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Neuroscience The Observer

Prenatal blueprints give an early glimpse of a baby's developing brain

Innovative research is allowing us to see neural activity in a baby's brain as it develops inside the womb



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Vaughan Bell

Sunday 4 January 2015 02.00 EST



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My partner is lying on her back and both of us are trying to hide our nervousness about the first ultrasound of the pregnancy. As the examination starts, we hold hands and stare intently at the bedside screen. Initially, the monitor shows little more than a shifting cauldron of grey and black organic forms but as the doctor fiddles with the machine, an image of our future son emerges from the monochrome static. I find myself looking at a picture that shows both the profile of his face and his developing brain and I am, unexpectedly, lost for words. This experience, repeated around the world, is both commonplace and astonishing. For the first time in history, most parents now see their child's brain before they look into their eyes.

Brain development during pregnancy is key for future health, which is why it gets checked so thoroughly during prenatal examinations. But neuroscientists have become increasingly interested in how the activity of the brain becomes progressively integrated and synchronised during development to support human experience, something developmental neuroscientist [Moriah Thomason](#) calls "bringing us closer to the blueprints of the brain". These "blueprints" are not easy to read, however, as they are encased within a tiny skull and float within the mother's body, protected and nurtured from the outside world, making them a difficult subject for scientific study. Undeterred, groups of innovative researchers have begun to develop technology to gently and non-invasively visualise the activity of the brain as it develops in the womb.

If you're not familiar with the challenges of neuroimaging, this is a formidable task. To complete an adult scan using functional magnetic resonance imaging, otherwise known as fMRI, stillness is essential because even slight movements can cause distortions in activity readings. To overcome this, adult participants are held in a firmly fitting head rest and software corrects for other tiny shifts in position. But as expectant mothers will tell you, the average third-trimester foetus is not an enthusiast for stillness and tends to shift and move around constantly. As a result, many neuroscientists thought that studies of the prenatal brain would be futile.

But this seemingly impossible feat has been overcome through slow, arduous manual labour. Each individual scan is like a frame from a movie that needs to be put into the same orientation. Because typical motion correction software designed for adults won't work when scanning the foetus, aligning all of the scans has to be done by hand, for each and every individual "frame". Thomason, an assistant professor at Wayne State University and foetal fMRI specialist, describes how it involves "more than 30

hours of work before we have the kind and quality of data that most folks using functional MRI postnatally start with". "It is a lot of extra work," she says, "but for very good reason."

These reasons include some preliminary but captivating insights into the earliest stages of brain development. A [recent study led by Thomason](#) looked at how key areas begin to link up and co-ordinate their activity from week 24 of pregnancy. The researchers were able to track the emergence of wide-ranging connections that support the co-ordination of movement and information flow, where the first flickerings of synchronised activity bloom into the beginnings of the functional brain networks that remain with us into adult life.

Other studies have looked at how the foetus experiences the world outside the mother, providing a picture of an increasingly aware individual during the last trimester. Several brain imaging studies have demonstrated that in the last weeks of gestation, sounds cause clear activity in the areas of the brain involved in hearing. We know babies in late-stage pregnancy react to light but [a particularly striking study](#), led by neuroscientist [Veronika Schöpf](#) from the University of Graz in Austria, used fMRI to determine the direction of eye gaze in the womb and showed how this was associated with surprisingly well co-ordinated neural activity in the action, visual and control areas of the brain. Many of these abilities were thought only to be present in elementary forms at birth, waiting to be shaped by experience. But we are now learning that during the last months of pregnancy, experience of the world, through the womb, is shaping the brain more fully than we previously imagined.

Although scientifically intriguing, this research area has not yet had any direct impact on medical practice, where clinicians hope to be able to better detect and treat problems during pregnancy. [Catherine Limperopoulos](#), a specialist in foetal brain injury and neuroimaging at the Children's National Medical Center in Washington DC, is optimistic that the basic science will lay the foundations for better care. "The potential future clinical role," she notes, "will be to provide novel, currently unavailable insights into the neurobiological underpinnings of brain disorders" and she hopes that identifying "network specific disturbances" will be key to developing specific forms of diagnosis and treatment.

Parents won't have the experience of staring at multicoloured measures of brain activity during their standard pregnancy checkups just yet but our understanding of the unborn brain is likely to increase vastly over the next decades. Centres for prenatal brain research are beginning to open across the world, and while we are currently impressed by the technical achievements of examining the brain during pregnancy, I suspect the biggest surprises about the earliest moments of human nature are yet to arrive.

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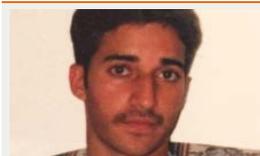
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rmstallman

5 Jan 2015 12:50

1

Fetal development is scientifically fascinating, but let's put the results in perspective, lest the enemies of abortion rights present them as more than they are. The fetal visual activities described here are puny compared with your average mouse or pigeon. They are noteworthy only because they are being done by a fetus.

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zorro_san

5 Jan 2015 11:55

0

"My **partner** is lying on her back..."

What awful prose to describe the woman you've (or someone else has -- IVF or FWB, e.g.) *impregnated*, the soon to be *mother* of your impending *issue*. You might as well be describing a business associate or a whore or a bloody cadaver waiting for a body bag after a successful

suicide bomber's maleficent self-martyrdom.

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babyant

5 Jan 2015 0:21

0

Wow great article. On a sort of lighter note when is the foetus in some way conscious and aware, whats is the average age for memories to start forming?

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ID4360290

babyant

0

I suspect that consciousness continues to develop throughout infancy after birth.

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RedPanda

4 Jan 2015 20:21

0

It figures that the fetus late in pregnancy would have some awareness. Precocious infants such as foals and calves can stand up, walk (or wobble) and find the teats within minutes or at most hours of birth, and that level of brain activity didn't start at the moment of birth.

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JackSlater

4 Jan 2015 13:11

1

Fascinating research. Hopefully it can be further utilised to help predict, and combat, congenital neurological diseases and disorders, leading to more specifically targeted treatments.

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Bionicflan

4 Jan 2015 8:15

1

"I'm a celebrity let me out of here"

"it ain't 'alf hot mum"

"Womb with a view, they said"

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IllusionOfFairness

4 Jan 2015 8:10

1

Very interesting picture, but is there an agenda here? Baby, leading in with first ultrasound, then segueing into discussions of work relating to third trimester and 24 week plus studies without an obvious shift...?

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KateR1

0



4 Jan 2015 7:44

Fascinating picture... curious about how newly born and unborn babies understand the world around them This area of research may help to maximise early stage development and some of the adult brain functioning

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ChineeChopper

4 Jan 2015 6:57

1

Interesting

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bollybollo

4 Jan 2015 5:58

1

Baby's first thought? " Turn that bleeding light off! "
All your neural development are belong to us.

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HaveyouseenEd

4 Jan 2015 5:13

6

A 'baby's' developing brain? One of the main points of contention I have with the pro abortion folk online is over the language used to describe the unborn. The words 'baby' or 'child' are usually verboten in such circles.

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MihangelapYrs [HaveyouseenEd](#)

1

quite

A number of pro-choice BTL commentators hold that it isn't a baby until it's out - because it's still parasitic on the mother

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CardioMonkey [HaveyouseenEd](#)

5

It really is not difficult to classify. In Utero it is neither a baby nor a child it is a foetus. Easy.

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zorro_san [MihangelapYrs](#)

0

"baby: a very young child" according to Merriam-Webster. A fetus isn't yet a child but is merely a protoplasmic mass in the teleological process of becoming a child. Is it alive? As alive as the mother's appendix: remove it and it withers instantly. All parasites are dependent upon their hosts. All children are dependent upon their parents. Ergo, all children are parasites until they can fend for themselves.

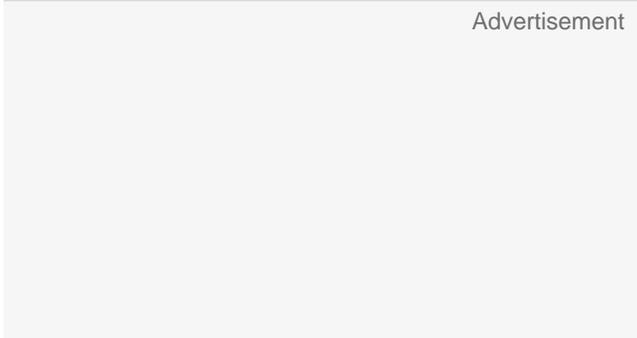
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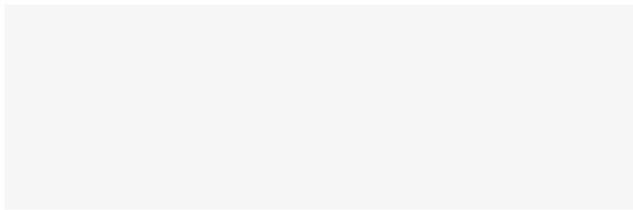
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