

Machines with Artificial Intelligence Cannot Attain Consciousness and Cannot Think: Evidence from Neuroscience

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ABSTRACT

Artificial intelligence programs have created machines with a remarkable ability to store, integrate, and retrieve information. That they can converse gives them human-like qualities and there is the fear that they will become conscious and threaten humanity. The premise underlying these fears is that consciousness is an attribute of the neuronal circuits in the brain and that once the functions of these circuits are completely understood, they can be mimicked by artificial neural networks and consciousness will emerge. However, this traditional view cannot explain how the electrical activity in the brain creates consciousness or how the brain can store billions of images in memory. Recent evidence indicates that the traditional view is not correct; the brain and consciousness are both functionally and spatially separate. Thus, the brain acquires information from our senses, encoded in action potentials (APs) that induce a long-term potentiation (LTP) in follower cells. The LTP results in the transformation of the information from the APs into EM waves that then communicate that information to consciousness where it creates an awareness of the qualities of the sensation. EM waves contain information about their source that is contained in their frequency, amplitude and phase and since these can vary there is essentially an inexhaustible number of unique waves conveying sensory information. Consequently, consciousness, and other higher mental attributes cannot be attained by replicating circuits in the brain because they are not properties of the brain.

Keywords

Sensations, Pain, Information, Electromagnetic Waves, Consciousness, Long-term potentiation, N-methyl-D-aspartate (NMDA) receptors.

Artificial Intelligence machines are altering the world due to their ability to store and collate enormous amounts of information. They appear human because they verbally respond to questions on almost any topic and can even carry on conversations. While it is generally understood that the machines are merely highly sophisticated computers, their uncanny ability interact with humans on many levels has raised serious concerns that machines will one day become conscious and pose a threat to humankind. Human consciousness provides an awareness of the qualities of an object, such as the color and shape of a ball and it is the summation

of all sensory information in consciousness at each instant in time that provides an awareness that we exist in the world. The information in consciousness is subsequently used in the mind to create knowledge and the ability to think, so the concerns about creating a conscious machine are warranted. However, the premise behind AI is that human consciousness arises directly from the activity of the billions of neurons that form circuits in the cerebral cortex in the brain. The implication is that once the functions of these circuits are completely understood, they can be mimicked by artificial neural networks and consciousness will emerge. There are three basic arguments against this view.

First, the brain is essentially an electric organ. It acquires information about the world via our senses and the information is encoded in action potentials (APs) that propagate along axons

of pre-synaptic neurons to synapses where the release of a neurotransmitter evokes APs in post-synaptic neurons. The result is the transmission of the information across the synapse and this is the primary means by which information is disseminated throughout the brain. The flow of information across synapses is regulated by the presence of a long-term potentiation (LTP) that is essential for consciousness yet, as discussed in detail below, LTP is not unique to consciousness but is also involved in learning and memory and many other functions. In other words, the functions of the brain can be attributed to common, redundant electrical and biochemical activities, none of which can explain consciousness or any other higher mental functions.

The second argument against the traditional view is the staggering amount of information that needs to be processed by the brain. From the moment we are born we acquire information from our senses about the objects that surround us. The information is manifest at every moment in time as an awareness of these objects in consciousness. But consciousness is much more than awareness because the information in consciousness is not lost, but is stored in memory where it can be retrieved years and even decades later. We can easily recall in great detail events from our early childhood, which means that hundreds of billions of sensory images that entered consciousness during our life-time must be retained in memory. There is nothing that we know about the functions of the brain that can explain how, or where this enormous amount of information is stored.

The final argument against the traditional view is the fact that the brain has mass and is physical whereas consciousness is an essence that lacks mass and is non-physical. According to the physicalist/materialist schools of philosophy, which support the traditional view, all things are physical so that consciousness and the brain are inseparable [1]. This is not correct, however because x-rays and electromagnetic waves, for example, are comprised of photons that do not have mass and are therefore non-physical.

The alternative to the traditional view of brain functions is based on the idea, first proposed by Rene Descartes in the 17th century, that the physical brain and non-physical consciousness are actually separate entities [2,3]. For this dualism to be correct would require a mechanism by which sensory information obtained by networks in the brain is communicated to consciousness. It is notable, therefore that S. Pockett [4,5] and J. MacFadden [6,7] had proposed independently that the brain and consciousness communicate via Electromagnetic (EM) waves. What follows is compelling evidence from multiple sources that Pockett and MacFadden were correct. Consequently, consciousness cannot be attained by mimicking the activities of the brain because consciousness is functionally and spatially distinct from the brain.

We experience the painfulness from an injury in consciousness and since we know a great deal about the pathways for pain, it is an excellent model to investigate how information propagating along these pathways become the suffering in consciousness. The perception, or experiencing of pain (aka nociception), begins when

agents released from a lesion evoke action potentials (APs) in the terminals of nociceptive neurons in the periphery [8]. The APs, which encode information about the severity of the lesion, convey the information first to neuronal centers in the thalamus and then to neurons in the anterior cingulate cortex (ACC) that are necessary for experiencing pain from a physical injury [9,10], from viscera [11], as well as the suffering from psychological causes [12]. Located within the ACC of humans, other primates, and rodents is a pain center (PC) that contains a population of large lamina V pyramidal neurons that are associated specifically with experiencing pain [13,14]. After a typical injury, APs propagating along axons from the thalamus activate many thousands of glutamatergic excitatory synapses on the dendrites of the pyramidal neurons in the PC. The release of glutamate (Glu) at the thalamo-pyramidal synapses induces a long-term potentiation (LTP) in the dendritic spines and generates synchronized oscillating electromagnetic (EM) waves in the extra-neuronal space around the pyramidal neurons [15-17]. The LTP sensitizes the transmission across the thalamo-pyramidal synapses and since the duration of the LFP and EM waves depends on the sensitization, characterizing the events that unfold in response to the induction of the LTP should provide important clues as to how suffering appears in consciousness. Multiple electro-physiological and molecular processes in both the presynaptic and postsynaptic terminals are involved [9,19,20], but it is the activation of N-methyl-D-aspartate (NMDA) receptors that is most important because it initiates a series of biochemical events that culminate in the activation of the cAMP Responsive Element-Binding protein (CREB) in the nucleus of the pyramidal neurons. Significantly, blocking these events prevented experiencing the pain [21,22]. CREB is a transcription factor that promotes the synthesis of ion channels, receptors, and other proteins that maintain the LTP, the sensitization of the synapses, and the EM waves [23]. However, after characterizing all of the electrophysiological and enzymatic events in detail, none could account for the suffering because they occur in many areas of the cerebral cortex that are not involved in nociception. The induction of the LTP is more complex than depicted here and the proteins that are synthesized in response to the activation of CREB will change the properties of the pyramidal neurons, yet these are refinements that do not alter the conclusion that neither the electrical activity coursing along neural circuits, nor the biochemical consequences of that activity can explain how nociceptive information results in experiencing pain in consciousness.

The focus then shifted to the other consequence of the injury-elicited activation of the pyramidal neurons, namely, the creation of the synchronized, oscillating EM waves in the extra-neuronal space surrounding the pyramidal neurons. The waves, which arise from the movement of charged particles due to the APs and synaptic currents [16,24], are composed of photons that contain energy and information about their source. Each wave is characterized by its amplitude, frequency, energy, and phase and since these properties can vary, there is an almost infinite number of unique waves. These findings led to theory that the information about pain that was initially encoded in APs was transformed in the PC into synchronized oscillating EM waves which then conveyed

the information to consciousness where the pain is experienced [22,25-27].

The studies of LTP highlight the importance of the NMDA receptor and Flohr [28] has argued that the plasticity of NMDA receptors is a necessary condition for consciousness because anesthetic agents that block these receptors lead to a loss of consciousness whereas their activation is among the first events in the return to consciousness. Important also is that the appearance of synchronized EM waves is linked to the induction of LTP and the activation of many thousands of synapses. In other words, when LTP is induced anywhere in the brain, EM waves are created.

LTP, EM waves, and the binding Problem

The hypothesis that EM waves convey information to consciousness would be bolstered if a specific function could be attributed to the waves. The sensations that we experience in consciousness, such as vision, are often compilations of synaptic activity that arise from circuits in the cortex that are widely separated in the brain. In the case of a simple injury, as discussed above, the intensity of the pain is commensurate with the severity of the injury that was encoded in APs. However, pain is adaptive and the suffering that is ultimately experienced in consciousness depends on attention, emotions and past and present circumstances, each of which is mediated via a neuronal center that is a component of an Integrated Pain Network [22]. How then is the information from each of these centers integrated to create pain with a specific intensity? This is an example of the so-called binding or combination problem, which is to explain how the information from each of these separate circuits is rapidly integrated in such a way that it results in a coherent experiencing of the sensation.

It was significant, therefore that in addition to the waves emitted from the PC, oscillating EM waves are also emitted from the amygdala and nucleus accumbens, both of which can modulate the intensity of the pain that is experienced. The modulation occurs when the waves from the various sources interact. For example, activation of circuits in the amygdala evokes fear, which exacerbates pain, and when the waves from the PC interact with those from the amygdala, the resultant wave is the algebraic sum of the two, which will result in more intense pain [27].

EM waves can also have a role in vision where different regions in the cerebral cortex contribute information regarding a specific aspect of the flower, e.g. color, orientation, etc. Since there is no neuronal center in the visual network where all of the information merges, the problem was to explain how the information from these areas of cortex is assembled into a coherent image that we perceive of as the flower. Crick and Koch [29] recognized long ago that electrical activity in these centers produces oscillating EM waves at different frequencies and by analogy to the results from the studies of pain it is possible to construct a model that depicts how interactions among these waves can create a visual perception of the flower in consciousness. In addition to explaining the integration of sensory information for pain and vision, EM waves are also emitted from the hippocampus and are important for the

creation of memories.

Taken together, these findings show that the synchronized oscillating EM waves that radiate from activated neuronal circuits are not a mere epiphenomenon of synaptic activity, but they offer an evidence-based explanation for the creation and integration of sensory information that culminates in experiences in consciousness. They also support the idea that EM waves arising from synchronous synaptic activity at circuits in the brain convey information into the extra-neuronal space that creates a dynamic consciousness EM field around the brain [7,22,25,27,30]. Evidence that this is correct comes from the many studies showing that interfering with these waves can alter functions in the brain

Externally Induced EM Waves Influence Brain Activity

The frequency of EM waves recorded from the brain range from 1Hz to 100Hz and there is a vast literature showing that externally applied EM waves in this range by Transcranial Magnetic Stimulation (TMS) protocols can alter the activity of circuits in the cerebral cortex with dramatic results [31-33]. TMS-evoked EM waves can elicit motor movements [34], are being used to treat depression and other psychiatric disorders [35,36] and can attenuate pain [37,38]. In addition to these global effects, there have been many investigations into how EM waves can influence events in discrete areas of the cerebral cortex at the cell and molecular level [39,40]. Extracellular fields have been shown to modify the activity of enzymes and voltage-gated ion channels and can therefore directly influence the activity of neuronal circuits [41,42]. A relevant example is the ability of EM waves to regulate LTP-mediated neuronal plasticity in a circuit by altering the activity of NMDA receptors and the entry of Ca^{+2} into dendrites [40,43]. Depending on their frequency, energy, and duration, EM waves can either induce LTP and neural plasticity, or they can induce a long-term depression, which diminishes the plasticity. Even the functions in the hippocampus that involve the formation of memories can be disrupted by waves with specific frequencies [44].

What emerges from these studies is that the brain is a complex organ that acquires and filters information from our surroundings. The information is processed via networks and circuits that adapt the information to conform to present circumstances. This culminates in the creation of EM waves that convey the information to consciousness.

Conclusions

The traditional view as to how the brain functions is based on the premise that all functions of the brain, including awareness in consciousness, can be attributed to the activity of neuronal networks and circuits in the cerebral cortex. As such, once all these activities have been characterized, they can be replicated in artificial circuits that can create machines that are conscious. The findings above provide compelling evidence that both statements above are incorrect; the brain and consciousness are functionally and spatially distinct. Moreover, they communicate via EM waves that emerge in response to the activation of circuits in the brain

that are dedicated to processing specific types of information. The information in consciousness is then communicated to the mind, where it becomes the knowledge that is used for higher mental functions, and to the subconscious where it is stored in memory [45]. It is likely, therefore, that the mind and the subconscious are also non-physical and distinct from the brain. What this means is that creating artificial neural networks that mimic the activity of circuits in the brain cannot create a conscious, thinking machine.

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