discussion, and do not detract that this book will be *the* classic text for students, researchers and practitioners in psychology and related disciplines. It will also be indispensable for families of people with autism. In the preface, Uta Frith promises us an insight into her science and her passion, and how these two can be combined, and this reader for one was not disappointed.

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Letter

HERA today, gone tomorrow?

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Habib, Nyberg and Tulving [1] have recently updated their views on the hemispheric encoding/retrieval asymmetry (HERA) model, almost a decade after the idea was first introduced into the memory literature [2]. Broadly speaking, the central tenet of HERA is unchanged; that is, that the left and right prefrontal cortices are disproportionately involved in the encoding and retrieval of episodic memories, respectively. Over the past 10 years, several authors have challenged the model [3–5], and a number of alternatives have been proposed. In their article, Habib and colleagues address these ideas and offer suggestions as to how they might in fact be accommodated within the HERA framework [1].

Although the HERA model has undoubtedly promoted fruitful scientific exchange through the provision of a concrete testable hypothesis, it still leaves many questions about the nature of functional asymmetry in humans unanswered. In particular, the model is based solely on functional neuroimaging data and, to a significant extent, it remains unsupported by data from other methodologies. For example, according to HERA, patients with unilateral frontal-lobe lesions should be differentially impaired at encoding or retrieval depending on the side of their lesion. As Habib and colleagues point out [1], patient studies of encoding and retrieval are often confounded experimentally, although there are certain cases where they might still provide valuable information about these processes. For example, it has been suggested that encoding and retrieval might be assessed relatively independently by testing memory over very short intervals [6], and autobiographical memory (in which information is encoded prior to the time of cortical damage) provides a mechanism for identifying specific encoding impairments in patients (e.g. see [7]). To date, neither of these methods has revealed any robust differences between patients with left and right sided frontal-lobe lesions. Disconnection of the two hemispheres in so-called 'split-brain' patients produces only minor deficits in episodic memory which again suggests that the hemispheric encoding/retrieval asymmetry may be 'more apparent than real' [8].

The data from repetitive transcranial magnetic stimulation (rTMS) studies in healthy volunteers is also equivocal with respect to HERA. For example, in the study by Rossi *et al.* [9], left-sided rTMS during encoding did not disproportionately affect the probability or speed of successful retrieval (relative to right-sided stimulation). The effect of right vs. left-sided rTMS during retrieval reached significance on one of two measures of performance accuracy, and not at all in terms of reaction times.

In short, although each of these alternative approaches is not without its own problems, the lack of significant trends in favour of the HERA model remains at odds with the fundamental nature of the distinction proposed.

However, as Habib and colleagues clearly show, the most significant challenges to HERA in recent years have come from within the functional neuroimaging literature itself (e.g. [3–5], and for review, see [10]). Indeed, in the most comprehensive review of relevant imaging studies to date, Fletcher and Henson [11] concluded: 'The HERA generalization may not be sufficient, however, in that our review included many studies of verbal retrieval that activate both left and right frontal cortex, or even left frontal cortex alone'. In another recent review, Lee and colleagues [10] have reported that between one third and a half of all functional neuroimaging studies of episodic memory encoding do not adhere to the HERA pattern. Of course, at the single study level, there are results that clearly support the predictions of the HERA model, but there are also a similar number of well-controlled, systematic evaluations of the model that do not (see [10,11]).

Notwithstanding these reservations, Habib and colleagues make a number of important recommendations for future research in this area. In particular, they suggest that 'to compute the difference in activity in each hemisphere, the proper reference condition for an encoding task is a retrieval task and the proper reference condition for a retrieval task is an encoding task' ([1], p. 242). The recent functional neuroimaging literature is filled with proposals concerning specialization of function within the prefrontal cortex, although in most cases these claims are based on a single observed association between a particular type of behaviour (or task), and activation in what appears to be a specific brain region. Comparisons between two experimental

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tasks with different cognitive demands (e.g. encoding and retrieval) and a common, or separate, control task are often conducted to identify similar and different regions of activity change. However, in agreement with Habib and colleagues, we have argued [12] that to conclude that any difference in activity change is specifically associated with those different cognitive demands on the basis of such comparisons is quite clearly unjustifiable. Unequivocally establishing how specific frontal regions, or even the two hemispheres, are specialized for particular memory processes will almost certainly require a greater commitment to such double dissociation methodology than is currently the rule.

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