents an insuperable limiting factor of human knowledge, can be achieved through the integration of porous materials, increasingly sensitive sensors, and learning techniques specifically designed for this interface in machines. This process can be viewed as analogous to the human condition.

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Conflicts of Interest

The author declares no conflict of interest.

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