Investigation of the Mirror Memory Tasks’ concurrent validity and sensitivity to temporal lobe dysfunction

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Introduction:

Background: Within Temporal lobe epilepsy (TLE) lateralisation of epileptogenic origin and/or sclerotic tissue to left temporal structures is often associated with poor verbal memory, whilst lateralisation to right temporal structures implicates visual memory impairments. Current assessments of verbal memory are sensitive to left pathology and widely validated. Assessments of visual memory, however, are less sensitive to right pathology and are largely reliant on subserving verbal processes (Castro et al, 2013; Frish & Helmstaedter, 2014). The most accurate measures of right TLE function include stimuli which activates visual, rather than verbal, processing.

Current Investigation: Firstly, investigation aims to establish convergent validity of the MMT, assessing utilisation within healthy populations (adult and paediatric) alongside gold standard measures of memory. Secondly, utilisation of the MMT within clinical populations (TLE) will be assessed, aiming to identify sensitivity to right temporal lobe pathology. Overall percentage of correct scores is expected to significantly decline in participants with right unilateral dysfunction.

Mirror Memory Task (MMT): A novel memory assessment developed to better measure visuospatial processing by using visual stimuli. This maximises right temporal lobe recruitment, promoting the spatial-encoding of scenes rather than verbal (Friars et al, 2014; Han et al., 2001).

Method:

Eleven patients with epilepsy participated in this study, 5 paediatric patients (mean age = 13.2 years) and 6 adult patients (mean age =41.4 years). All participants completed the MMT, which included graduated task difficulty. In addition, paediatric participants completed subtests from the WISC and established memory measures such as the CMS.

During encoding (WATCH) trials, participants were instructed to attend to the novel visual stimuli and in particular to its spatial layout (see image above).

The mirror image of the scene (CHOOSE) is presented alongside A for participants to discriminate between during a recognition phase of the study.

Stimuli were presented in blocks of 20 consecutive images. Subsequent recognition blocks were presented comprising 8 images from the immediately preceding block and images from earlier blocks.

Analysis: Behavioural data was analysed to determine encoding success (hits) or failure (misses) during early blocks (predominantly easy) versus later blocks (predominantly difficult).

Current Research and Results

Task difficulty

As shown above, the presentation of stimuli (F) and recognition trials (P) was structured such that later trials were subject to greater interference. Therefore the difficulty of discriminating true images from mirror images was systematically increased throughout the procedure.

Patient demographic characteristics, pathology, and performance on Gold standard memory test (CMS) and WISC Perceptual Reasoning Index.

Behavioural results of healthy adult participants are shown alongside child participants on each stage of lag difficulty on the MMT (Daisyseley et al., 2014; Ryan et al., 2015). Percentage of correct mean scores decrease with task difficulty across both samples, with no significant age-effects found.

Conclusions:

- Behavioural results show good levels of recognition accuracy following visual scene encoding.
- Preliminary analysis with patient data suggests that the Mirror Memory Task could be used to detect visuospatial memory impairment. In patients with epilepsy, this study demonstrates the sensitivity of the MMT to temporal lobe dysfunction and specifically to visuospatial memory deficits associated with right temporal lobe pathology.
- The conclusions drawn suggest that the Mirror Task is a promising predictor of visuospatial memory ability, which has high convergent validity and two levels of difficulty. It further suggests that this paradigm is suitable for determination of right hippocampal recruitment for visual memory.

Further Research:

Extension of this investigation will incorporate fMRI data with behavioural performance on the task to determine the merit of the MMT in maximising BOLD asymmetry to the right by placing a preferential load on spatial memory.