INTRODUCTION

We are the beings that we are because we have a soul and are conscious, according to Descartes. A simple definition of consciousness is awareness of our body, ourself and the outside world. According to Searle, consciousness is ‘those states of sentience and awareness that typically begin when we awake from a dreamless sleep and continue until we go to sleep again or fall into coma or die or otherwise become unconscious’. Our consciousness is characterised by how we live our lives, think, describe ourselves and our self agency. It is important to distinguish between our states of consciousness, such as wakefulness, sleep, coma and general anaesthesia, versus the content of our consciousness. This paper discusses the emergence of consciousness in human beings. We discuss how some current models of consciousness apply to the foetus and the newborn and the biophysical and psychological methods that can be used to study consciousness and milestones in the development of the brain and the mind. Finally, we discuss when the foetus and infant has developed its sense of identity and becomes a person, in other words ‘one of us’.

CONSCIOUSNESS—WHERE AND HOW?

It is generally assumed that consciousness is mainly localised in the cerebral cortex. There are about 10 billion neurons in the gut and, although we talk about having a gut feeling, we do not think that consciousness is actually located in the gut. However, it is mainly asleep and probably not aware of itself and its environment. In contrast, the newborn infant is awake after its first breaths of air and can be aware of its own self and others, express emotions and share feelings. The development of consciousness is a progressive, stepwise, structural and functional evolution of multiple intricate components. The infant fulfils some of the more basic criteria for consciousness. However, there are some important missing pieces at this stage, as it cannot remember the past and anticipate the future.
recently, Merker\(^4\) promoted the idea of being conscious without a cortex after studying children with hydranencephaly. He claimed that they are still conscious, despite the fact that they are often blind, cannot talk, have no memories and lack the capacity to plan for the future. However, they fulfill some of the criteria of being conscious,\(^5\) as they seem to be aware of environmental events and can express emotions and joy. This processes may be mediated by subcortical structures.\(^6\)

Most of the contemporary theories of consciousness\(^1,7-16\) are based on physical processes and assume that subjective conscious experiences originate in the brain. In this sense, consciousness can be considered to be a natural evolutionary consequence of the biological adaptation of the nervous system. In this scenario, the brain is a necessary condition for consciousness and the underlying complexity of the nervous system is critical. These theories converge in the concept of ‘information processing’.\(^7\) The ‘dynamic core’,\(^15\) which emerged from the neuronal Darwinism theory, involves the integration of activity in widespread distributed cortical areas. This is in accordance with Baar’s concept of the ‘global workspace’,\(^7\) which suggests that there could be a cluster of brain regions that control and broadcast information. This has been described as: ‘A “bright spot” cast by a spotlight on the stage of a dark theatre that represents the integration of multiple sensory inputs into a single conscious experience’. This theatre corresponds to the ‘global neuronal workspace’.\(^12\) Whenever we become conscious of something, it can be retained in our working memory and then processed in our global neuronal work.

Another influential scientific theory of consciousness is the ‘integrated information theory’,\(^15\) which states that consciousness corresponds to the capacity of a system to integrate information. For example, while the family photographs on a laptop are not usually linked, they are very much integrated with the memories in our brains. A number of neuronal circuits are involved in integrating all our conscious experiences. This theory provides a framework that can be used to quantify consciousness from neuroimaging data and studying this is of particular interest when humans cannot talk, such as young infants.\(^18\)

In addition, Zelazo\(^19\) has proposed the ‘levels of consciousness’ model, which has been described as ‘an alternative to the rather simplistic notion that infants either are or are not conscious in an adult like sense’. According to this theory, the development of complex functions in humans parallels the development of consciousness and defines the levels of consciousness. Newborn infants have only reached a minimal conscious level, which is unreflective, focused on the present and makes no reference to any concept of self. The infant is not really seeing what it sees and cannot recall what it has seen. However, complex levels of behaviour and consciousness are reached as their brain develops.

### 3.1 Resting-state activity

The neural activity of the brain is composed of both spontaneous and resting-state activity and task-evoked or stimulus-induced activity.
have also been shown in preterm infants\textsuperscript{27} and term-born infants.\textsuperscript{21} In newborn infants, the main hubs are localised in the primary networks—the vision, auditory and sensorimotor networks—which are organised in the same way as adults. In contrast, the higher-order networks and hubs—the attention, memory, executive function, salience and default mode networks—are less complex and more segregated at birth. These develop later, mainly during the first two years of life.\textsuperscript{28} The latter networks also echo behavioural improvements throughout in self-awareness, salience detection and working-memory functions.\textsuperscript{5,29}

As the child develops, the functional networks show both increased segregation and integration, as the organisation of the modules moves from local anatomy to a more distributed architecture.\textsuperscript{28} That is why consciousness tends to emerge gradually as human beings develop. Newborn infants have modules of consciousness that come from multiple modalities, including visual, auditory, sensorimotor and proprioceptive senses. These gradually come together during development until they build a unified consciousness.\textsuperscript{30}

### 3.3 How to test consciousness

Conscious awareness is associated with the increased ability of the brain to sustain a rich repertoire of dynamic neural patterns and maximise the global entropy rate. A resting-state study by Deco et al\textsuperscript{31} found that the optimal timescale for brain processing, namely broadcasting and the availability of information, was around 200 milliseconds. This is sustained by a set of brain regions or dynamical workspace of binding nodes\textsuperscript{32} which is also in line with other theories of consciousness, such as the integrated information theory of consciousness.

It is particularly interesting to find out how the brain becomes conscious of all the sensory input that it receives. The Paris-based research team of Dehaene and Dehaene\textsuperscript{33} have demonstrated this in both adults and infants, by developing a specific technique that uses the psychophysical phenomena of visual masking. Subjects are shown a picture briefly and then this is followed by a second picture. During the first 200-300 milliseconds of processing, the brain responds linearly in relation to intensity and duration. This response can be recorded even if the subject does not seem to be aware of what they see. However, after about 300 milliseconds event-related potentials can be recorded, which have been related to awareness in adult studies. In this setting, subliminal stimulus can propagate into the cortex until it passes a specific threshold when the subject becomes conscious of the stimulus. This generates increased, organised and synchronised activity (avalanche) that is broadly distributed in the fronto-parietal-temporal networks.\textsuperscript{12} The broadcasting for conscious reportability is related to ignition of activity at around 270 milliseconds in the aforementioned networks.\textsuperscript{13} This can be can be interpreted in terms of the global workspace theory.\textsuperscript{7,13} Kouider et al\textsuperscript{34} used this technique for babies aged 5-15 months. Infants have an innate preference for faces, so the researchers briefly showed the subjects an attractive face and then showed them an ugly face. A weak, but delayed, event-related potentials response was discovered as early as five months of age and this was more pronounced.
in the older infants. This study showed that conscious perception is already present in infants. The integrated information theory model was also used for a study of preterm infants.\textsuperscript{18} Integrated information was computed, based on electroencephalogram recordings, after special pre-processing. Phi was found to be highest during wakefulness and lowest during active and quiet sleep.

4 | HUMAN FOETAL DEVELOPMENT

The hemispheres of the brain develop after the formation of the neural tube (Figure 2). The sonic hedgehog protein seems to induce the ballooning of the brain. Neurons, which are the atoms of consciousness, are generated at a high speed of 200 000 per minute from 10 to 20 weeks of gestation.\textsuperscript{35} They originate from the germinal layer in the ventricles of the brain and migrate via the thalamus towards the subplate of the cortex. The thalamocortical axons then wait there to invade the cortex from the 24th postconceptional week. Reaching the cortex is a crucial connectivity event.\textsuperscript{36,37} The somatosensory fibres are the first to reach the cortex, and these immature connections are reflected by patterns of spontaneous electrical activity. Despite the specific differences between species, this sequence of key events is largely consistent among humans, primates and rodents.\textsuperscript{38} The behaviour of the immature fetes corresponds to the responses displayed by reptiles, which depend on the sensory organs as separate entities.

4.1 | What the foetus senses

The foetus reacts by moving when its lips are touched, as soon as they are formed from about eight postconceptional weeks. From about 10 weeks, the foetus changes its position when its body is touched. The foetus cannot differentiate between the different kinds of stimulation from the start. For example, cooling or heating may cause similar aversive reactions as painful stimuli.\textsuperscript{39}

The sense of smell is developed during early foetal life. About 5% of our genome is involved in the process of smelling and maybe this is due to the evolutionary importance of smell. The foetus can probably smell from about the 20th postconceptional week, and it may remember certain smells it was exposed to as a foetus after it is born.

The foetus can also experience taste. If something acid or bitter is infused into the amniotic fluid, the foetus reacts by grimacing. One study showed that when rat foetuses were exposed to a bad smelling substance that had been combined with apple juice, did not want to eat apples for the rest of their life.\textsuperscript{40} Human infants seem to remember the taste of amniotic fluid, which attracts them more than other cues.\textsuperscript{41}

The foetus can probably react to sound from about the 20 postconceptional week. Cortical activation to sound has been detected in the foetus from the 33rd postconceptional week.\textsuperscript{42} What is the foetus hearing and how loud is it? Maternal heart beats, intestinal movements and the flow in the big arteries may reach 80 decibels, which is the level of traffic on a street, but it is usually around 40 decibels, similar to the noise in a normal home. In spite of this noise, the foetus seems to hear its mother’s voice, as it has a relatively higher frequency than the other sounds from her body.

Both foetuses and newborn infants have an innate capacity to recognise faces. One study projected visual stimulation through the abdomen and womb, and this showed that human foetuses were more likely to turn their heads to upright face-like stimuli than towards inverted faces.\textsuperscript{43}

4.2 | Foetal movements and behaviour

The foetus has an advanced repertoire of movements. Breathing movements can be observed as early as 11th postconceptional week, and this mainly occurs during active sleep. It is less affected by changes in blood gases than the spontaneous activity in the brain stem. The foetus can grimace in a number of ways, and this includes raising their brows and cheeks, wrinkling their noses, in dimples, nasolabial creases and upper and lower lip movements.
and in stretching their mouths and blinking their eyes. The development of grimaces as early as the foetal stage may be important for promoting bonding with its parents and aiding communication. The human foetus often moves its hands towards its head, face, mouth and feet. It seems to learn the position of these parts of its body and this shows that it is becoming aware of its self.

If the foetus is exposed to photoflashes several times when the mother is being photographed, it gets bored and stops reacting. In other words, it habituates. Habituation is a short-term memory, which appeared early during evolution. Short-term memory has also been demonstrated in the human foetus from the 25th postconceptual week by repetitive exposure to the vibrations of an electric toothbrush, that are felt in their mother's stomach.

The foetus can demonstrate heart rate deceleration when it hears speech. It seems to learn to recognise its mother's voice, which is indicated by its sucking behaviour soon after birth. In a similar way, the foetus starts to learn the language its mother speaks before birth. Swedish newborn infants were found to recognise the typical Swedish vowel u, while American infants preferred the typical e vowel. French newborn infants cried with increasing frequency, which mirrors the rhythm of the French language, while German newborn cried with the decreasing frequency displayed by their native language.

4.3 | Foetal consciousness?

If we work on the assumption that the cortex plays a crucial role in the awareness of sensory inputs, this suggests that the immature foetus cannot be conscious before 24th postconceptional week. Although it may demonstrate reflexes when it reacts to various sensory stimuli, it is less likely that those sensory inputs reach the cerebral cortex. The neurons from the sensory organs terminate in the subplate of the cortex, with the exception of olfaction. The subplate may be up to four times thicker than the cortical plate and serves as a waiting zone and a guidance hub for the afferents from the thalamus and other areas of the brain. In this way, the cortex is activated by the thalamocortical fibres constituting the neural correlates of consciousness (Figure 3). Thus, the foetus is more likely to be aware of pain if the incoming information from the sensory organs is available to integrate with cortical activity. However, while the cortex is not activated by the thalamocortical fibres, subcortical structures, such as the brainstem, may mediate any sense of pain in foetuses.

After the 24th postconceptional week, the ingrowth of the thalamocortical axons in the somatosensory, auditory, visual and frontal cortex commences and the foetus may have the potential to process input from the sensory organs at a cortical level. Furthermore, it seems to develop a primitive memory, as seen in Figure 3. However, the foetus has closed eyes 95% of the time and displays the rapid eye movements that are seen in active sleep and, to a lesser extent, in quiet sleep. It can open its eyes for short periods of time, particularly when it switches between the two sleep states. However, that does not indicate that the foetus is awake and conscious, as unconscious adults can also open their eyes. A study that analysed 5000 hours of recordings of foetal sheep through a plexiglass window in the uterine wall, showed that they never seemed to wake up and make purposeful movements. They reacted to noxious stimuli, like pinching, with inhibition rather than arousal. Studies of foetal baboons also indicated that they did not wake up. Even stress, such as acute hypoxia, does not induce arousal and the same is true after birth. The foetus does not respond by displaying the classic fight and flight response. Instead, its movements stop and it becomes apnoeic and bradycardic, in a similar way to diving animals. This freeze and dive...
response is a defence mechanism to save oxygen, but it does not arouse the foetus and it does not become awake and conscious.

It can be questioned whether the foetus is conscious if it is able to habituate and learn some rudiments of language and music. However, this learning probably occurs during active sleep, a process that has been demonstrated in preterm infants. It is less likely that the foetus is conscious during active sleep. We don’t even know if it is dreaming, as that process is closely linked to the ability to imagine things visually. The lack of purposeful movements, and any sense of time and space, indicate that even more mature foetuses are not conscious.

Furthermore, the foetus is living at a very low oxygen level, which has been referred to as ‘Mount Everest in utero’. This probably suppresses foetal activity by increasing the level of adenosine, which acts as a sedatory neuromodulator together with the neurosteroid pregnenolone and prostaglandin D2. On the other hand, gamma-aminobutyric acid (GABA), which is the dominant neurotransmitter, is excitatory during early foetal life. Thus, there is probably a high level of activity in the foetal brain, which is important for neuronal wiring. This ‘noise’ in the foetal brain may be related to high cortical activity during active sleep, but there is not enough integration and coherence to generate a conscious state.

5 | THE INFANT

The blank slate doctrine has been particularly applied to the newborn brain and William James said that the newborn baby experienced the world as ‘blooming buzzing confusion’. Behaviorists regarded the brain as a black box and, in particular, the infant brain as a blank slate. They advised parents to leave their babies in dark rooms and not cuddle them. According to most textbooks in paediatrics and child psychology, newborn infants were not regarded to be conscious and an infant’s cortex was assumed to be very immature, with low activity. However, we now know that newborn infants fulfil many of the criteria for being conscious, albeit at a lower level.

The word infant means someone who cannot speak, but we can get some idea of their consciousness by studying their actions: sucking, looking, touching, tracking, reaching out and grasping. By recording preferential looking, it is possible to study the intention of an infant’s consciousness. It is particularly interesting to see how they imitate gestures and establish relationships between themselves and others. In this section, we list the main criteria for the newborn infant being conscious.

5.1 | Awakening and sleep after birth

Being born is an ordeal that triggers a surge of neurohormones, particularly catecholamines, which are about 20- to 100-fold higher in the blood of a newborn infant than in a resting adult. It is likely that, as the newborn infant awakes, there is parallel activation of the peripheral sympathoadrenal system and the noradrenergic network in the brain. There is also activation of the locus coeruleus related to the onset of respiration (Figure 4). The eyes of the newborn are wide open, usually with large pupils, and they may cry. The locus coeruleus is probably responsible for this arousal. This little bluish structure lies in the brain stem and contains most of the nuclei of noradrenergic neurons, which are distributed to the whole brain. A study that analysed noradrenaline metabolites in the cortices and brain stems of newborn rat pups found a significant increase of the noradrenaline turnover in their brains when they compared that levels to rat foetuses. Since most of the noradrenaline in the brain originates from the locus coeruleus, we believe that this increased turnover reflected the activation of the locus coeruleus (Figure 4). The cholinergic system is also important for consciousness and is probably activated at birth as well. One study found that transgenic mice that

![Figure 4](image-url)
lacked the $\beta_2$ subunit of the nicotinic acetylcholine receptors did not arouse to the same extent as wild-type mice when they were exposed to hypoxia.56

After the newborn infant has been awake for about an hour it falls asleep. This occurs at about the same time as the catecholamine concentrations level off and become more normal, as in adults.57 During the first two weeks after birth, the newborn infant sleeps for an average of about 16 hours per day. It tends to sleep for four-hour periods that are intermingled with periods of awakeness that last about two hours. More than 50% of that sleep is active, with rapid eye movements known as REM sleep, but it lacks tonic muscle activity. It is questionable whether infants can be regarded as conscious when they are in active sleep.

However, they do seem to be able to learn conditioned behaviour while they are asleep. One study exposed infants to a tone followed by an air puff that made them blink.58 They soon learned to blink when they heard the tone, even if they did not receive an air puff. Furthermore, event-related potentials were recorded by electroencephalography, but this was not seen in the control infants who were not trained to expect a puff directly after the tone.

5.2 | What the newborn infant senses

Newborn infants react differently when another person touches them than when they touch themselves. When they suck on a sound-producing pacifier, they systematically explore the consequences of their own action. They seem to have some awareness of their bodies and a sense of their self-movement and body position.59 They do not just sense the world, they feel it.

Although infants react to pain, for example during heel lancing, it was a common clinical practice to induce minimal or no anaesthesia in newborns during invasive procedures. Any facial expressions suggesting discomfort were assumed to be mediated at a subcortical level. However, a study that used near-infrared spectroscopy demonstrated that painful stimuli elicited pronounced responses in preterm infants in the somatosensory area of the brain.60 This study confirmed that the cortex even reacts to pain in infants, indicating that they may be conscious of the painful stimuli. It is likely that the cingulate cortex is particularly involved in this process, because it plays an important role in pain awareness.

Newborn infants recognise their mother’s smell. This was demonstrated by a study that presented infants with cotton that had been soaked in their mother’s milk and the milk of another mother. The infants clearly demonstrated a preference for their own mother’s smell. Smell is processed in the orbitofrontal cortex, which has been demonstrated with near-infrared spectroscopy. Pleasant smells like vanilla and colostrum have been shown to evoke increased hemo-dynamic responses,61 unlike unpleasant smells like disinfectant or detergent.61

Earlier research suggested that newborn infants could not see or recognise anything and that they only saw a fog. They are certainly short-sighted and have lower visual acuity at this age. But if a face or object is close then, within about 20 cm, they can see fairly well and process complex visual stimuli and recognise and imitate facial expressions. Human newborn infants have an inborn capacity for recognising faces, which is crucially important for developing social networks.

Infants prefer sounds with higher frequencies and they seem to prefer what has been called motherese, which is when the mother speaks more or less automatically with a higher pitch when she interacts with her baby. Full-term infants have also shown that they can turn their heads towards sounds. If they are shown an object and hear a sound at the same time, they will move their eyes towards the sound rather than the object. This indicates that their hearing is more mature than their sight at birth.

5.3 | Integration of multiple senses and memory

One study showed that babies looked excited, with big pupils, the first time they saw a red ball and this excitement continued when they saw the ball for the second and third time. But they lost interest when this process was repeated. This is called habituation, which has been related with perception and cognition.62 A newborn infant’s long-term memory is less developed, although they do remember sounds, melodies and rhythmic poems they were exposed to during foetal life, as mentioned above. Newborn infants can also learn certain behaviours during sleep. At about two months of age, they form some kind of mental representation of faces and things.

Full-term infants can connect what they see and hear. A well-established example is that sucking sucrose can calm newborn infants exposed to nociceptive stimuli. The optimal effect can be obtained, for example, when a four-week-old baby can also see their caregiver. However, this combination is less effective in younger infants. Human infants are able to integrate different types of sensory signals, unlike other creatures, like reptiles (see above).

Newborn human infants express so-called primordial emotions, which can be regarded as marking the dawning of consciousness, and these include hunger and thirst63 and seeking their mother’s breast areola soon after birth. The respiratory drive or ‘hunger for air’, which is initiated at birth, can also be seen as a primordial emotion. An almost unique feature of the human newborn infant is that it cries after it awakens at birth. This may be a sign of its discomfort with its new environment, and it is probably an essential part of mobilising its parents’ caring instincts. Emotional feelings are processed in the orbitofrontal cortex, the cingulate cortex and the amygdala. However, it is possible that the amygdala is less involved in the neonate.64

The newborn infant expresses joyful facial expressions, particularly when it is placed at its mother’s breast. It likes sweet tastes, and it demonstrates this by contentedly licking its lips. Joy or hedonic feelings are important components of consciousness, and it seems difficult, or even impossible, to programme a computer to feel joy.
Joy consists of two components: the desire for the reward and the pleasure when the reward has been obtained. Dopamine seems to encode the desire, while the opioid system provides feelings that are closer to pleasure.

5.4 | After birth

Other newborn mammals are relatively mature at birth. Lambs can stand up immediately after birth and walk to their mother for food. Newborn monkeys can cling to their mother while she jumps between trees. In contrast, the human newborn infant is very helpless. It has been speculated that the human infant is born two months too early, in order to get their relatively large head out, as it needs to be rotated to pass through the birth canal. This theory stems from the fact that it takes about two months before the human infant can interact at a more sophisticated level with its parents. Unlike other species, the human mother usually needs assistance from others to give birth, such as midwives.

The protoconversation begins from about six weeks of age, as the infant responds with smiles, hand gestures and cooing. If the mother freezes her facial expressions, the infant becomes a little anxious, showing negative affect and gaze aversion but it is happy when the mother shows loving expressions again. The two-month-old infant is also able to anticipate that an adult is going to pick them up. This social awareness is related to increased synaptogenesis, particularly in the visual and auditory cortex. Their visual acuity has improved by this age, and the infant can follow what is going on in the environment and recognise familiar faces. Spontaneous crying also decreases at 2-3 months, and this may be due to inhibition from the frontal and cingulate cortex and of the nuclei in the brain stem, which are involved in localisation and crying. The baby can also be consoled when it is crying by diverting its awareness to something more pleasant.

The brain matures slowly in human children. From about 2½ years, the human child has catch up with the monkeys and at that age they have developed better cognition and communication skills. This probably parallels the development of a more sophisticated mind.

6 | WHEN DOES THE MIND EMERGE?

The human foetus was not regarded as a human person by the Greek philosopher Plato, since it has no soul or mind. He thought it gained its soul at birth. Another Greek philosopher Aristotle held the view that human beings started to exist when the foetus had a human form and the mother could feel foetal movements. He thought there were three kinds of life or soul: the vegetative, the sensitive and the rational. Sensitive life included all animals, vegetative life covered plants and only humans lived rational lives. In some way, he had a more modern view than the 17th century French philosopher Descartes, who claimed that only humans can be conscious.

According to Judaism, life begins at birth when the infant takes its first breaths of air and becomes animated, marking the emergence of consciousness. Galen, a widely celebrated physician, surgeon and philosopher during the Roman Empire, also developed the idea of a ‘psychic pneuma’, which was regarded as the soul. It is interesting that the Latin word for air, which is spiritus, also means the mind. Thus, the infant did not gain its soul or its consciousness until it took its first breaths. The foetus was not regarded as alive, before foetal heart rate activity was discovered. In 2006, the Nuffield Council on Bioethics stated that when the newborn infant ‘encompasses the capacity to breathe independently, or with support of a ventilator, is the moral and legal point when human life must be preserved independent of gestational age’.

However, foetal life has been sustained outside the womb in non-human species, without breathing air, by using an artificial placenta. This technique may soon be available for the human foetus. Furthermore, foetuses that are aborted late in pregnancy can be artificially ventilated and survive. Using the onset of breathing air as the hallmark for when the infant should be regarded as a human person, and whose life should be preserved, may be obso lete in the near future. An alternative suggested by Gazzaniga could be when the foetus or infant has the capacity to be conscious, which occurs from around the 24th postconceptional week, when the thalamocortical connections start to be established. The infant can then be aware of itself and its body and, to a limited extent, of the environment. The parents can feel some eye contact. Someone is looking, someone is moving, someone is hearing. As time goes by, the baby interacts more and this initially and apparently non-coordinated ‘someone’ starts to become a coordinated conscious being. In the same way, self-awareness goes from basic perceptual differentiation to a more complex level of self-awareness or self-consciousness. These conditions parallel the maturation and organisation of a proper physical infrastructure, where consciousness can be supported.

7 | CONCLUSION

The infant was previously regarded as an unconscious automata, and the cerebral cortex was assumed to be very immature. Unlike automata, the baby does not just sense and respond to the situations around it. It exhibits sensory awareness, expresses primary emotions and remembers rhymes and vowels it was exposed during foetal life. However, we cannot base the emergence of consciousness in the newborn infant solely on these studies. The activation of the cortex, due to the thalamocortical connections, and the development of the resting-state networks, which constitute the physical structures for neural correlates of consciousness should also be taken into account. In newborn infants, and even foetuses, consciousness may emerge gradually, as the functional thalamocortical connections are established and the neural networks are developed and integrated, providing the necessary conditions for emerging consciousness in the human baby. Bergson defined consciousness as thinking of the past and planning for the future.
This certainly does not apply to the newborn infant, who is living very much in the present. But the newborn infant probably fulfills some of the more basic criteria. However, a unified consciousness emerges as the thalamocortical connections are functional and the neural networks develop in a constant interaction between the brain, body and environment.

CONFLICT OF INTEREST
The authors have no conflict of interests to declare.

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