

# When do humans become conscious — in the womb or after birth?

Neuroscience is beginning to provide clues about the emergence of human consciousness.

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There's a scene in season ten of *Curb your Enthusiasm* in which Larry David — the mansplainer's mansplainer — runs into Randi, a friend of his ex-wife's, at the gym. After some jousting about the statute of limitations for wishing someone Happy New Year — “It's a little late, frankly, for the ‘Happy New Years,’” he grumbles — they make for the treadmills. Randi starts off at a steady trot, but Larry can't focus on his run. Randi is eight months pregnant, and Larry's transfixed by her belly as it swings from side to side. “Oh my God,” he says, “I pity that fetus.” “My body, my fetus,” Randi replies, as Larry storms off in disgust. The scene works because Larry's concern doesn't seem to be

entirely misplaced. What kinds of experiences, one wonders, might Randi's fetus be having?

I was struck by a similar question a few months before the birth of my son. My partner needed regular exercise. Walking aggravated her already sore hips, and so she took up swimming. It was mid-morning, and the pool was busy. A group of excited schoolchildren had congregated at one end; at the other, elderly ladies did steady lengths. As my partner swam toward me doing the backstroke (her belly looking for all the world like an over-stacked luggage trolley), I couldn't help but wonder what kinds of experiences our soon-to-be-born son was having. Did he enjoy being rolled from side-to-side? Could he hear the chattering of the children? Was he aware of the beating of his heart — or indeed of his mother's heart? What is it like to be suspended in 800 mL of amniotic fluid, surrounded not by a world of moving objects and hard surfaces but by the soft tissue of the womb? Indeed, *is* there anything that it's like to be a fetus or a newborn infant? *How* might we tell? *Can* we tell?

## **When does consciousness begin?**

There is little consensus about when consciousness might first emerge. Some endorse a late onset account, holding that consciousness isn't in place until late infancy, or even toddlerhood. For example, the psychologists Joseph Perner and Zoltan Dienes

have argued that consciousness is probably not in place before age 1, while the philosopher Peter Carruthers has defended an even more radical view, arguing that consciousness does not emerge until age 3.

Late onset views are typically motivated by the thought that consciousness requires heavy duty cognitive resources. On Carruthers' account, the child must be able to grasp the distinction between how the world is and how it appears or seems in order to have any kind of awareness. The claim that consciousness requires significant cognitive capacities is controversial. Those who reject it typically endorse an "early onset" account of consciousness, according to which consciousness is in place by early infancy, if not prior to birth.

Those who spend extended periods of time caring for infants are, I suspect, likely to gravitate toward an "early onset" view of infant consciousness. That is certainly my own experience. My 5-month old daughter refused to sleep the other night. As I played peek-a-boo with her into the early hours of the morning, she chortled like a drunken sailor. Consciousness seemed to be evident in her laughter, and the question of whether she was genuinely conscious was no more deserving of serious consideration than the question of whether the barista who makes my morning coffee is genuinely conscious.

That said, intuition — what seems “obvious and undeniable” — may not be trustworthy. It may seem “obvious and undeniable” to someone interacting with ChatGPT that it is communicating with a conscious agent, but that assumption would be flawed. And even if our intuitions about 5-month-olds are trustworthy, intuition can hardly support a comprehensive account of the emergence of consciousness. Newborns tend not to strike us as “obvious and undeniable” candidates for consciousness in the way that older infants do, and we certainly don’t know what to say about fetuses without going beyond intuition.

Unfortunately, going beyond intuition is challenging. We cannot measure consciousness in the way in which we can measure temperature, pressure, and radiation. In the absence of a “consciousness meter,” we are forced to rely on inferences about infant consciousness based on the behavioral, cognitive, and neural correlates of consciousness in adults. Such inferences are unlikely to provide “proof,” but they might take claims about the emergence of consciousness beyond mere intuition and place them on a firmer footing, especially if multiple correlates of consciousness point to the same conclusion.

## **Brain networks**

Research into the neural networks thought to underlie consciousness provides one correlate

of consciousness. One of the most prominent of these networks is the default mode network (DMN). Studies have suggested that the recovery of consciousness following anesthesia and severe brain damage in adults is associated with the re-emergence of interaction between the DMN and other brain networks, in particular the dorsal attention network (DAN).

Using functional MRI data, a team at Trinity University Dublin led by Lorina Naci and Rhodri Cusack found that interaction between the DMN and the DAN can be seen at full-term birth. (Interestingly, this interaction was also observed in pre-term infants, but only once they had reached term-equivalent age.) It would be a mistake to take this finding as proving that (full-term) infants are conscious from birth, but it is certainly suggestive.

Data about the development of brain networks speaks most directly to questions about when the capacity for consciousness is acquired. However, even if infants have the capacity for consciousness from birth, they may not realize that capacity until much later. (Compare: My Subaru Forester has the capacity to reach 117 mph, but to the best of my knowledge, it has never realized that capacity.) Is there any evidence that the capacity for consciousness might be realized in early infancy?

## **Attention, integration, and oddballs**

There is, although it too is suggestive rather than demonstrative. One line of evidence concerns the capacity of infants to segregate auditory input into distinct streams. Suppose that one hears someone speaking in the context of another sound, such as background music. In adults, sorting auditory input into two distinct streams (the spoken words versus the music) appears to require conscious attention. Thus, it is interesting to note that the capacity to segregate auditory input into distinct streams appears to be in place from birth.

A second clue to the emergence of consciousness involves the integration of sensory modalities. Although some forms of sensory integration can take place outside of consciousness, others — such as those involved in the McGurk effect — appear to presuppose consciousness. First described in 1976, the [McGurk effect](#) occurs when one watches a video in which the audio track of one phoneme (for example, /ba/) has been dubbed onto images of someone mouthing a different phoneme (for instance, /ga/). Rather than consciously perceiving either /ba/ or /ga/, listeners are likely to perceive another phoneme altogether, such as /da/. Crucially, the McGurk effect appears to occur only when one is conscious of both the visual input (the mouthed phoneme) and the auditory input (the spoken phoneme); when that input is prevented from reaching consciousness, the effect disappears.

Behavioral studies suggest that the McGurk effect can be found in 4-month-old infants. It is possible that comparable forms of intersensory integration might occur in even younger infants, although neural measures of integration would likely be needed to find them.

Perhaps the most intriguing evidence of consciousness in early infancy comes from a study conducted by Julia Moser at the University of Tübingen. Moser and her colleagues used second-order (“global”) auditory oddballs to probe for consciousness. Consider a sequence of tones that are clustered together into four groups of four tones, where each tone is either high pitched or low pitched. In the global oddball paradigm, the final tone in the first three groups differs from the preceding three tones (for example, if they are low then it will be high), but the final member of the last group will be identical to the preceding three tones (for example, they might all be low tones). In this scenario, the final tone is not an oddball (that is, outlier) relative to the preceding three tones, but it is an oddball relative to the entire sequence, for anyone who hears the three earlier groups of tones will expect the final member of this group to be an oddball.

Earlier research has suggested that the brain produces a distinctive response to second-order oddballs, which can be roughly thought of as a neural marker of surprise. Further, there is

some evidence that this response is produced only when an individual is conscious. Using fetal magnetoencephalography (MEG), Moser and her team discovered that a version of this response could be found not only in newborns but also in 35-week-old fetuses. Again, this result does not provide proof of perceptual awareness in early infancy (let alone in utero), but it is yet another illustration of how neuroscience is beginning to pull back the curtain on infant experience.

### **Is it really *human* consciousness?**

Whenever consciousness first emerges, it surely does so in a form that is radically unlike that with which you and I are most familiar.

Experience in the infant is (one presumes) absorbed by its immediate objects — the movement of a branch, the sound of voices, the taste of breastmilk. Infants presumably lack the capacity to stand back from their own experiences — to make them objects of critical reflection. Nor, presumably, do they have any sense of themselves as a continuing subject of awareness or as members of a community of conscious agents.

We, of course, can subject our experiences to critical scrutiny; we can ask whether the world is as it appears to be. Our awareness is not limited to the contents of immediate perception, but includes both memory and imagination — an awareness of how things were or how they might yet be. And we are not



solipsists, but conceive of ourselves as inhabiting a shared world of experience.

In many respects then, the most interesting question may not be when the developing human being first becomes conscious, but when those features that are distinctive of human consciousness first emerge. When do we first acquire the capacity to subject our experiences to critical scrutiny? When do we first acquire the capacity to recollect the past or imagine the future? In some important sense, it is only when we have figured out the answers to these questions that we will know when “human” consciousness first truly emerges.