THE BLUE BRAIN METAPHOR FOR AI

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> No algorithm exists for the metaphor, nor can a metaphor be produced by means of a computer's precise instructions, no matter what the volume of the organized information to be fed in.
>
> (Umberto Eco 1984: 127)

Abstract

Artificial Intelligence (AI) is an absolute key term in contemporary digital reality. It has become an umbrella term for a wide range of technologies developing rapidly, spanning and influencing diverse sectors and domains and, thereby, with an increasing impact on how more and more people live

Digital Age in Semiotics & Communication, Vol. VII, 2024, 21–45
https://doi.org/10.33919/dasc.24.7.2

their daily lives and/or work. Public discourse on AI often involves metaphor or other imagery and thus a common way to represent AI is by what is sometimes called the "blue brain metaphor". This visual metaphor is frequently used by a number of rather diverse addressers (stakeholders), in order to capture the essential elements of AI by conferring to it human-like characteristics.

In the following work we describe the semiosic background of the "blue brain metaphor" for AI. Inspired by the terminology of Umberto Eco, we understand the metaphor as a function of the socio-cultural format of the encyclopaedia which decides the relevant relations of similarity between AI and the human brain underlying the metaphorical production and interpretation. We address what characterises the "blue brain metaphor" visually and try to interpret (some of) its meanings. We will also accentuate how it builds on to the (old) metaphor: the "computer is a brain". Finally, we briefly describe how the "blue brain metaphor" is related to diverse normative discourse concerning AI.

Keywords: artificial intelligence (AI), metaphor, the "blue brain metaphor", Umberto Eco, encyclopaedia, semantic componential analysis, normativity

1. Introduction

In the tapestry of myriad meanings coined with artificial intelligence (AI), the threads of history, mythology and human ingenuity weave a story not just of technological progression, but also of cultural evolution. The idea of automating or mimicking human thought processes and intelligence, however, predates modern understandings of AI. For centuries, various automata and mechanical devices designed to simulate aspects of human behaviour, or to resolve specific problems, have been an integral part of human history. Before the advent of modern computing, early conceptions of artificial intelligence were rooted in folklore and myths. Stories were told about artificial beings mimicking or surpassing human capabilities (Cave, Dihal, and Dillon 2020). The narratives identified by Cave et al., demonstrate recurrent themes found in the visions of AI, such as the creation of life, the relationship between creator and creation, the potential risk for AI to surpass human intelligence, and the existential risk AI may pose for humanity. Noah Harari and Adrienne Mayer, respectively authors of books on the cultural development of human technology (Harari 2017) and (Mayor 2018), discuss how the ideas and conceptions of technology

and developments of automata and visions of AI are nested in the confinements of cultural developments and ideas. The parallel between the titles "God and Robots" and "Homo Deus" are remarkable, both connecting technological creations to divinity. While grounded in different historical perspectives, Mayor and Harari converge on several points, reflecting on human aspirations, anxieties and ethical considerations, as prevalent implications of technological creations. Both authors showcase how visions of human automata and artificial intelligence stem from a multitude of different factors, rooted in the fascination of technology itself, the quest for understanding and replicating the essence of life and intelligence, and the developments in society. The portrayals of technology and automata exist since the mythologies of ancient times, throughout different historical eras, nurtured by scientific discoveries and prevalent philosophical and theological ideas. Mayor delves into mythology and reveals how stories of automata and ideas of artificial beings were imagined as early as in ancient Greece. They were expressed in the myth of Talos, a giant bronze automaton created by Hephaestus to protect the island of Crete. What makes the myth of Talos of particular interest in our context is the way he is described as an animated mechanical construction, sustained by divine force. Thus, coupling early conceptions of the technological achievements of the time with artificial life, merging the mechanical with the divine. Where Mayor delves into the myths of ancient Greece, Harari turns our attention towards the transforming nature of technology itself, considering it as an integral force of human nature. Harari uses the concept of "Homo Deus" or "God-Man", in order to suggest how technological achievements are a pathway to God-like powers. Harari discusses how AI could foster new forms of experience, and improvements and through developments in biotechnology alter the building blocks of human life itself. Where the ancient myths see the life-force of Talos as given by the Gods, in the age of modern AI, human becomes God and creators of life themselves. Thus, the strong metaphorically based conceptions of technology, automata and robots is deeply engrained in human history and the technological developments which connect visions of artificial beings and intelligence to ideas of the mechanics of life itself, to the danger of autonomous machines, and to the ideas of transhumanism. Transitioning into the age of computers, the focus on AI has shifted from mechanics towards abstract intelligence. The origin of contemporary AI can be traced back to the works of Alan Turing (1912–1954). Alan Turing was a British Mathematician who introduced the concept of universal computing (Turing 1937). Turing's research into computation played a pivotal role in the decryption of the German Enigma code during World

War II. Turing later proposed the concept of the imitation game, later also known as the Turing Test (Turing 1950).His test sets the criteria for a machine's ability to exhibit intelligent behaviour, indistinguishable from that of a human. However, where the physical and mechanical form were prevalent, computation marks a shift towards disembodied intelligence. The term Artificial Intelligence was coined in 1955/56 by John McCarthy in a proposal for the Dartmouth Summer Research Project. Here, the aim for science and engineering was described as making machines intelligent, based on the presupposition that: "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it." (McCarthy et al. 2006). The era of machine learning marks a significant shift in the evolution of AI, starting in the early 2000s, and continuing to the present. The focus on AI shifted from rule-based algorithmic reasoning towards data-driven approaches, enabling machines to learn from experience and improve over time, and make decisions with minimal human intervention. This development is underscored by three pivotal developments: the explosion in data, the advancements in machine learning techniques, and a surge in computational power. As technology has evolved from mechanic machines towards data-driven digital computers, the conceptual metaphors that are used to describe machine intelligence have also evolved, and as such they reflect the dynamic interplay between human ingenuity and technological advancements. In today's information environment, a number of definitions for AI exist. Looking at AI from a broad perspective, this concerns models for processing information for the purpose of performing tasks originally done by humans or computer software systems (involving algorithms) which can perform processes normally understood as involving cognition. For example, these systems can involved the collection of data, in order to recognise patterns, learn from recognised patterns, make decisions, and achieve goals etc. (Demir & Güraksin 2023). AI has now become an umbrella term for a wide range of technologies which are developing rapidly, spanning and influencing diverse sectors and domains. These areas include health and medicine (Obermeyer & Emanuel 2016), legal and compliance (Ashley 2017), business and finance (Bahoo et al. 2024), military and defence (Raska & Bitzinger 2023), as well as transportation and autonomous vehicles (Bathla et al. 2022; Sørensen, Thellefsen, and Thellefsen 2020). Therefore, AI has an increasing impact on how many people live their daily lives and/or do their work: driving public discourse involving both optimistic hopes and pessimistic anxieties. Often the discourse on AI involves the use of metaphors. AI is itself a metaphor (we will return to that later),

and metaphors make it possible for us to think about, make sense of and use AI. This is witnessed, for example, witnessed by metaphors such as machine vision, learning and memory etc. For a number of stakeholders, metaphor serves many purposes in relation to AI. This is particularly the case for – companies commercially bringing AI to the market, organisations/institutions informing the broader public about AI (such as UNESCO and the European Parliament), neuroscientists trying to advance their field (Baria & Cross 2022), or developers designing new AI software (Colburn & Shute 2008). In short, metaphors are used as a valuable tool to explain the abstract/complex subject matter of AI (Baria & Cross 2020). As accentuated by Wallenborn (2022) and Halbryt (2023), when using a search engine for finding images of AI, many (stock) images will show a machine involving a human brain and, often, is the image held in dark/deep blue colours. In the following, we will refer to this as the "blue brain metaphor" for AI. The reason why this metaphor in images of AI has become so common and used by very different addressers is, perhaps simply, because it builds on or is a visual variation of the well-known metaphor "the computer is a brain". Nevertheless, following the terminology of Umberto Eco (and thereby, partly Peirce) (1984) we can say, that AI, as a "blue brain metaphor", has become a prominent node in a semantic network. Series of interpretants represent metaphorical meaning potentials of AI and make it meaningful within a larger (socio) cultural encyclopaedia.

The question is then, if this visual AI metaphor is a (semiotic) consequence of the encyclopaedia of interpreting subjects then what readings are possible, why are they possible, and can new paths be discovered by semiotic relationships within the encyclopaedia?

The purpose of this article is therefore two-fold: Firstly, to describe the semiosic background for the "blue brain metaphor" for AI, and, secondly, to give different readings of the metaphor inspired by Eco's semantic componential analysis. We will begin with the more obvious interpretations of the metaphor, hopefully moving on to more diverse, complementary and/or perhaps contradictory meanings. Finally, we will briefly address some normative implications of these interpretations of the visual "blue brain metaphor" in relation to the (encyclopaedic) understandings cultivated by the public discourse.

2. Metaphors, the Computer and AI

Metaphors are central to language, thought, feeling, and experience and the intricate relationships between them. For the last 40-50 years or so, this has been argued within fields and disciplines, such as, linguistics, psychol-

ogy, philosophy, and semiotics (Black 1962; Ricoeur 1978; Lakoff & Johnson 1980; Eco 1984; Ortony 1993; Gibbs 1994; Gentner et al. 2001; Brandt 2004). For centuries metaphors have been used to make technology meaningful, enabling its understanding and use. They have been used to represent something abstract in terms of something (more) concrete or well-known. Formulated differently, metaphors can frame the relationship between humans and technology and, thereby, mediate (Rosenberger & Verbeek 2015; Sørensen, Thellefsen, and Thellefsen 2024), not only the use of technology as such, but also the relation between humans and their world (Chown & Nascimento 2023). The "blue brain" metaphor for AI is based on or is related to, of course, the metaphor "the computer is a brain". That is, the computer is represented by an anthropomorphising metaphor where it has human(-like) qualities/characteristics. In the 1940s, popular computer magazines suggested how the computer could "think" and had a "memory" (Berry 1993) and, today, we all know that the computer can sleep, wake up, become sick (when it has a virus), see, read, accept, and check our spelling etc. etc. The word computer was etymologically already recorded in the beginning of the 17th century referring to someone doing computing or calculations in an observatory (Oxford English Dictionary 2024, online). In the 1940s, the word computer was still used in this way, for someone doing calculations for engineers. However, also in the late 1940s, when programmable digital devices were designed to do the same task, these devices were denoted "electronic computers" quite quickly. However, they were just called computers (Videla 2017). Hence, calling the computer a "computer" has all along been a metaphor, not surprisingly, involving a meaning potential where "the computer is a brain". Furthermore, "the computer is a brain" metaphor is related to another well-known metaphor, namely, "the brain is a computer". Brain functions are understood in terms of computer functions: for example, processing information or having input data activating perception (Baria & Cross 2021). Not only, "the computer is a brain" metaphor, but, also, "the brain is a computer" metaphor, and their sometimes entangled meanings, are a part of the semiotic possibilities for representing, describing, and explaining AI. The "computer is a brain" and the "brain is a computer" metaphors are part of the same metaphorical language, where AI e.g., can make sense of data, learn and even has a neural network such as human brains. Formulated differently, AI is related to certain potentials of meaning involved within what we below, along with Eco, will call the encyclopaedia. This is understood as a multidimensional space for semiosis and shared knowledge (Desogus 2012), which, inter alia, governs the production and interpretation of metaphors. Let us therefore look into the semiosic background for the AI metaphors.

3. The Semiosic Background of the "Blue Brain Metaphor" for AI

Before going into possible interpretations of the "blue brain metaphor", inspired by Eco, we will now consider the semiosic background for the metaphor: where the concepts of similarity, interpretant and encyclopaedia are central. Furthermore, we will look into Eco's suggestion for a componential analysis of the semantics of metaphors, which, methodologically, can guide our interpretations of the AI "blue brain" metaphor. Finally, we briefly address how AI metaphors (in general) offer perspectives on the encyclopaedia.

3.1 The "blue brain metaphor" for AI rests on a relation of similarity Looking at the image of the human brain, constructed from intricate circuit lines glowing with an electric blue hue, the human brain is a visual metaphor for AI (see Figure 3); or the human brain is metaphorising (parts of) AI. Along with Eco we can say that this metaphorisation is possible due to a relation of similarity between the human brain and AI (Eco 1984: 113). However, that which characterises and qualifies this relation of similarity – the answer from Eco – concerns both Peirce's concept of interpretant and his own encyclopaedia. Eco explains how (every) metaphor is: "produced solely on the basis of a rich cultural framework, on the basis, that is, of a universe of content that is already organised into networks of interpretants." (Eco 1984: 127). The universe of content involves a semiotic dynamic, or infinite semiosis, where signs, qua Peircean interpretants, continuously, interpret other signs into networks of meaning (Eco 1984: 113) – also, regarding relations of similarity (Sørensen 2011: 152–155). Eco writes as follows:

> By similarity…we mean the fact that in a given system of content…properties are named by the same interpretant, whether it is verbal or not, and independently of the object that the objects or things for the designation of which that interpretant is customarily used may manifest perceptual "similarities." (Eco 1984: 111)

The visual metaphorical similarity between the human brain and AI, therefore, concerns interpretants. The similarity has nothing to do with presumed ontological relations or the structure of reality "itself". The similarity is coherent, not motivated, and it depends on rules, codes and conventions within what Eco calls the encyclopaedia. The encyclopaedia is a multi-dimensional space making possible the processes of signification and communication (Eco 2014: 49–60; Desogus 511–515), as well as communicative acts as metaphors (Sørensen & Thellefsen 2014: 104–110), involving images of AI represented as "digital brain" and "blue brain". The

encyclopaedia has no centre, it is, virtually, infinite as a regulative ideal. It is possible to isolate a portion within the encyclopaedia, chains of interpretants, but it will, always, be a local representation (Sørensen & Thellefsen 2014: 206). This is also true of visual metaphors concerning AI and our attempts to understand what they mean. Of course, structured knowledge is possible within the encyclopaedia and truths can be registered. However, the encyclopaedia, furthermore, registers what is believed to be false and even legendary (Eco 1984: 83–84). Hence, the "digital brain" and "blue brain" visual metaphors are semiotic mechanisms which base themselves, and are working within, the encyclopaedia, no matter whether they are true, false or, simply, depends on cultural myths. Arguing for different interpretations of these visual AI metaphors means describing paths within the encyclopaedia where interpretants guarantee validity of the signs. This begins with looking for relations of similarity between what is metaphorising (the human brain) and what is metaphorised (AI).

3.2. Isolating relevant portions of the encyclopaedia to interpret the "blue brain metaphor" The AI metaphor "blue brain" has been created, and subsequently interpreted, and will be interpreted in the future – on the basis of a rich semiotic network: the encyclopedia, organized into, virtually, infinite series of interpretants. So, the following question naturally arises: how can portions of the encyclopaedia be represented meaningfully, in order to interpret the visual AI metaphor – when the series of interpretants are virtually infinite (Eco 1984: 117; see also Jensen 1993). Eco suggests a method for possible interpretations of metaphors which is based on Aristotle's four causes. He writes: "It is a representation based on nothing other than the four Aristotelian cases (efficient, formal, material, and final), it being clear that these are assumed in merely operational terms without metaphysical connotations." (Eco 1984: 115). And, Eco, furthermore shows, using the representation of a noun /x/, how such a representation looks like:

/x/)	F(orm)	A(gent)	M(aterial)	P(urpose)
	Perceptual aspect a x	Who or what produces x	What x is made of	What x is supposed to do

Figure 1: Eco's representation of encyclopaedic properties (Eco 1984: 115)

In order to interpret a metaphor, we first need to make a componential description of "what", potentially, is metaphorising. Then after this description, we must look in the encyclopaedia for "something" which can be metaphorised – because it shares some interpretants with "what" is poten-

tially metaphorising it. In our case concerning the visual AI metaphor, we already know, of course, that we are dealing with a relationship between the human brain and AI. Nevertheless, it seems methodologically relevant to follow Eco's semiotic suggestion for the interpretation of metaphors because it permits us to understand the AI metaphor as related to parts of the encyclopaedia. However, a componential (semantic) representation of the encyclopaedic properties involved in the visual AI metaphor cannot stand alone (analytically).We also need to remember how certain constraints will influence our interpretations of this metaphor. Following Eco, there is a contextual pressure that potentially activates a given portion of the encyclopaedia, and, thereby, proposes interpretants underlying the relation of similarity in the AI metaphor. This contextual pressure concerns the identification of a theme, i.e., that which is being talked about with the metaphor, including from what perspective and to what end this is being talked about. In short, a topic or certain frames are involved which restrict which interpretations of the AI metaphor are possible or seem to make sense concerning their underlying series of interpretants (Eco 1984: 117–118).

3.3. The AI metaphor as perspectives on the encyclopaedia

It is important to accentuate that the encyclopaedia is not a static or coagulated semantic structure. The encyclopaedia, qua the Peircean interpretants and the processes of infinite semiosis, allows for new creative semantic couplings. AI metaphors are indeed semiotic mechanisms with potentials for semantic innovation: if they, to some degree, are creative. Eco writes how some metaphors provide: "a new semantic coupling not preceded by any stipulation by the code…but which generates a new stipulation by the code." (Eco 1976: 284). Formulated differently, metaphors can provide: "shortcuts within the process of semiosis" (Eco 1984: 129). Indeed, these shortcuts can convey new patterns of signification within the encyclopaedia where portions of the encyclopaedia become re-arranged with the effect that the encyclopaedia becomes expanded or new semiotic potentials arise. Furthermore, for Eco, the encyclopaedia does organise the ways in which we see the world or how we think about it. So if metaphor can re-organise or perhaps create new parts of the encyclopaedia, it can also rearrange or create new meanings concerning how we think – including how we are thinking about AI. Finally, we should remember that AI metaphors (as every other metaphor) only activate or rearrange a part of the encyclopaedia. They therefore represent a point of view seen from the perspective of similarity which concerns series of interpretants. This also means, that AI metaphors involve a semiotic effect where they will focus

on some interpretants and not on others; or the AI metaphors emphasize some semantic similarities between what is metaphorizing and what is metaphorized – while other similarities as well as differences will not appear or may be down toned or even (purposefully) hidden (Jensen 1993: 102). Other similarities as well as differences will not appear or may be down toned or even (purposefully) hidden (Jensen 1993: 102). Through the encyclopaedia, the AI metaphors thus potentially enable certain ways of thinking while restricting others (Halbryt 2023). At the same time, they can influence and define what is culturally meaningful as well as significant concerning AI: including consequences for what is considered true and false, good and bad, right and wrong, and thus impacting social behaviour, for example.

3.4. The blue brain metaphor for AI

In the previous pages, we talked about *the* "blue brain metaphor" for AI. We mentioned how both Wallenborn (2022) and Halbryt (2023) stress that AI is often represented in (stock) images by a blue brain metaphor. Although the two authors do not present any statistical premises for their conclusion, we believe that they have an important point – which we will return to below. In a thought-provoking article, Cave and Dihal (2020) argue how AI is predominantly portrayed as white referring to colour or ethnicity or both. They also examine, inter alia, stock images but do not mention metaphor. In order to indicate the prevalence of racialised AI in stock images, as the two authors call it, they undertook two image searches on Google (using the Tor browser) for the term "artificial intelligence" (on the 13th April 2020). In relation to our article, the interesting fact is, that the top 18 image results of their search showed that four images displayed "Whiteness", but also that a number of images: "were too abstract, featuring stylised brains and circuits" (Cave & Dihal 2020: 692). Then, we indeed return to the "blue brain metaphor" for AI. That is, when we look at the screenshot of the 18 top results found by Cave and Dihal, we can see that at least nine of these images involve versions of the "blue brain metaphor". We are not saying that Cave and Dihal do not have a good point when they argue for a prevalent "Whiteness" in categories such as the representation of AI concerning humanoid robots, portrayals of AI in movies and television as well as stock images, what we are saying is, that there also is an important category of stock images which concern AI involving the "blue brain metaphor". This is indeed shown by the search by Cave and Dihal shows. Four years after Cave and Dihal, we conducted the same Google image search for the term "artificial intelligence" (see Figure 2).

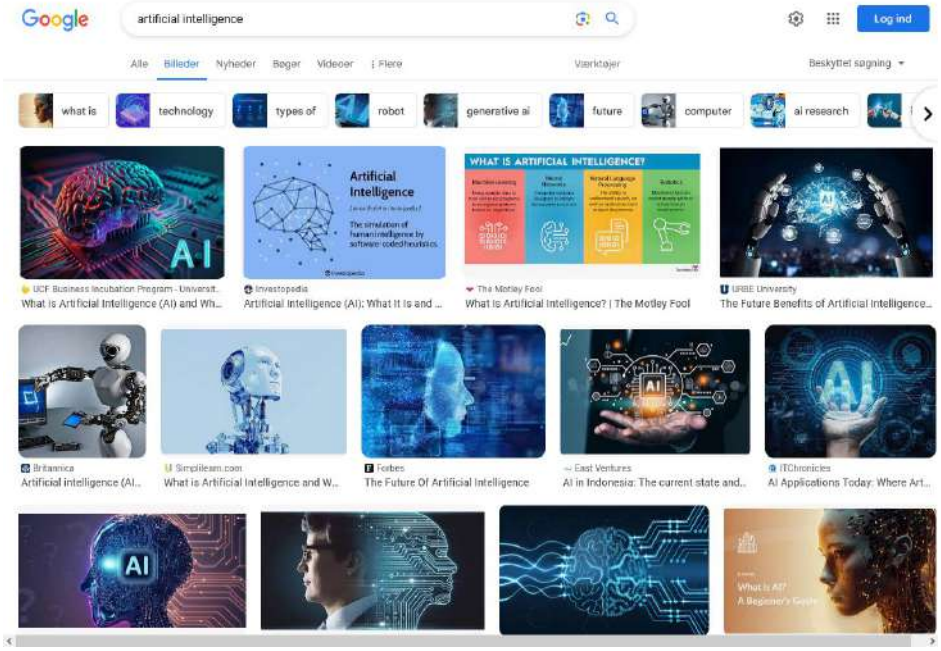

Figure 2: Tor browser Google image search result for the term "artificial intelligence", 27th March 2024

Hence, also today can we find a number of examples of the "blue brain metaphor" for AI. Of the 13 top search results seven images involve the metaphor. Thus considering both the search result found by Cave and Dihal as well as our own, we can return to Wallenborn (2022) and Halbryt (2023) and say that we support their claim: AI in stock images is often represented by a "blue brain" metaphor. So, what do we mean, more precisely, in the following, when we talk about the "blue brain metaphor" for AI? First, or most obviously of course, we mean a visual metaphor which depicts/represents a human brain with a blue hue. Furthermore, the brain often involves interconnected lines constituting a circuit; and the brain is encased in a head seen in profile. Finally, some "blue brain metaphors" appear within a visual context where 0s and 1s or some programming code is shown. Below we will make an interpretation of a stock image used by UNESCO which involves the "blue brain metaphor" for AI, possessing all the characteristics already mentioned. Or formulated differently: We believe that this image involves a good (representative) example of the "blue brain metaphor" for AI.

4.0 Interpreting the Blue Brain Metaphor for AI

Figure 3: The blue brain metaphor for AI
https://www.unesco.dk/videnskab/kunstig-intelligens

We find this image on the website for the Danish UNESCO-National Commission (Den Danske UNESCO-nationalkomission). Above the image we read the headline "Artificial Intelligence" (Kunstig Intelligens) and with the sub-headline the viewer learns how "UNESCO will set common international standards for the work with artificial intelligence" (UNESCO vil sætte fælles internationale standarder for arbejdet med kunstig intelligens). Furthermore, UNESCO accentuates how AI is spreading to more and more areas of life and it concludes that AI seems to involve almost endless possibilities, but also, challenges and risks. Finally, when UNESCO defines AI, it is described as being built on mathematical models, algorithms, and while AI cannot, in the strictest sense, think, UNESCO concludes that it undoubtedly can be programmed to learn from experience. The image, unsurprisingly, involves that which in the previous pages we called the "blue brain metaphor" for AI. Therefore, using the terminology of Eco, we already know the topic or what the visual metaphor is about. If we did not know the topic, the immediate (con)text of the web page (its headline etc.), will guide our interpretation to the conclusion: that the topic is AI. Furthermore, we know that the human brain is metaphorising AI. More precisely what do we see when we look at the image from the UNESCO website? First, the central focus of the image is an outline of a

human head and brain seen in profile. The outline is white and glowing. The central figure of the image is encased in a sphere made of a complex network of interconnected lines. Furthermore, the interconnected lines are also surrounding the central figure. In the background of the image, we see sequences of the numbers 0 and 1. The sequences are visible on both sides of the central figure, and they glow in a blue light. The overall colour scheme is dominated by various shades of blue. Bright neon-like elements illuminate certain aspects of the image. Let us keep this brief description in mind. Now we will try to represent the metaphorising human brain with relevant interpretants from the encyclopaedia, thus returning to Eco's proposed "case grammar" analysis of metaphor based on the four Aristotelian causes.

/The human brain/ (	*F(orm)* Perceptual aspect of x	*A*(gent) Who or what produces x	*M(aterial)* What x is made of	*P(urpose)* What x is supposed to do
	Organ composed of neurons, biochemical	A product of biological evolution	Biological matter	Enable consciousness, feeling, thought, control etc.

Figure 4: A case grammar analysis of the metaphorising human brain

A similar representation of the metaphorised AI can be formulated as follows:

/AI/ (	*F(orm)* Perceptual aspect of x	*A*(gent) Who or what produces x	*M(aterial)* What x is made of	*P(urpose)* What x is supposed to do
	Digital representations	Created by humans; computer scientists, engineers, developers etc.	Digital data and algorithms	Automate tasks, mimic human intelligent behaviour

Figure 5: A case grammar analysis of the metaphorised AI

Thus, it is possible to select a number of interpretants from the encyclopaedia which represent the metaphorising human brain and the metaphorised AI respectively. We thereby see certain similarities and differences between the two entities. The differences are obvious. In particular, they concern the aspects of A and M. The human brain e.g., is a product of biological evolution over millions of years involving natural selection. AI, in contrast, is produced by humans using sophisticated programming languages, coding, and techniques regarding machine learning etc. Furthermore, the human brain consists of biological matter. It includes, for example, neurons, glial cells, blood vessels and different neurotransmitters, whereas AI involves digital data within the memory of computer systems and servers represented by algorithms and data structures. We must therefore find the similarities (qua interpretants), underlying the possible metaphorical semiosis, and which involve the human brain as metaphorising and AI, as metaphorised, in relation to the aspect of P or what "something" is supposed to do or serve for. Then, we return to the "computer is a brain" and the "brain is a computer" – because the similarities regarding the P aspect seem to concern certain functionalities and processes. However, looking at image, what is it more specifically that leads us to this interpretation? Firstly, as mentioned before, we can see that the brain involves a complex network of interconnected lines. Furthermore, on both sides of the brain/face there are sequences of 0s and 1s. Finally, the website describes (verbally) AI as capable of learning. It is this complex of possible visual and verbal signs which we understand as the premise for our interpretation: identifying relevant interpretants for the metaphoric relation of similarity. It is not possible to say what a potential viewer of the website actually knows about the human brain and AI, yet it is (in principle) known what language or other semiotic systems have already said (in the encyclopaedia) about these two entities. Therefore, looking at the image and the brain with its intricate network of interconnected lines, we can say that these lines constitute a circuitry which represents how (billions) of neurons (the basic information unit of the brain and nervous system) form networks enabling information processing and thereby cognitive processes. Furthermore, the sequences of 0s and 1s, glowing in the background, feature a binary code which is often used to represent data or processing of information. Thus, taking this into account we can point at the below potential significant relations of similarity underlying the "blue brain metaphor" for AI:

- Both AI and the human brain process information. The brain processes and transmits information via vast networks of neurons. AI,

on the other hand, processes information via algorithms and powerful computational operations. AI as well as the brain involve input which is processed to outputs (represented in the image with some of the interconnected lines which are woven in and out of the brain).

- Both AI and the human brain learn. This is done by the brain through a process called synaptic neuroplasticity, i.e. brain learning from experience (where connections between neurons are strengthened and weakened over time through experience). AI, on the other hand, learns from data by means of machine learning algorithms (adjusting their parameters to the exposed data). In this way the brain as well as AI can adapt/improve their performance.
- Both AI and the human brain can recognise patterns. The brain and AI recognise patterns through examples. The brain does this through sensory experience and cognitive processes and AI uses algorithms. Pattern recognition enables both the brain and AI to make, for example, generalisations, predictions and decisions.

Most laypeople viewing the image will not be able, we think, to unfold these relations of similarity in an explicit, self-controlled way (especially with reference to concepts such as neuron, synaptic neuroplasticity, neural networks etc.). However, most viewers will probably say, if they were asked about the meaning of the metaphor, that it suggests AI possesses brain-like characteristics. Some viewers may mention one or more of these characteristics, such as that AI can learn and recognise patterns. Seen from the perspective of the "blue brain metaphor", it is suggested that there is a complex relation between the human brain and AI – a relation which involves a semiotic integration between biological intelligence (the brain) and artificial intelligence (binary code and network connections). Formulated differently: The profile of a human head filled with circuitry not only represents the integration of AI with human cognition but also serves as an iconic sign which can mirror our own biological neural networks. It is the same semiotic potential which is at play as when MacCormac writes how: "We talk about the neuronal states of the brain as if they were like the internal states of a computer; we talk of the mental processes of thinking as if they were algorithmic." (MacCormac 1985: 10). In short, then, and returning to Eco's terminology, we can say that with the "blue brain metaphor" we have a topic which involves a certain *frame* for AI concerning epistemology. Thus, AI is metaphorised, qua the human brain, as something which, for example, can perform tasks due to its ability to think, learn, infer etc. (Watson 2019: 417). In close connection to this is the blue brain metaphor part of

the well-known tendency to anthropomorphise AI. This can be seen in the (more or less intentional) attribution of traits to AI typically inherent in humans, such as cognitive processes and outcomes (Sales et al. 2020: 91; Dippel 2019: 34). As Salles et al. (2020) accentuate, this tendency is driven by the fact that the inner workings of AI "although created by humans, remain inherently opaque for laypeople." (Salle et al. 2020: 90). However, the anthropomorphisation rests on the presupposition that there is a mental similarity between AI and the ways in which the human brain functions and performs etc. The question is whether the wider public (and some experts) understand AI as actually thinking, learning etc. (Dippel 2019: 34 believes so). In any case, with the anthropomorphisation of AI, via the blue brain metaphor, can something abstract and complex become known (to some degree) and seem less complex. Furthermore, can a sense of familiarity with and proximity to AI be created which fosters social/cultural acceptance all because of AI works like the human brain (Wallenborn 2022; Halbryt 2023). The feeling of familiarity with AI is further amplified because the metaphor also involves the profile of face (a silhouette). With the profile of a face follows the representation of a (anthropomorphic) physical entity concerning which the viewer, potentially, can ascribe additional human traits/characteristics to AI: for example, emotion, motivation etc. Reflecting further on the outlined head profile, there are, however, other interpretations possible, including (at least) one interpretation which stands in contradiction to the positive connotations concerning the feeling of familiarity with AI. The outlined head profile is namely also encased within a glowing sphere, and as mentioned above, the head involves an intricate network of interconnected lines (representing a circuit). However, these lines are also interconnected with the network surrounding the sphere. This could suggest that the sphere represents how AI and human thought processes are intertwined (for example in relation to the term "neural network"), but also that the very same thought processes are seen in relation to the boundless and (ever) expanding realm of AI – potentially transcending or surpassing the cognitive abilities by intelligent technology. Formulated differently, with the terminology of Eco, the metaphor also involves a possible frame where AI is spreading to increasing areas of life involving promising (sometimes immense) opportunities. However, at the same time it is complex, challenging and can have negative consequences. Returning to the verbal text of the UNESCO website, this is exactly what is accentuated. In particular, does UNESCO warn about the negative consequences of AI concerning ethics, human rights and security. A question remains, however: why is the visual brain metaphor for AI often presented in the colour

blue and its various shades? It is probably a many facetted phenomena involving different answers, but it seems that the meanings associated with colours rely partly on cross cultural biological abilities and partly on cultural habits. No matter what, however, the potential associated meanings are registered in the encyclopaedia. Let us mention first, though, how it is difficult to imagine that the brain representing AI visually should be featured in its natural colour; the outer part of the brain consists namely of the tissue called grey matter which, unsurprisingly, is (pinkish) grey. Furthermore, blue is a focal colour (together with yellow, red and green) which compared to non-focal colours, corresponds to specific wavelengths of light more easily categorisable by the human eye and therefore more easily identified and remembered by the viewer (Berlin & Kay 1969). Colour is also a vehicle involved in socio-semiotic communication (Kress & Van Leeuwen 2002; Kourdis 2014). The colour blue and its potential meanings are rooted within a society and historically conventional associations (Pastoureau 2001). In 1997, AI and the colour blue became very closely related when the chess-playing super computer from IBM beat the world champion Garry Gasparov. The computer was named Deep Blue (a reference to "Deep Thought" and IBM's nickname "Big Blue"). Not only was this event a milestone in the history of AI, it furthermore made possible a strong association between AI and the colour blue in the wider public. This resonates well with Eco's thought of the encyclopaedia which is not considered a fixed repository of knowledge, but a dynamic and culturally flexible base for signification and communication, constantly evolving as new relations of meaning are added: as when the relation between the colour blue and AI became a significant semiotic possibility within the encyclopaedia. Since then, AI has often been represented with the colour blue in different forms of media, from business logos and branding to visual representations in movies and (digital) art as well as concerning various organisations informing the broad public about AI, for example, using the "blue brain metaphor". Furthermore, the colour blue also involves a number of possible culturally fixed associations. Firstly, the perceived meaning of the colour blue exists within a cultural landscape, (Lavrenova 2023), and as demonstrated by (Pastoureau 2001), the colour blue appeals to meanings deeply embedded within the tapestry of cultural and social values and norms, see also (Broeder 2022). Also, colours invoke psychological effects and can have an important impact on cognition and behaviour (Elliot & Maier 2014). The colour blue is also associated with trustworthiness in commerce (Alberts & Van Der Geest 2011; Labrecque & Milne 2012; Su, Cui, and Walsh 2019). Thus, the use of blue in AI imagery, including metaphors

such as the "blue brain", plays a crucial role in demystifying technology and instilling emotions of reassurance when AI is rapidly developing into various and more and more aspects of modern life. Expanding on this notion, the blue colour also establishes references to the "blue sky", "the blue planet" and the "blue ocean", associating AI with a sense of limitlessness and depth, encapsulating human intelligence within what seems to be the boundless and evolving realm of AI – pointing towards, for example, the future, involving innovation and progress. Finally, a partial (and simple) explanation for the dominance of the colour blue in AI imagery could also be that the tech industry is predominantly male and blue is strongly preferred by men. Thus, this preference could be of some influence in the colour choices of the visual representation concerning AI – also when it comes to the visual metaphor where the human brain is representing AI.[1]

5. Normativity and the Blue Brain Metaphor for AI

Throughout this paper, we have explored how metaphors have shaped the conceptualisation of AI, and how metaphorical expression provides rich and nuanced meanings that can be explained by reference to Eco's concept of the encyclopaedia. The visual representation of AI, here represented by the "blue brain metaphor", suggests how understandings of AI are established by referencing AI to the human brain, suggesting the convergence between the analogue and digital worlds.

This metaphor draws on a range of established cultural norms and values. Below, we will briefly address some normative implications of the "blue brain metaphor" for AI, and thus the understandings cultivated by the imagery in the public discourse.

5.1. Historical and Cultural Contexts

The encyclopaedia is considered both dynamic and open-ended, and thus reflects the interpretation of signs both with reference to actuality, historical roots as well as possible future semiosis. Thus, the general understanding of AI, depicted as digital machinery (0s and 1s) and in the shades of blue colours, invoke certain interpretations that draw on ideas anchored in ancient myths where the blue colour is associated with divinity or eternity (Pastoureau 2001). However, this is also connected to imaginations about technological creations and achievements, and the modern-day narratives of performance, efficiency, reliability and productivity (Labrecque & Milne 2012). From a historical perspective, the developments in tech-

[1] https://forestreet.com/why-is-ai-always-blue/ (accessed 1 April 2024).

nology have always followed a path of easing the cost of human work. As discussed by Harari (2017), humans have used technological achievements to conquer new grounds. However, the narratives also suggest concerns about the inhuman nature of AI, that AI may become too influential, too powerful and obscure, and give rise to ethical considerations of its impact on society. "The blue brain metaphor", however, cultivates different narratives and can sustain the close relationship between AI and human reasoning. However, at the same time, as demonstrated in our example (figure 3), they can invoke interpretations about the boundaries of AI, and thus motivate considerations about how to safeguard and control the future developments and integrations of AI in society. "The blue brain metaphor" may also invoke fears about the efficiency of AI in e.g., decision-making, surveillance, and thus concerns about bias in data and opaque algorithms that influence public life. Therefore, while metaphors indeed do reinforce certain conventionalised concepts and diminish others, the meaning of the metaphor relies on the context in which it is communicated.

5.2. Anthropomorphism and Normativity

Anthropomorphism means to attribute human characteristics to a non-human (animate or inanimate) object. What the anthropomorph projection does is it enables cognitive and emotional perceptions of non-human objects, and in terms of AI, endows the behaviour of AI with human rationality "…*as if* it were a rational agent who governed its "choice' of "action' by a "consideration' of its "beliefs' and "desires" (Duffy 2003: 180). Anthropomorphism thus highlights the similarities and differences between artificial and human intelligence, influencing how AI is understood in society. This mechanism is also called conceptual borrowing (which in our view is synonymous with the metaphor) (Floridi & Nobre 2024), where AI has borrowed concepts from mainly cognitive science and neuroscience. AI is thus endowed with biological and psychological concepts as AI learns and adapts.AI is trained, behaves, has a memory, has neurons, and conducts sensory processing. Consequently, the visual "blue brain metaphor" for AI potentially establishes a conceptual framework which draws on a complex network of terminology often borrowed from other scientific vocabularies. It enables a sense of understanding by representing the complex and abstract notions of algorithms, big data, computation, binary codes, neural engines in more familiar and understandable language. This is a language which reduces, or perhaps shades the complex nature of AI. It can also emphasise certain human like understandings that AI is akin to the human brain, or that the brain is akin to the functions of AI, i.e.,

thinking is computation. Furthermore, the blue colour evokes emotions, which resonate with cultural norms and values, and add these qualities to the AI metaphor. The conceptual framework embedded in the metaphor consequently acts as a substitute for complexity which allows for interpretations, using knowledge and experiences from other areas. Thus, through substitution, the metaphor creates new meanings, perspectives and even new and innovative ways of understanding.

5.3. Ethics and Social Impact (values)

One of the main traits of metaphors is that they emphasize certain aspects while obscuring others. Using anthropomorphising metaphors in AI terminology, does indeed create understandable meaning potentials between human intelligence and artificial intelligence. It can thus make AI systems more familiar and even less threatening. However, this can also lead to unrealistic expectations about AI capabilities; for example that AI exhibits the same intelligent behaviour as humans. If humans consider AI a threat, then AI presumably considers humans as a threat, leading to visions of doomsday scenarios such as "the singularity" – the self-aware artificial intelligence. By endowing AI with a terminology traditionally associated with life and human intelligence, it is inadvertently suggested that AI systems possess greater autonomy and moral status that they actually do, and that algorithms and data pools are not unbiased (Crawford 2021; Noble 2018; O'Neil 2017). Thus, algorithms tend to be saturated in Western values and based on accessible data. The belief that AI systems are autonomous systems capable of neutral and unbiased decision-making is highly problematic, because AI algorithms operate restricted by their pre-defined parameters and the data they are trained on.

6. Final Remarks

The "blue brain metaphor" (in its different variations) is part of contemporary foundational imagery for AI. That is, the metaphor has become deeply established and is widely used in visual public discourse by a number of (rather) different addressers (e.g., organisations, policy makers, tech firms, educational institutions, media companies etc.) – looking at AI from different perspectives having different communicative purposes. The "blue brain metaphor" for AI is clearly related to the (primarily) verbal metaphor "the computer is a brain". It may also tap into the already established (conventionalised) meanings of this (older) metaphor also having the possibility of expanding its meaning potentials as AI evolves as a performing technology. The "blue brain metaphor" for AI can do this because it is a function of an "Econian" semiosic logic. In this logic, a socio-cultural encyclopaedia

(potentially) decides which relations of similarity (based on interpretants) between AI and the human brain make sense. This concerns how, for example, AI is similar to the human brain (epistemologically speaking), and why (concerning normativity) – AI is able to learn. Ergo does it think. The development of brain-like characteristics (similarities) on the part of AI involves extraordinary socio-technical opportunities for humanity. The "blue brain metaphor" for AI can be said to be both trivial (not creative) and open towards new interpretations. On the one hand, its semiotics relates to the already established meanings of "the computer is a brain" metaphor and on the other hand, it seems to have a potentiality to drive very diverse interpretations on AI: from overly optimistic hopes, we postulate, to extremely pessimistic anxieties. This is perhaps, almost, the same as saying, that the "blue brain metaphor" (at least in relation to the perceptions of the general public) (almost) begets over-interpretations. Some commentators have, perhaps therefore, also criticised the "blue brain metaphor" calling it misleading (Wallenborn 2022), while others warn that there is no single metaphor which can capture the complexities of AI (Barak 2023)[2] – including the "blue brain metaphor" we will add. Finally, there will be, of course, a great difference between the ways in which a neuroscientist and a lay person could interpret the "blue brain metaphor" for AI (Baria & Cross 2021). However, both will be involved in the ongoing semiosis concerning AI of the socio-cultural encyclopaedia, where it is decided what relations of similarity make sense – when talking and visually communicating about AI and the human brain.

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