Experiences from 'Brain Camp'

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The Dartmouth Summer Institute in Cognitive Neuroscience was held at Dartmouth College, Hanover, NH, USA, from 24 June to 6 July, 2001.

This year's Dartmouth Summer Institute in Cognitive Neuroscience focused on the imaging of cognition and mechanisms of reward and learning. An eminent faculty lectured and directed 'hands-on'practical sessions and demonstrations, and, in an added feature, graduate students from Dartmouth supervised the running of fMRI experiments throughout the duration of the course.

The first week opened with a talk by Mark D'Esposito (University of California, Berkeley, CA, USA), who warned of the 'trials and tribulations of fMRI'. Students were asked to consider the relation of the blood oxygenation level-dependent (BOLD) fMRI signal to neural activity, as well as the spatial and temporal characteristics of this haemodynamic response. D'Esposito emphasized the value in studying the consistency versus variability of the BOLD signal, both within and between neural areas, but noted the inherent difficulty in finding stimuli that would be equivalent in terms of duration and complexity across heterogenous brain regions. Various factors that could produce differences in the BOLD response between individuals were also discussed. Here, D'Esposito showed that age-dependent changes in neural vasculature could result in a change in the BOLD signal-to-noise ratio (SNR) – increased age is associated with reduced SNR. These changes were shown to be independent of neural activity, and hence serve to illustrate the potential difficulties in interpreting differences in the BOLD signal between different age groups.

Helen Neville (University of Oregon, Eugene, OR, USA) focused on early sensory deprivation within a single modality and the effect this can have on processing within other modalities. ERPand imaging data was presented, showing that peripheral visual stimuli produced stronger responses in deaf compared with hearing subjects. Similarly, congenitally blind subjects were shown to have a selective enhancement in their representation of the auditory periphery. The importance of the dorsal visual stream in the representation of peripheral stimuli is well known. In addition, this pathway has been found to exhibit a significant amount of redundant intermodal connections in early life, at least in non-primates. Such findings, combined with those of Neville, suggest that the absence of input from one sensory modality can lead to 'hijacking'of a part of this system by intact sensory modalities. Neville also argued that such a modifiable system would is also likely to be a vulnerable system, thus providing a hypothesis

with which to explain the prevalence of dorsal stream processing deficits in several developmental disorders, for example, dyslexia, Williams syndrome and autism.

Marcus Raichle's (Washington University, St Louis, MO, USA) insights into the 'default state of the brain'provided a useful perspective on how best to interpret activations and deactivations within neuroimaging studies. The implementation of an appropriate baseline task is considered to be crucial for any cognitive subtraction paradigm. But Raichle convincingly argued that meaningful interpretation of any neuroimaging results also relies upon an understanding of the physiological default state of the brain. Without such an understanding, the interpretation of activations in response to even a simple 'baseline'task will be problematic. A metaanalysis of activations seen across nine different PET studies showed that whereas activations tended to be specific to the precise task used, deactivations were, on the whole, unrelated to the task performed. The brain system in which these deactivations were observed have been implicated in different aspects of self-referential processing. Such 'default'processing is attenuated during goal-directed behaviour, hence the deactivations seen during cognitive tasks. Ideally, then, the baseline condition in any cognitive subtraction paradigm should be one in which such self-referential processing is completely attenuated. However, as Raichle noted, one complication is that the areas implicated in such a default state are heavily interconnected with emotional centres, such as the amygdala, hence the degree of attenuation of processing in these areas will vary with individual differences in traits such as anxiety. Raichle has clearly founded a new area of research: one in which the default state of the brain is of equal interest to that of the brain 'in action'. One wonders how this default state might vary during sleep, under anaesthesia, in persistent vegetative state, and even across different species.

The talks, only a few of which could be highlighted here, were well complemented by the neuropsychological and neuroanatomical sessions. Robert Rafal (University of Wales, Bangor, UK) and Robert Knight (University of California, Berkeley, CA, USA) presented videos in which various visual, motor, cognitive and affective syndromes were clearly illustrated. Delegates were able to study post mortem brains of patients who had suffered from a wide range of neuropathologies, the cognitive and behavioural implications of which were discussed by the session leaders. Finally, Scott Grafton (Dartmouth College, Hanover, NH, USA) led a session on transcranial magnetic stimulation (TMS), and highlighted the importance of this technique as a tool with which to explore cognitive function in the normal brain with a demonstration of electromagnetically-induced visual and motor phenomena and an example of transient interference with speech output. These provided an illustration of both the productive and disruptive effects TMS can produce, depending on the context in which it is used.

The range, depth and quality of the educational program combined to produce an intense learning experience whilst the range, depth and quality of the social program ensured a lively two weeks. The organisers of the Summer Institute, Marc D'Esposito, Scott Grafton, Michael Gazzaniga and Donna Rocke are to be warmly congratulated.