Verbal games in the scanner – information-specific or domain- and process-general activity?

Very reliably, 'passive' (task-independent) presentation of stimuli will result in little or no deactivation of the default mode network (DMN). Equally reliably, task-dependent presentation of stimuli will activate two networks: the cingulo-opercular or salience network (SN), and the fronto-parietal or central executive network (CEN). These two networks are functionally separable, and it has been proposed that the former maintains performance over the time course of repeated trials on a task whilst the latter is responsible for moment-to-moment monitoring during task performance. Univariate statistical analyses of contrasts between conditions may or may not show significant effect sizes in part of all of these networks, depending on the specific task design, but multivariate analyses, such as independent component analyses, will almost invariably reveal their underlying activity.

The identification of these domain general networks is colouring our views of much of previous language research with functional imaging, including our own. Activity in the SN/CEN domain-general networks can be readily interpreted as language-specific activity. This has perhaps happened most often when left inferior frontal damage, such as following a stroke, is associated with 'abnormal' (i.e. not observed in normal subjects performing the same language task) right inferior frontal activity. Often interpreted as a 'relateralisation' of language function, in many (if not all?) instances it most likely reflects increased activity in the normal right frontal opercular component of the SN as the patients struggle to perform a task made difficult by their aphasic stroke. By the simple method of making the task more difficult for the normal control subjects, one sees equivalent activity across both normal and patient groups.

More problematic is the top-down effects of the SN/CEN networks on domain-specific cortical regions and on subcortical activity. We have recently observed a decline in anterior striatal activity as subjects trained on articulating foreign words. This effect of vocal motor learning seemed to parallel the role of the striatal component (area X) of the anterior forebrain pathway (AFP) for song learning in birds. Simple parallels between the songbird literature and our study suggested that as accuracy of pronunciation increased, and trial-by-trial variation decreased, activity in the anterior striatum of our subjects would decline. No such activity-behaviour relationship was apparent, and it seemed that anterior striatal activity better reflected the subjects own assessment of their performance, which was more optimistic than the opinion of external raters – an instance of "I'm doing all right" altering activity in SN/CEN projections to the anterior striatum?

Studies designed to observe very focal activity in specialised cortical regions will continue to attract attention, with high-resolution imaging and analytical techniques, such as multi-variate pattern analysis, improving spatial resolution. However, multivariate analysis of correlated and anticorrelated activity in large scale networks is going to give us a better clue to the neural correlates of learning in the normal brain and recovery in the damaged brain.