General

Development of the nervous system, which includes the sensory pathways, is not complete at birth. The impact of this on sensory development is difficult to assess, as it is difficult to design methods of demonstrating what babies can sense.

Empiricist view:
Piaget – Sensori-motor stage – chaos of early perception only makes sense when babies start to link their actions with their perceptions. Empiricist stance – but adds active construction to the process.

Nativist view:
Core knowledge – **Spelke** – babies have a basic understanding physical objects, numbers at birth.
Social knowledge – **Meltzoff** – babies are born with an understanding of faces and people as social objects.

Definitions

Sensation- the interface between the person and the environment. Receptors, such as eyes and ears are active – not passive like cameras or microphones. Pre-processing performed before information reaches the brain – **Hubel** – work on cat's retina demonstrates this.

Perception **-** a mental construction of the world, generated through the senses. Several sources of evidence suggest babies perceive the world differently to adults – but very difficult to test as they can't communicate.

Cognition **-** The relating of a current perception to previous perceptions – e.g. recognition of family members. Cognition is inferred from behaviour – cannot be determined directly. Each new perception has the ability to modify previous perceptions – therefore cognition can change over time.

Behaviour **-** One of the products of cognition, directly observable. Differences in behaviour are used to infer what is being perceived.

Book 1 Chapter 3 – Sensation to Perception

The Sensation -> Behaviour System

Substantial development occurs during childhood => perceptions of a baby are very likely to be different to those of an adult.

The system is not linear. Sense organs are direct-able – therefore we can choose what we want to perceive to some extent. Selective attention occurs – therefore, can regard sensation and perception as a product of behaviour. As this is a dynamic system, it makes it difficult to study the way one part of the system works from another.

Vision

There is significant development during the first few months of life; but at birth it is good enough for recognition and discrimination to be possible.

At birth, the eye is nearly mature – but infants have slow and inefficient accommodation (ability to focus the eye on objects at different distances).

Cones help the eye sense detail; rods provide sensitivity to light and dark. No new rods or cones formed after birth but the migration of cones to the fovea is only complete at age 11 (**Abramov et al**). Means that fine detail (acuity) and colour perception not mature (**Hainline**) [– blur and pastels].

Optic nerves lack myelin – means that information travels more slowly to the brain and gets diffused. Myelination is complete by about 3 months (**Yakovlev & Lecours**).

LGN compares inputs from adjoining nerve fibres and so respond to differences in the amount of light at the centre (vs edges). Some processing already done by retina – LGN enhances detail. Not mature until around 1 year old – leading to a lack of clarity in the visual field (**Hickey**).

Visual cortex compares inputs from different receptive fields covered by the nerve fibres from the LGN (**Hubel & Wiesel**). Some cells respond to light and dark lines & boundaries; others to their movement; others to size and colour of stimuli in large receptive fields. **Horton and Hedley-Whyte** found evidence that the organisation of cells into complex structures continues for at least 6 months after birth. Connections between neurons in the visual cortex greatly increase in first 6 months.

As the visual system takes time to reach full capacity, it must constrain perception in young infants. Behavioural evidence is used to assess this.

Scanning – develops in first 2-3 months to become similar to adults – before then, infants look at far fewer parts of an image than adults (**Maurer & Maurer**)

Attention & Acuity – **Fantz -** reasoned if babies look at some things more that others they must be able to perceive differences between objects. Viewing chamber used to record visual preferences – Forced-choice preferential looking. Time spent looking at both stimuli recorded. Used to determine acuity. Pattern of bars paired up with a grey square of equal brightness 25cm from face. Up to one month, only thick stripes preferred to grey square. Acuity improves as they get older – at 6 months, finest stripes are distinguished. Similar findings in cats. **Hainline** – normal development of infant vision is adequate for what infants need to do. Using **Fantz's** method, infants:

- Prefer more complex stimuli as they get older
- Symmetry is preferred from 4 months onwards
- Curved features preferred to angular ones
- Moving stimuli preferred to stationary ones
- 3D objects preferred to photos of 3D objects

Karmiloff-Smith – 'visual processing starts with a vengeance'. E.g. studies show 12 hour old infant prefers looking at mother – can be apparent after an hour, gets stronger with experience (**Bushnell**). This is a ***familiarity preference***.

Clear evidence for ***novelty preferences*** -as ***habituation*** occurs.

Size constancy – **Slater et al** – found evidence that when habituated to a cube of one size they looked more at a new cube even though they were at different distances away to make the retinal image the same size. This is therefore an organising feature of perception present at birth.

Occluded objects recognised from around 2 months.
5-6 months – two touching objects are not one object
6-8 months – have learnt about support & gravity
Stereopis emerges at around 3-6 months – near adult capability between 6-12 months

Sen et al – fronto-parallel cylinder illusion noticeable at 7 months but not 5 months (pictorial depth cue).

Gibson and Walk – visual cliff – 3/27 crawled over the drop; all 27 crawled over the visually solid side. **Campos et al** found new crawlers would go over the 'drop' – so starting to crawl => necessary for wariness of heights to develop.

Faces – infants have:

- A preference for mother soon after birth]
- Attractive faces preferred (**Langlois**) –even in < 3 day old infants (**Slater et al**)
- They imitate facial expressions minutes after birth (**Reissland**) – interpreted as a form of social interaction by **Meltzoff & Moore**.

Research with animal & human faces (**Pascalis et al**) suggests first year of life the face processing system becomes tuned to human faces. Gender distinction also evident from 3-4 months (**Quinn et al**) Male face familiarised infants (female primary care giver) showed preference for looking at new female faces; female face familiarised showed preference for female faces. Opposite results occur if there is a male pcg.

Hearing

Onset is around 6 months pre-natal – at birth, anatomical structures mostly mature and functional – exception being the neurons in the Heschl's gyrus – maturing in adolescence like the visual cortex neurons.

Hearing sensitivity gradually increases in the early years.

Like vision, preference for some auditory stimuli is shown. 'Motherese' – **Fernald** – demonstrated preference in 4 month olds over normal speech. However, happy normal speech preferred to unhappy Motherese – **Singh et al.**

DeCasper and Fifer – used sucking rates to control what an infant heard – ba and pa phonemes. Rates increase when first heard, habituation occurs and rates drop. Peak sucking doesn't occur again on same phoneme re-presented later. Phoneme changes do increase sucking – dishabituation.

DeCasper and Spence found evidence that newborns can hear in the womb – preference shown for a piece of prose read to them before birth demonstrated.

Voice onset time (VOT) – adult speakers can discriminate between [b] and [p], but not between two different versions of [p]. Babies can. They don't become "native listeners" until older – **Werker**

Jusczyk found evidence that infants acquire knowledge about the nature of their native language long before they can speak.

Developmental course of speech goes in two directions – less competence in distinguishing non-native sounds; but become more sophisticated in understanding the characteristics of their own language.

Cross-Modal Perception

Evidence that infants do have the ability to integrate vision and hearing – **Wertheimer** – immediately daughter born tended to turn her eyes right or left depending on which side a click was made. **Morrongiello et al** found infants could learn that sound was an attribute of an object only when the sound and visual object were in the same place. **Slater et al** found evidence that infants only learned sight-sound co-ordination when their on/off presentation was synchronised.

Intersensory redundancy (linking information from one sense to another) – the ability to link two modalities. Important example is voice to face – no obvious way in advance as to what face will produce a particular voice but at 3 months infants can work this out – particularly when the mouth can be seen moving (intersensory redundancy happening).

At 11 weeks – infants expect a single object to make a single sound and a compound object a complex sound when dropped (**Bahrick**). **Bahrick and Lickliter** suggest redundant information is important for infants when learning object names.

Perceiving the world – a multisensory experience

Research suggests preparedness at birth for dealing with dynamic perceptual experiences – much experimentation has been with less rich stimuli, which may underestimate what babies can perceive.

Butterworth – moving wall experiment with 15-34 month old infants – move wall towards child they fell over backwards, move it away they fall over forwards. Likely to be due to the vestibular system and kinaesthetic feedback occurring. (e.g. viewing a moving train from a stationary train). Similar expt in 2 month old infants found the same effect.

Onset of crawling prompts development – e.g. visual cliff. Also introduces infants to ***social referencing*** – looking to care givers to see what is safe/what isn't.