PERCEPTION

Achtung baby!

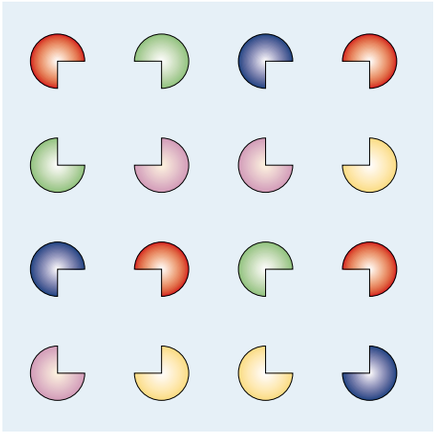
The study of the object processing abilities of infants is a growing area of research that extends our understanding of object cognition by complementing the numerous studies in adults and non-human primates. Not surprisingly, probing the mind of a 6-month old baby presents a series of problems that have led to some ingenious experimental procedures. One commonly used method involves measuring the amount of time that an infant will orientate to a given stimulus. This 'preferential looking' paradigm provides a measure of how interesting the infant finds a given stimulus and thereby offers a window into their previous experience with that object and their developing perceptual and cognitive abilities. Although this type of behavioural paradigm has been used with great success, the ability to make more direct measurements of brain processing in infants would provide a significant step forward for this area of research and would strengthen the link with the adult and non-human primate literatures. Csibra and colleagues provide an example of how non-invasive imaging can be combined with more traditional approaches to bring the development of object processing systems in the infant brain into the neuroscience arena.

Their experiment focused on one of the key questions in visual perception — if the visual features of an object such as form and colour are, to a large degree, processed separately, how is this information 'bound' together in the brain to allow the perception of a unified object? One theory suggests a prominent role for gamma-band (40 Hz) oscillatory activity in perceptual binding.

This form of binding can be studied through the use of illusory percepts such as the Kanizsa square, in which an illusory square can be induced between four appropriately orientated 'pacman' elements as shown in the figure. In adults the perception of illusory objects induces a burst of 40 Hz oscillations shortly after stimulus onset. Csibra *et al.* used electroencephalography to measure the oscillatory brain activity of 6 and 8-month old infants while they viewed either a Kanizsa square or a control stimulus consisting of misaligned elements that did not induce the illusory percept. There was an enhancement of gamma-band activity in response to the Kanizsa square in 8-month-old infants but not in 6-month-old infants. This activity was not observed in response to the control stimulus.

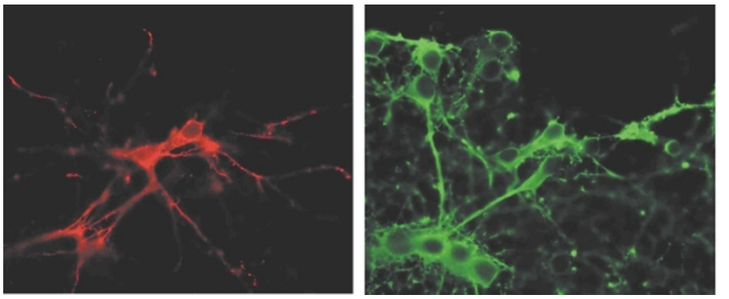
This work is consistent with, and extends, the behavioural studies that suggest that perception of the Kanizsa square begins at around 7 months of age. But the wider importance of this work may reside in the demonstration that direct measurements of neural processing can be undertaken in very young infants during the performance of behavioural tasks. By encouraging the dialogue between cognitive development and cognitive neuroscience, this study may therefore bind these two areas together and so open the doors of infant perception.

Peter Collins



References and links

ORIGINAL RESEARCH PAPER Csibra, G. *et al.* Gamma oscillations and object processing in the infant brain. *Science* **290**, 1582–1584 (2000)
FURTHER READING Singer, W. & Gray, C. M. Visual feature integration and the temporal correlation hypothesis. *Annu. Rev. Neurosci.* **18**, 555–586 (1995)
WEB SITE Gergely Csibra



Two neurons generated from a mouse radial glial cell, double labelled with a mouse-specific antibody (red) and the neuron-specific anti-β-tubulin-III (green). Image supplied by Paolo Malatesta, Max-Planck Institute of Neurobiology, Germany.

NEUROGENESIS

Changing glia

Traditional concepts of vertebrate neurogenesis, in which neurons and glia arise from separate, irreversibly committed lineages, are gradually being eroded. It has been shown that a subset of astrocytic cells in the adult brain can give rise to neurons, suggesting either that these cells are able to de-differentiate or that they are less committed to the glial lineage than was previously supposed. In a new paper in *Development*, Malatesta *et al.* show that radial glial cells also demonstrate a rarely recognized potential for neuronal differentiation.

The radial glia appear in the developing cerebral cortex around the time of onset of neurogenesis, which is embryonic day 11 (E11) in the mouse brain. They send out long processes that extend from the ventricular zone to the pial surface, forming a scaffold to guide neuronal migration. Their marker expression profile has placed them in the astrocytic lineage, and a role as glial progenitor cells has already been established.

Using fluorescence-activated cell sorting, Malatesta *et al.* isolated individual radial glia from the mouse cortex at various stages of embryonic development. Two different criteria were used to select the cells: the expression of green fluorescent protein (GFP) under the human promoter of the astrocytic marker GFAP and the presence of long radial processes. These processes could be labelled from the pial surface of the intact brain using a fluorescent retrograde tracer. It was confirmed that the sorted cells expressed markers characteristic of radial glia, including RC2, GLAST and BLBP. The differentiation potential of the isolated cells was analysed in co-culture with rat cortical cells to replicate their normal developmental environment. Of the cells isolated from the E14 cortex, half gave rise only to neuronal clones under these conditions and the rest generated mostly astroglia. By contrast, radial glia isolated from the cortex later during development (E18) gave rise mostly to astrocytes, suggesting that the differentiation potential of the radial glia becomes more restricted as development proceeds. Intriguingly, the radial glia demonstrating the highest level of neurogenic potential were isolated at a stage during which the brain is most active in neurogenesis, raising the possibility that these cells could be acting as neuronal precursors *in vivo* as well as *in vitro*.

Heather Wood

References and links

ORIGINAL RESEARCH PAPER Malatesta, P. *et al*. Isolation of radial glial cells by fluorescent-activated cell sorting reveals a neuronal lineage. *Development* **127**, 5253–5263 (2000)
FURTHER READING Doetsch, F. *et al*. Subventricular zone astrocytes are neural stem cells in the adult mammalian brain. *Cell* **97**, 703–716 (1999)
ENCYCLOPEDIA OF LIFE SCIENCES Cells of the nervous system