Comparative Neuropsychology

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David Milner has brought together an impressive array of scientists to pay tribute to the memory of George Ettlinger (1927–1993), one of the founders of comparative neuropsychology. The papers in this book echo the themes that were important to Ettlinger. These include the importance of research that uses both animals and people, the value of the experimental method as well as astute clinical observation, and the higher order nature of the deficits seen in agnosia and apraxia. It is unusual for one person to maintain active research programs with both non-human and human animals, although Ettlinger did so throughout his career. He helped introduce scientific rigor to neuropsychology, but he was also a keen observer of both monkeys and patients in non-experimentally controlled situations. His papers report experiments with animals, experiments with human participants and clinical case studies. Ettlinger's demonstration, in 1956, that the visual sensory abilities of patients with and without agnosia did not differ and, therefore, differences in vision could not explain visual agnosia, was a milestone in the development of neuropsychology. Similarly, Ettlinger showed that the misreaching seen after damage to the posterior parietal cortex was a genuinely visuomotor deficit rather than a problem with motor execution or spatial perception.

One of the pleasures of this book is the wealth of older references as well as the newest findings. Often, gems from the past are lost simply because they are from the past. I found the chapters by Milner and Dijkerman, Halsband, and Passingham, all of which relate to the functions of the posterior parietal cortex, to be particular highlights of the book.

It seems clear that a stark dichotomy assigning all visual object processing to the ventral stream and all visual spatial processing to the dorsal stream (including the parietal cortex) is not supported by the data available. The dorsal stream must take object properties into account to some extent and the ventral stream cannot completely ignore spatial information. I find the hypothesis that the dorsal stream is concerned with the visual information needed to guide action (for example, 'How far should I extend my hand to pick this object up?') and that the ventral stream stream is concerned with the visual information needed for object identification and recognition memory (for example, 'Even though this object is in a different location, is it still the same object?') to be rather compelling.

The work of Colby and colleagues on parietal neurons, discussed in the chapter by Milner and Dijkerman, elegantly demonstrates that stimuli that will fall on the receptive field of neurons in the lateral intraparietal sulcus (LIP) after an eye movement is completed, influence the cell's activity before the eye movement occurs[1]. That result is as fascinating as the experiments are superbly conducted.

Halsband gives a convincing explanation for why Heilman's theory of apraxia[2] can better account for the array of empirical data than Geschwind's theory of apraxia. Apraxia appears to result from a fractionation or destruction of the spatiotemporal representations of learned movements. We have known for some time that memories are constructed actively, or reconstructed, each time they are retrieved. It appears that the same is true for motor skills. They too are apparently constructed *de novo* each time they are used.

As both a behavioral neuroscientist and a developmental psychologist, I am struck by the similarities in the misreaching errors seen after damage or destruction of parietal cortex and the reaching errors seen in human infants during the later half of the first year of life. Historically, there has been a lack of correspondence between human and non-human primates in the region within parietal cortex that, when damaged, produces misreaching errors. In monkeys, misreaching to visual targets has usually been reported to result from lesions to the inferior parietal cortex, whereas in humans, misreaching to visual targets has usually been claimed to result from lesions to the superior parietal cortex. Passingham explained this seeming lack of correspondence rather well by showing that lesions in the vicinity of the intraparietal sulcus produce misreading errors in both humans and monkeys. The lesions that were made in the monkeys included area LIP in the ventral bank of the intraparietal sulcus. The lesions in patients included both banks. Indeed, a recent positron-emission-tomography study by Clower *et al.* found activation of the ventral bank of the intraparietal sulcus when participants learned to reach under conditions in which they saw the targets through distorting prisms[3].

It is interesting that both aphasia and apraxia are more common after left-hemisphere injury. The left hemisphere appears to be dominant both for language and for motor programming, especially for tasks that involve complex sequential movements of the limbs. It might be coincidence or it might be related to the importance of temporal order for both language (for example, 'the dog bit the boy' means something totally different from the 'the boy bit the dog') and for many motor programs. It could be related to commonalities between motor skills and language. It is interesting to remember, in this regard, the theories about how and why tool use and language might have evolved at roughly the same time (see, for example, MacNeilage[4] and Greenfield[5]).

Why do human infants reach back to the location that was previously correct on the A-not-B or delayed-response tasks, even when they never actually reached to the previous location, but only observed someone else reach there? The work of Jeannerod and his colleagues[6] might hold the answer: when someone observes an action, the observer might start to prepare the same action. According to Jeannerod, the neurons responsible for motor-image formation appear to be the same as those the participant will later activate during the planning and preparation of the action.

Readers will find such gems as these for themselves in the chapters of this readable and delightful book. Neuropsychologists, behavioral neuroscientists, neurologists, comparative psychologists and others will find this a valuable edition to their libraries.

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