Further Forms of Intelligence in the Continuum of Human Evolution

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Abstract

Recent years have seen growing debate about the capabilities of artificial intelligence (AI) in relation to those of human beings. The assumption that AI may rival human cognitive abilities has prompted calls for an ethics of AI. Enormous investments have also raised expectations about what AI can do. AI has thus moved from a supporting role to a central place in human life. Researchers in biology and computer science predict that humans and AI will merge. Such a merger would take humanity away from its natural evolutionary path. This research examines that prospect and how humans might evolve alongside both AI and nature.

Keywords Artificial intelligence, forms of intelligence, IQ, animals, evolution, consciousness.

1 Introduction

Large language models (LLMs) are becoming increasingly common in AI applications. They imitate aspects of the human brain using a model trained on large numbers of data points, most of them drawn from the internet. These models represent a considerable simplification of the brain. In effect, humans pass their knowledge down to machines that run AI algorithms.

Expectations for these models are high, at least in economic terms. Yet beyond the storage and recall of data, much remains unknown about how AI and human thought processes work, including how human memory has developed over evolutionary time.

It is widely accepted that intelligence has made human development possible over the past several thousand years (Riedl 2003, Precht 2018). Consciousness is also fundamental to the forms of intelligence considered here. It enables reflection and thereby active adaptation to the environment. Adaptation can also occur through genetic mutation over much longer evolutionary timescales.

AI is intended to assist people in their daily lives. It gives them an important tool for responding and adapting to changes in their environment. Living in symbiosis with such tools requires humans themselves to develop further. An evolutionary expansion of consciousness could bring this about. This is the central thesis of the research.

2 Other Forms of Intelligence

Consider one example of what might constitute another form of intelligence. The blob, a slime mold (Physarum polycephalum, Figure 1), has at least the following characteristics and abilities (Beekman 2012):



Figure 1. The blob in a maze. The starting point is on the right. Food has been placed at the exit on the left.

Navigation without a brain. When the blob is placed in a maze with food at two ends (rolled oats are a favorite), it withdraws from every dead end. It finds precisely the shortest and most efficient route between the food sources.

The Tokyo experiment. Scientists placed rolled oats at sites representing built-up areas in the cities around Tokyo and put the blob in the center. What happened? The network of paths the blob built to reach the food was almost identical to Tokyo's highly efficient rail network. The blob can thus solve complex infrastructure problems.

Remembering by means of a slime trail. How does the blob remember a route without a memory of its own, so that it can follow the best or shortest path? As it moves, it leaves a trail of slime. When it encounters its own trail, it "knows" that it has already been there, that there is nothing left to discover, and that it should turn aside.

Knowledge transfer through fusion. If one blob has learned that a bridge coated with salt, a substance it dislikes, is harmless, and is then allowed to fuse with a second, inexperienced blob, the newly fused blob immediately acquires that knowledge. The two share their experience directly through their cytoplasm.

The blob is a single-celled organism without a brain, which makes this last ability especially interesting for humans. If we understood how knowledge is shared at the cellular level, we would very likely be able to "program" cells. This could open up important applications, such as curing cancer by programming cancer cells to die promptly. This process is called apoptosis (DARPA 2017 and Cai et al. 2026).

The blob dates back approximately 1.5 billion years and has shown a remarkable and distinctive capacity to survive. Understanding it and integrating its intelligence with our own could greatly improve our ability to adapt to changing environmental conditions and thus enhance our chances of survival.

The blob illustrates a striking possibility for extending capabilities by programming the cell nucleus. As with any new development, there is a risk of misuse, making ethical principles and new rules necessary. New developments also offer potential benefits for humans and their environment, particularly by helping to conserve resources.

Perception shapes our reality. What, then, would happen if our perception expanded? We could come to understand and interpret a greater quantity and variety of data, including data that currently lie beyond our grasp. These would then become available for human use. In short, more input (data) would mean greater awareness and, in turn, greater intelligence.

What forms of intelligence have we identified so far, and how are they measured?

3 Human Intelligence

There are several models of human intelligence. One of the best-known classical models distinguishes two core components. A more recent approach divides intelligence into several independent domains.

3.1 The Classical Model (Cattell 1963)

Cattell (1963) distinguishes two core components of general intelligence:

Fluid intelligence. This is the innate ability to solve unfamiliar problems through reasoning. It helps us recognize patterns and reason logically without drawing on prior knowledge. It peaks in early adulthood and then gradually declines for biological reasons.

Crystallized intelligence. This is the knowledge accumulated over a lifetime. It includes vocabulary, general knowledge, and learned skills such as arithmetic and driving. It grows through education and experience and often remains stable or even increases well into old age.

3.2 The Modern Model of Multiple Intelligences (Gardner 1983)

The psychologist Gardner (1983) transformed research in this field by arguing that a single IQ test cannot do justice to human abilities. He distinguished the following independent forms of human intelligence:

Linguistic intelligence. A talent for language, writing, reading, and speaking, as seen in writers and lawyers.

Logical-mathematical intelligence. Strong reasoning skills and an aptitude for working with numbers, abstractions, and scientific problems, as seen in programmers and physicists.

Musical-rhythmic intelligence. A sensitivity to rhythm, pitch, melody, and musical composition, as seen in musicians and conductors.

Visual-spatial intelligence. An exceptional ability to visualize spatial relationships and find one's bearings, as seen in architects, pilots, and sculptors.

Bodily-kinesthetic intelligence. Excellent control of one's body and skill in coordinating movements, as seen in athletes, surgeons, and dancers.

Interpersonal (social) intelligence. The ability to understand other people's feelings, motivations, and intentions and to interact well with them, as seen in teachers and therapists.

Intrapersonal intelligence. A deep understanding of one's own emotions, strengths, weaknesses, and goals.

Naturalistic intelligence. A keen sensitivity to nature, animals, plants, and ecological relationships, as seen in biologists and foresters.

Interpersonal intelligence in particular poses a limit for AI. As the philosopher Gabriel (2024) argues, even if a person's goals are known, AI cannot deduce from them what that person will do next.

Average IQ has been observed to decline in many Western industrialized countries since the mid-1990s (Pietschnig & Voracek 2015). This trend, known as the negative Flynn effect, breaks with the decades-long rise seen in the previous century. Scientists attribute it mainly to digital overstimulation, shorter attention spans, and changing learning habits. Two observations illustrate the point:

The Flynn effect. Until the 1990s, people consistently scored higher on intelligence tests, gaining about three points per decade as education, nutrition, and health care improved.

Changing abilities. Studies find that younger generations perform measurably less well than their predecessors, particularly in critical thinking and verbal comprehension.

It is striking that the definitions offered by both the classical and the modern models fit humans but apply only in part to animals. To the extent that the models include animals, they subsume them under human categories. Both definitions thus place humans above other animals.

3.3 Animal Intelligence

Researchers measure animal intelligence primarily through behavioral observation and specially designed experiments, since conventional human IQ tests are unsuitable. They test a range of cognitive abilities.

Problem-solving and tool use. Can an animal overcome obstacles or use objects to obtain food, as when crows bend sticks?

Learning and memory. How quickly can an animal find its way through a maze or recall hiding places, as squirrels do?

Self-recognition (the mirror test). Does the animal recognize itself in a mirror or take its reflection for another member of its species? Examples include chimpanzees, dolphins, and magpies.

Abstract thought and numerical understanding. Can animals distinguish quantities or learn symbols, as African grey parrots do?

Social intelligence. Do animals understand the intentions of other members of their species or work together as a team? Wolves and elephants are examples.

Animal intelligence is always adapted to the animal's habitat. An octopus faces quite different problems than a dog, which makes direct comparisons of their intelligence difficult. Animals must adapt flexibly to their environments, and the resulting diversity of intelligence can be grouped into several forms:

Tool use and cognition. Chimpanzees, crows, and sea otters use and modify objects to obtain food.

Social intelligence. Group-living animals such as wolves, elephants, and dolphins show empathy, hunt cooperatively, and recognize hierarchies. Human IQ tests have no corresponding category.

Linguistic and communicative intelligence. Whales use complex songs, while bees use the waggle dance to pinpoint food sources.

Spatial intelligence. Migratory birds and squirrels have an extraordinary ability to find their way and remember routes and hiding places. In human IQ tests, spatial intelligence refers to visualization, the brain's ability to construct internal models.

Numerical understanding. Some primates, birds, and even fish can distinguish quantities and count.

Two examples illustrate abilities that lie beyond the reach of human senses. Many bony fish have tetrachromatic, or four-color, vision. Humans have three types of cone photoreceptor (red, green, and blue). These fish have a fourth type sensitive to ultraviolet (UV) light at wavelengths of 300 to 400 nm. Examples include salmon and gurnards (Sabbah et al. 2013, Enright et al. 2015). Another example is the spatial intelligence of migratory birds. Magnetoreception, involving proteins in their eyes, allows them to map magnetic fields in their brains and thus to "see" them (Mouritsen 2018).

4 Consciousness as a Fundamental Capacity of Intelligence

Perception is a prerequisite for the development of living organisms (Precht 2018). It enables reflection, which in turn leads to insight and better adaptation to the environment, including the natural world, and thereby to further development and long-term survival.

The different forms of animal intelligence can be mapped onto categories of human IQ. So far, we have understood only individual categories of intelligence in animals. Within these categories, animals often surpass human abilities. If humans possessed these abilities, human consciousness would expand (see Precht 2018).

Consciousness is the foundation of, and a prerequisite for, reflection, human insight, and development. In Cattell's classical model (1963), a person can cultivate this development through training and attain a high IQ, depending on individual aptitude and diligence.

For completeness, plants deserve a brief mention. According to current scientific understanding, plants lack consciousness (Taiz et al. 2019). They perceive their environment, respond to stimuli, and communicate with one another, yet they lack a brain and a central nervous system. A

nervous system is essential for conscious experience, pain, or feelings. The following examples illustrate how plants perceive and respond to their environment:

Sensory abilities. Plants have receptors that "see" light, "feel" gravity, and "smell" airborne chemicals.

Communication. Plants release scents (volatile organic compounds) that warn one another of pests or attract beneficial insects.

Response. Plants can sense touch and regulate their responses through direct signals. The sensitive plant, for example, folds its leaves in response to danger. A brain is necessary to process information and give rise to consciousness. Plants are therefore excluded from this discussion of how AI might contribute to the development of human consciousness.

The blob described above is a single-celled organism distinct from both plants and animals (Figure 1).

How, then, can AI assist living beings whose highly developed consciousness includes the capacity for reflection? The aim of AI is to help humans become highly adaptable to their environment, thereby improving their ability to survive. This accords with Darwin's principle of "survival of the fittest" and operates alongside genetic mutation. It can thus be seen as accelerating the natural process of mutation. Lamarck, a pioneering naturalist who lived shortly before Darwin's time, held that living beings have an inner drive to develop until they are perfectly adapted to nature (Riedl 2003 and Precht 2018, p. 40). Lamarck inferred this from the insight that consciousness is bound to the physiology and neurology of the body. Every organism, and its brain in particular, is therefore both limited and capable of change. This capacity for change is a prerequisite for evolutionary adaptation from one generation to the next.

5 Human Development and AI's Dependence on Computation

Implementing an AI system requires programmers to encode algorithms based on formal logic. Gödel's incompleteness theorems, however, place limits on what such systems can establish as valid (Stegmüller 2013). Even fairly simple AI systems will therefore give contradictory answers to questions. In this respect they partly resemble humans, who can also reach mistaken conclusions. This places a substantial limitation on AI and on today's LLMs.

An AI system that assists a person generally consists of algorithms that require a processor and therefore hardware. The person must have that hardware nearby or carry it, for instance in a mobile phone. Alternatively, a microchip could be implanted in the body, as in a cyborg, although the thought understandably makes most people uneasy. If we think of microchips as switches, simple versions can already be introduced into the DNA of cells (Cai et al. 2026).

An alternative to computer chips comes from biomimetics, the field that studies how ideas and analogies from biology can be applied to technology (Vincent et al. 2006, Bhushan 2009). Examples include hook-and-loop fasteners and glasses that shift the color spectrum. Such glasses could, for example, make the infrared spectrum mentioned above visible. Biomimetics can dispense with complex algorithms, whereas AI requires substantial computation.

Once we understand phenomena beyond the range of human perception, we can reproduce them in ways that enable or support further human development. One advantage of biomimetics is that nature supplies a model people can understand, allowing them to follow how it is reproduced in technology. People can understand biomimetics more readily than AI, so it arouses less fear and concern. It also draws on natural models that have generally been perfected over the course of evolution. Humans share in that natural history, which makes it, at least in part, known and familiar.

6 Outlook and the Role of Trait X in the Development of Intelligence

Beyond its use in assistance systems and in developing technical systems, AI itself is widely seen as a major innovation. How does AI see itself? Asked how AI will evolve, one AI system identified three themes (Gemini 2026):

From tool to autonomous assistant (agent). AI is moving from systems that respond only to instructions toward "AI agents." These can independently plan and carry out complex, multistep tasks, such as booking an entire trip while optimizing the budget or managing workflows in the background.

True multimodality. The future will be fully accessible. AI systems will be able to process and combine text, speech, gestures, facial expressions, images, and live video simultaneously. Interacting with them will feel as natural as a conversation between people.

Deep integration into science. The most spectacular advances lie ahead in medicine, materials science, and climate research. AI will be used less often to write "funny poems" and more often to decipher protein structures, find new cancer treatments, or run complex climate models.

These predictions suggest that AI could help people organize daily life, communicate, and conduct research. It remains for AI developers to show how much of this will become reality. AI has no consciousness and therefore no capacity for reflection or feeling. It can only simulate these capacities, acting as though it understands us.

People have defined ethical principles for those who develop and operate AI. One example is the EU Act (2018), which divides AI applications into four classes according to whether, and to what extent, they process sensitive data. Each class imposes requirements on operators with the aim of preventing applications in that class from harming people.

AI's capacity for pattern recognition can certainly serve a worthwhile purpose. One application might be to identify what would need to change in a cell nucleus for the cell to take on a different or expanded function, such as triggering apoptosis in cancer cells. Old, damaged, or surplus cells destroy themselves after a certain time. For cancer cells, the aim would be to trigger apoptosis immediately.

If we understood apoptosis in a cell, it might be possible to induce it by modifying the chromatin in its nucleus, in which DNA wraps around proteins. Very small electrical voltages might bring about such a modification (Weaver 2003).

Assuming the mechanism of apoptosis in cancer cells were understood, it might be possible to "program" those cells to die by activating electrical switches, e. g. with a microchip (see DARPA 2017, Cai et al. 2026).

One reason for studying the single-celled blob described above (Beekman 2012) is to understand cellular programming and thereby find ways to cure diseases such as cancer.

AI can contribute to the development of human consciousness and abilities. The evolutionary biologist Rainey (2022) also sees this possibility when humans and an AI system are well matched. One route is cultural transmission, in which people develop AI algorithms and pass them on to the next generation, who develop them further. A prerequisite for evolutionary change is that the algorithms affect humans in ways Rainey calls "fitness-affecting." His example is the development of AI algorithms in mobile phones and their transmission to the next human generation.

Consider an example. Let X2 denote the mental capacity we call consciousness. X2 is a human trait and thus part of human nature. Its scope is bounded by nature. Even if some form of intelligence can develop it further, it remains subject to those limits and therefore cannot come to dominate humanity. Moreover, the evolution of X2 would presumably take a long time, even with AI assistance. Such gradual change is natural for humans and need cause no fear. One example is the increase in brain size and the accompanying growth in cognitive capacity. This differs from Kurzweil's prediction (2024, especially p. 332) of a symbiosis between humans and machines through microchips in the brain.

AI cannot experience or reflect on feelings because it lacks consciousness. It can imitate feelings and give humans or even animals the impression that they are real. It is up to living beings to accept these displays, recognize them for what they are, or dispel the illusion. AI therefore remains a technology that, in the case of LLMs, is opaque and technically limited. Because it is outside nature, it lacks consciousness and will continue to do so. It can, however, help protect nature and with it the human habitat in which people have been evolving for thousands of years.

Some readers may find these ideas far-reaching. Yet humanity has already turned aside from its evolutionary path and is developing AI in place of itself. There may be economic reasons for this. The philosopher Precht (2018) captures the idea with the term "Monetocene," an age of "less nature and more money."

The ideas presented here suggest that we need no longer live solely with whatever capacities consciousness develops on its own. Humanity could take a more active role in its own evolution by adopting, from the bottom up, further capacities of consciousness found in nature, for example in animals and it could do so in a way that also preserves nature and allows it to survive.

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