This rather leaves open the question as to whether such basic mechanisms as depth cues have to be learned or whether they are automatically mediated by the visual system. The infants in the Gibson and Walk (1960) study were able to judge depth by visual cues. An alternative explanation is that S.B. had passed the critical age for picking up distance cues. Or, as Gregory and Wallace suggest, S.B.'s prolonged reliance on touch cues may have interfered with the development of normal visual mechanisms.

Another interesting observation was that S.B. never learnt to interpret facial expressions like smiles and frowns, although he could read a person's mood from the sound of a voice. Unfortunately, experiences like this depressed S.B. and, like other tragic cases of this kind, he often reverted to sitting in darkness, and eventually died 3 years later. The sad case of S.B. provides a timely reminder that the emphasis on vision in this chapter, and in many other psychology textbooks, ignores the importance of other senses such as touch and hearing.

This consideration of whether we 'learn to see' raises again the important question of the role of past experience in perception. It seems indisputable that normal infants are born with sense organs, physiological mechanisms necessary for processing sensory information, and a brain which can interpret information it receives. Nevertheless, evidence also shows that human perceptions depend on the integration of past experiences with current sensory inputs. These issues are of crucial importance in defining human perception.

6.6 What is perception?

I have given this last section the same title as the very first section to give us the opportunity to reconsider the three basic questions about perception posed in Section 1.

The first question asked how information is extracted from the multitude of inputs received by sensory receptors. Relevant physiological evidence was presented in Section 2 suggesting that information derived from patterns of light falling on sensory receptors in the retina is transmitted to the visual cortex in the brain in the form of electrical activity in nerve cells at all levels in the visual system. Psychophysical judgements of elementary sensations and the gestalt laws explaining perceptual experiences of figures were described in Section 3. Section 4 considered evidence about basic perceptual processes for extracting information from the retinal image about the size and distance of objects in the environment.

The second question asked how sensory information is processed to provide a representation of the environment. The theories outlined in Section 5 defined object recognition as the matching of sensory cues against stored mental representations of objects. Feature detection theories like pandemonium concentrated on bottom-up extraction of features from sensory images. Neisser points out the need for a continual cycle of interaction between analysis of sensory cues in the environment and expectations based on prior knowledge. This is a plausible description of what goes on in perception, but it needs a more precise specification of the mechanisms involved.

In this section, we have seen that Gibson also addresses the problem of how perceivers interact with the environment. However, Gibson emphasizes the complex structure in the light rays which impinge on the eye. Gibson's theory is at its strongest when explaining innate stereotyped reactions to the overall 'optical flow' of the environment. Neisser accepts the importance of the information in the optic array but makes the point that Gibson's theory says 'nothing about what is in the perceiver's head' (Neisser, 1976). From this point of view, Gibson's is a bottom-up theory with its stress on information picked up directly from the environment. In contrast, Neisser's main concern is with the prior knowledge which is employed in a top-down direction to generate the perceptual models which underwrite perception.

This raises important issues in connection with the third question about the role of past experience in perception. What indeed would our perceptions be like if we knew nothing about the environment? The evidence presented in Sections 6.4 and 6.5 about the development of perception in infants and recently sighted adults was rather equivocal. However, when it comes to recognizing objects, children have to learn what tables and trees are, how to use an object such as a spoon even if they do not yet know what it is called. Adults, too, are constantly exposed to new experiences. Despite television pictures about events all over the world, it is impossible to imagine the feel of snow or the heat of a tropical sun until you have experienced them. It is even more difficult to grasp what a baby, or someone with restored sight, actually 'sees'. The same light rays shine on the eye of a baby as on the eye of an adult. What we perceive are ordered representations of a room with furniture, curtains at the window and pictures on the wall. It is almost impossible to visualize perceptions of the environment by an infant lacking such knowledge.

These are deep and difficult issues. Psychologists certainly do not claim that all the physiological and psychological theories of perception add up to a complete explanation of the complex interaction between knowledge and perceptual experience. We exploit our perceptions to gain experience and knowledge about the world. We use current expectations to explain apparent contradictions in the environment. At the same time, we have to pay attention to what is actually happening. Survival would be difficult if animals moved around in a haze of top-down expectations, without the ability to react instantaneously and directly to bottom-up stimulation of sensory receptors. It is not at all easy to strike the right balance between representations of prior knowledge and the analysis of sensory inputs by sensory systems. Perception can be thought of as a 'conflation of what one remembers and what one sees'. This is indeed a crucial issue both for perceivers in general and for psychologists who study perception, although, as perceivers ourselves, it normally causes us very little bother.

Summary of Section 6

- According to feature detection models, feature detectors operate in a bottom-up direction, analysing sensory inputs and combining them at higher levels.
- Perceptual hypotheses and perceptual models involve the testing of hypotheses based on past experiences against sensory cues, incorporating both top-down and bottom-up processing.
- Gibson's theory of direct perception emphasizes the total array of light stimulation which he claims is sufficient for perceptual interactions with the environment, without the need for intermediate processing stages.
- Basic sensory processes like depth perception are innate in most species and develop at a very early stage of infancy in humans. Without some basic perceptual mechanisms, human infants would not have the equipment necessary to learn about the environment.
- Evidence from the restoration of sight to people born blind indicates that some learning is required for fully effective perception.
- For perception to provide a basis for adaptable behaviour in humans, there needs to be an interaction between analysis of sensory information and interpretations based on learned knowledge and expectations about the environment.

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Further reading

GREGORY, R.L. (1972) *Eye and brain*, 2nd edn, London: Weidenfeld and Nicolson.
This little book is a delightful introduction to all aspects of visual perception including optics and physiology, illusions and hypotheses, perspective and painting. It gives many interesting examples, including the case study of S.B. the man whose sight was restored (see Section 6.5). It is packed with well-chosen illustrations.

Other interesting books by Gregory include:

GREGORY, R.L. (1970) *The intelligent eye*, New York: McGraw Hill.

GREGORY, R.L. and GOMBRICH, E.H. (eds) (1973) *Illusion in nature and art*,