

DAY 1: TALKS

The Efficacy of Neurofeedback Therapy with particular reference to ADHD and Autistic Spectrum Disorders.

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Objectives: To demonstrate the efficacy of Neurofeedback. This is a treatment approach for a range of psychophysiological disorders including ADHD and Autistic Spectrum Disorder. The presentation will include academic research and clinical case studies.

Methods: A description and an overview of the efficacy of neurofeedback, referring to a meta-analysis of neurofeedback feedback treatment for ADHD and also case studies of neurofeedback and Autism. These two specific learning difficulties share a common problem, that of disturbed attention systems. Several treatment protocols, which impact on different neural networks are used and these, with their rationales, will be outlined.

Results: Before and after reviews of treatment using qEEG, IVA, TOVA and parent and school ratings as pre and post assessment measures will be presented. Both within and between subject analyses were undertaken with, in the case of ADHD, the differential effects on inattention, impulsivity and hyperactivity being evaluated. Case studies of ADHD and of Autistic Spectrum Disorder will be presented.

Conclusions: Neurofeedback is an approach which has demonstrable efficacy as a treatment in both ADHD and Autistic Spectrum Disorder. It does not have the adverse side effects of drug treatments and can be effective even when drug treatments no longer work.

Slow wave and REM sleep deprivation effects on explicit and implicit memory during sleep

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Objectives: It is debated whether different stages in the human sleep cycle preferentially mediate the consolidation of explicit and implicit memories, or whether all of the stages in succession are necessary for optimal consolidation. Here we investigated whether the selective deprivation of slow wave sleep (SWS) or rapid eye movement (REM) sleep over an entire night would have a specific effect on consolidation in explicit and implicit memory tasks. We aimed to address the limitations of the commonly used split-night deprivation paradigm, where sleep is fully deprived either early or late in the night, and to identify the specific role of SWS and REM sleep in memory consolidation.

Methods: Participants had one control night of undisturbed sleep and two experimental nights during which either SWS or REM sleep was selectively deprived across the entire night. Polysomnography recordings precisely quantified the amount of SWS and REM sleep that occurred during each of the sleep conditions. On each visit, participants completed a range of explicit and implicit tasks, both before sleep and again the following morning.

Results: Neither SWS nor REM sleep deprivation affected aspects of short-term or working memory, nor measures of verbal implicit memory. However, SWS deprivation disrupted the consolidation of explicit memories for visuospatial information, and both SWS and REM sleep deprivation adversely affected explicit verbal recall.

Conclusions: Our findings demonstrate the importance of measuring the sleep cycles throughout the entire night, and indicate the importance of the cyclical succession of sleep stages on memory consolidation.

Feeling Touch from Seeing Touch in Developmental Synaesthesia: A Hyperactive Tactile Mirror System?

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Objectives: To discover the functional and structural neural correlates of 'mirror touch synaesthesia' in which people report tactile sensations as a result of seeing touch on others.

Methods: We conducted an fMRI study in which participants (synaesthetes, controls) watch movies of stimuli (face, dummy, object) being touched or approached. In addition we examined the structural differences in the brain using VBM and DTI.

Results: Both synaesthetes and controls activated the somatosensory system (primary and secondary somatosensory cortices, SI and SII) when viewing touch, and the same regions were activated (in a separate ROI analysis) when feeling touch – i.e. there is a mirror system for touch. However, SII (but not SI) discriminated between the two groups on a number of measures: it was hyper-active for watching touch to a face in synaesthetes; it correlated with subjective intensity measures (taken outside the scanner), and it was associated with increased grey matter. In addition, the synaesthetes showed hypo-activity when watching touch to a dummy in an adjacent region of SII.

Conclusions: The secondary somatosensory cortex has a key role in this form of synaesthesia, and this fits with a number of models of multi-sensory processing.

DAY 1: POSTER ABSTRACTS

The role of clustering and switching in discriminating patients with Alzheimer's disease from patients with Sub-cortical Vascular Dementia.

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Objectives: Verbal fluency tasks are commonly used in the assessment of patients with known or suspected dementia. Several authors proposed that a good way for discriminating between patients affected by cortical or sub-cortical dementia is to analyze clustering (i.e. the production of words within semantic or phonemic subcategories) and switching (i.e. the ability of shifting between clusters). The aim of this study is to assess whether these two scores discriminate patients with Alzheimer's disease (AD) from patients with sub-cortical vascular dementia (SVD) and healthy subjects.

Methods: We administered semantic and phonemic verbal fluency tasks to 31 AD patients, 30 SVD patients and 30 healthy subjects and calculated switching and clustering scores for both.

Results: Analysis of variance confirmed a result that has been well documented in literature: AD patients are more impaired in the semantic fluency task, while SVD patients are more impaired in the phonemic fluency task. As regards the switching scores, SVD patients switched less frequently than AD patients and healthy subjects in the phonemic fluency task. However both AD and SVD patients made less switches in the semantic verbal fluency task comparing to healthy subjects. On the other hand, AD patients produced smaller clusters than healthy subjects in the semantic verbal fluency task. No significant differences were found in the cluster size in the phonemic verbal fluency task.

Conclusion: The findings suggest that the total verbal fluency scores, the phonemic switching score and the semantic cluster size are the best indices for discriminating AD patients from SVD patients.

Improving 7-day memory via a brief wakeful rest

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Objectives: A short period of wakeful resting after new learning enhances memory over several minutes. It remains to be established whether or not this memory enhancement extends over the longer-term. The purpose of the present investigation was to examine the effect of a post-learning 10 minute period of wakeful resting on story retention over a long (7 day) delay, and to gain insight into the mechanism underlying memory enhancement via minimal interference.

Methods: 33 participants were presented with two stories. One story was followed by a 10-minute period of wakeful resting; the other story was followed by a 10-minute period of spot the difference games. Participants were asked to recall the stories after a short delay (15-30 minutes) and after a long delay (7 days). The design was within subjects.

Results: Participants remembered significantly more prose details over the short-term and the long-term delay under conditions of post-learning wakeful resting. This effect remained even when participants did not retrieve the material following the short delay. Post-learning wakeful resting has a long-lived memory benefit.

Conclusions: We hypothesize that a short period of wakeful resting after new learning allows for superior consolidation by causing an increase in offline reactivations/replay of memory traces, and that this effect is maintained over later consolidation stages.

The role of personality variables on memory source monitoring

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Objective: Source monitoring is the ability to identify the original source of information retrieved from memory, which is often a critical aspect of remembering (Johnson et. al 1993).

Observing performing an action can induce false memories of having actually performed it: this effect is called *observation inflation* (Lindner et al. 2010).

The aim of this study was to assess whether individual traits of personality may influence subjects' performance in a source monitoring task.

Methods: Personality traits have been evaluated administering Personality Style Questionnaire (Picardi et al., 2003). Participants were divided into two groups: *inward* personalities (i.e. more body perception bounded) and *outward* personalities (i.e. more externally anchored) (Arciero & Bondolfi et al., 2009). Subjects observed actions, some of which they had not performed earlier, and took a source memory test after one week. We evaluated the percentage of occurrence of the observation inflation effect and of the incorrect responses coded as "not performed" action after the observation of the experimenter.

Results: We found that the observation inflation effect occurs in both groups without significant statistical difference between groups. Moreover, a higher percentage of incorrect responses coded as "not performed" actions was obtained by *outward* subjects.

Conclusions: The higher proportion of incorrect responses in outward subjects can be explained by the fact that they are more focused on an externally anchored coordinate system, with a weak awareness of their body. In addition, this preliminary study shows that personality traits and cognitive performance are interrelated domains in source monitoring processes.

Effects of different prefrontal cortex lesions on fluid intelligence

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Objectives: Two contrasting positions have been put forward regarding the organisation of the prefrontal cortices (PFC) functions. One position suggests that the PFC implements a unitary process whereby multiple demand units on the lateral and medial PFC play a key role in operations that depend on fluid general intelligence (g) (Duncan, 2010). A contrasting proposal suggests that intelligence can be fractionated into separate processing components (Shallice et al., 2008). The Raven's Advanced Progressive Matrices (RAPM), is a test tapping fluid intelligence, widely used in clinical practice. Evidence on the effects of PFC lesions on this test is rather scarce. Here we investigated whether lesions located in different parts of the PFC may differentially impact performance on RAPM.

Method: 81 frontal patients divided into 4 subgroups according to their PFC lesions (Stuss et al., 2002), and 82 healthy controls (HC) were administered the RAPM and general background neuropsychological tests.

Results: The Medial, Left lateral and Right lateral frontal subgroups showed a significant impaired performance on the RAPM. Interestingly, there were no significant differences between the Orbital patients and HC on the RAPM. No significant differences were found between frontal patients and HC on measures of premorbid, perceptual and nominal functions. However, frontal patients were significantly impaired on the 'executive' tests.

Conclusions: Our findings suggest that the lateral and medial PFC regions are involved in fluid intelligence. This is compatible with both positions on the organisation of function in PFC.

Limbic modulation of movement speed: Paradoxical movement in a shock avoidance task in Parkinson's disease and healthy controls

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Objectives: Paradoxical movement (PM) occurs when people with Parkinson's disease (PwPDs) temporarily overcome bradykinesia to move at near-normal speeds when facing danger. Enhanced motivation may contribute to PM and external stimuli may also play a role. We investigated the effects of motivation to avoid shock on movement speed in a self-initiated (SI) versus externally triggered (ET) task in PwPDs and healthy controls.

Methods: 14 PwPDs and 16 age-matched controls performed a button press task. Movements were self-initiated or externally-triggered. In half the trials, a precue warned that there could be a shock if movements were slow (criterion set individually set using a staircase procedure).

Results: Both PwPDs and controls moved 8-14% faster in potential shock trials. PwPDs moved 5-6% faster in SI than ET tasks, but there was no difference for controls. Controls moved faster than PwPDs in the ET condition, but not the SI condition, and in both shock conditions.

Conclusion: When motivation was induced to move faster to avoid shock, paradoxical movement occurred in both PwPDs and controls. This occurred in both SI and ET conditions,

suggesting that external stimuli may not be necessary for PM in conditions of strong motivation. Unusually, PwPDs moved faster in the SI than ET condition, which may have been due to the presence of the precue which informed them about the potential of shock. The results provide empirical evidence for limbic modulation of movement speed in health and disease.

Positive changes in mood after switching on deep brain stimulation of the subthalamic nucleus in Parkinson's disease

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Objectives: Deep brain stimulation of the subthalamic nucleus is an effective treatment for the motor symptoms of Parkinson's disease. While a range of psychiatric and behavioural problems have been documented following deep brain stimulation, the acute effects of subthalamic nucleus stimulation on patients' moods has only been investigated in a few studies. Our aim was to compare self-reported mood in Parkinson's patients with subthalamic nucleus (STN) deep brain stimulation (DBS) ON and OFF.

Methods: 23 Parkinson's patients with bilateral deep brain stimulation of the subthalamic nucleus and 11 unoperated Parkinson's patients completed an established mood visual analogue scale twice. Operated patients completed the mood scale with DBS of the STN ON or OFF. All patients were assessed on medication.

Results: The operated Parkinson's group reported feeling significantly better co-ordinated, stronger and more contented with STN DBS ON compared to OFF. There was no change between the two sets of ratings for the Parkinson's control group. Compared to DBS OFF, 14/16 mood scales completed changed in a positive direction when DBS of the STN was ON. The operated patients also reported significantly less effort when completing a battery of cognitive tests with DBS ON than OFF, but no change in physical or mental fatigue. Parkinson's control group showed no changes on these measures.

Conclusions: Acute changes in DBS of the STN have a small but generally positive effect on mood. The implications of these results for day-to-day management of patients with deep brain stimulation of the subthalamic nucleus are discussed.

Imitative ability in adults with Autism: evidence for intact visuomotor and visuospatial aspects of imitation

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Objectives: The integrity of imitative ability in Autism Spectrum Disorders (ASD) has been debated extensively (Williams et al, 2004). However the locus of proposed deficits (motor, visuospatial or social difficulties) is unclear. Whilst controlling for motor and visuospatial factors, we aimed to assess imitative ability using a novel computerised task.

Method: Ten adults with ASD and 17 neurotypicals completed preliminary motor tests and the imitation task. In the imitation task participants were shown frontal-views of an actor drawing on a digitising tablet, or a dot moving across its surface. Participants were instructed to copy the size, shape and speed of the actor or the dot's movements on a second tablet. The dot condition controls for the visuospatial demands of transforming an observed motion path into egocentric coordinates.

Results: Preliminary tests highlighted gross motor deficits in the ASD group, but normal coordination in visuomotor tasks performed with a stylus on the digitising tablet. When comparing the produced movement to the stimulus movement, including the fidelity of the visuospatial transformation, we found no effect of group or imitation condition (actor or dot).

Conclusions: These findings suggest that visuomotor and spatial transformation aspects of imitation are intact in adults with ASD. Since previously reported imitation deficits have often been in younger groups, our data may suggest that such problems are typically resolved by adulthood. Alternatively, previously reported deficits may reflect a reluctance to imitate in social situations, which was overcome by the computer-based nature of our task, and the explicit imitation instructions provided.

DAY 2: TALKS

The Neural Network Supporting Semantic Representation and Control: An fMRI Study of Concrete and Abstract Word Comprehension

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Objectives: Verbal comprehension depends on representations of word meanings and on executive processes that regulate access to this knowledge in a task-appropriate manner. Neuropsychological studies indicate that these two elements depend on different brain regions and can be impaired independently. We investigated the neural basis for these functions using fMRI, focusing in particular on differences between concrete and abstract words. Concrete and abstract words differ in the types of information that contribute to their representation (sensory vs. linguistic/emotional) and in the demands they place on executive control processes. Specifically, abstract words require more control because their meanings vary depending on context.

Methods: 20 healthy subjects underwent fMRI while completing a synonym-matching comprehension task with concrete and abstract words. Executive demands were manipulated by sometimes preceding the comprehension judgement with a sentence that placed the target word in a particular context. This cue aided comprehension by reducing the executive demands of selecting the context-appropriate meaning.

Results: Behavioural results indicated that context benefited abstract words more than concrete. A network of regions were involved in the comprehension task, including inferior frontal gyrus, angular gyrus, posterior middle temporal gyrus, and superior and ventral areas within the anterior temporal lobe. Response to the concreteness and cueing manipulations varied, with frontal areas activating more strongly when no cue was present and anterior temporal regions showing greater activation when a cue was provided.

Conclusions: The results reveal areas of the semantic network implicated in representation vs. control, and how these functions differentially support abstract and concrete words.

Charting the effects of TMS with fMRI: Changes in cortical recruitment and connectivity within the semantic control network

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Objectives: Semantic memory comprises everything we know about words, objects, pictures and faces. However, in any given task or context, not every aspect of our knowledge is retrieved; instead, semantic activation is shaped such that it becomes appropriate for the situation we are in (e.g., relevant features of concepts are selected, while others are inhibited). These control processes are vital for successful semantic cognition, yet the large-scale neural network underpinning this function is not well-understood. The current study used a combination of TMS and fMRI to assess dynamic changes within the semantic control network.

Methods: We temporarily disrupted processing within a key semantic control region, left inferior frontal gyrus (LIFG), via repetitive brain stimulation (TMS). We then used fMRI to measure the effect on neural activity in other putative components of the semantic control network.

Results: Additional activation was seen in a second component, posterior middle temporal gyrus (pMTG), compared to a baseline scan with no stimulation, and there was an increase in the coupling between pMTG and frontal brain areas. These changes were restricted to situations where the demand on the semantic control network was high.

Conclusions: Our results demonstrate the power of studies that combine TMS and fMRI to investigate effective connectivity within large-scale neural networks and reveal that LIFG and pMTG are both components of a distributed cortical system underpinning semantic control.

Direct evidence for the crucial role of the ventral anterior temporal region in semantic processing

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Objectives. Recently, an increasing number of neuropsychological and neuroimaging studies have implicated the ventral part of the ATL as potentially crucial in pan-modal, semantic processing. The purpose of this study was to investigate the nature and necessity of this region in semantic processing directly with combined cortical-surface ERP and electrode-stimulation. Specifically, we investigated the functioning of this area in a patient with late-onset epilepsy consequent upon a frontotemporal dysplasia, whose semantic performance appeared to be normal.

Methods. Grid electrodes were implanted on the surface of the left frontal and temporal lobes and were used to measure the cortical ERPs associated with naming pictures. In addition to assessing the impact of cortical stimulation on semantic processing across different modalities (for neurosurgical work-up), we also undertook a systematic assessment of the vATL in comprehension and naming. High frequency stimulation [4 levels of intensity: sham (0mA), 3mA, 6mA, and 9mA] was delivered to the grid at the vATL electrode-pair whilst picture naming and written-word to picture matching were tested.

Results. The clinical stimulation investigation indicated that, as expected, the vATL region was involved in pan-modality, semantic processing. Cortical ERP during naming were observed on the vATL, maximally in the left anterior fusiform. When exactly the same area was stimulated (6mA, 9mA), responses were slower and less accurate in both naming and matching.

Conclusions. The vATL is crucial for pan-modal semantic processing, both in expressive and receptive tasks.

Interfering with category specific visual impairment: a single case study of retraining

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Objectives We describe our investigations of PHD, a patient with category specific visual agnosia that affects his recognition of animals more than objects. We wished to ascertain whether there was any evidence for implicit representation of stimuli that he failed to recognise.

Methods. The techniques borrowed from the Prosopagnosia literature and employed a true-false name learning procedure. Pairs of semantically confusable stimuli were determined. In year 1, PHD learned valid names for one subgroup of stimuli and semantically related invalid names for the remaining items. In year two the procedure was reversed (i.e., with the previously “valid” items being taught invalid names). He was also tested for generalisation by asking him to name new exemplars.

Results. PHD showed a significant advantage for valid name learning on both occasions. There was also apparent evidence of priming with “intrusions” of the valid name being produced during the invalid trials. However, there was no evidence of name generalisation when PHD was confronted with new stimulus exemplars.

Conclusions. Although the valid name advantage appears consistent with the preservation of implicit knowledge, we shall argue that the absence of generalisation is problematic for this account. The results are consistent with PHD having a degraded representation of visual knowledge that prevents him from generalising verbal labels to novel variants of the “same” item. Category Specificity and Modality Specificity may be orthogonal and the true-false name learning procedure may be more revealing about episodic memory than implicit semantic representation.

SYMPOSIUM: The Organisation of Conceptual Knowledge: A Role for Embodied Cognition?

The last decade has seen a growing awareness that conceptual knowledge is not purely abstract in nature but is grounded in the sensory and motor processes used to acquire or implement that knowledge – so-called ‘embodied cognition’. However, the extent to which sensory-motor processes are a central hub of conceptual knowledge or are activated ‘downstream’ of core conceptual knowledge remains hotly debated. The intellectual foundations of this approach stem, in part, from the earlier sensory-functional account of semantic memory proposed by Warrington, Shallice and others based on behavioural dissociations amongst patients. However, the motivation for the newer sensory-motor theories of semantics tends to derive from data concerning the neuroanatomical substrates of conceptual knowledge. In this symposium, experts will discuss the current state-of-the-art in the conceptual knowledge of actions, numbers, abstract words and other concepts using evidence from neuropsychology and other methods.

Numerical Cognition: Grounded, embodied and situated

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Abstract: The traditional symbol manipulation approach to cognition gives way to an embodied stance. This change of perspective even holds for numerical cognition, a stronghold of the traditional view. In this presentation I will outline a hierarchical proposal for grounded, embodied and situated numerical cognition. Examples from the recent literature will illustrate how this approach might yield novel predictions.

DAY 2: POSTER ABSTRACTS

Early and sustained contributions to phonology by the supramarginal gyrus

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Objectives. Reading is a surprisingly difficult task that requires recognizing a visual stimulus and linking it with its corresponding sound and meaning. Neurologically, this involves an anatomically distributed set of brain regions cooperating to solve the problem. It has been hypothesized that the supramarginal gyrus (SMG) contributes preferentially to phonological aspects of word processing and thus plays an important role in visual word recognition. The functional specificity and timing of SMG involvement in reading were investigated in this experiment using transcranial magnetic stimulation (TMS).

Methods. Double pulses of TMS, delivered 40 msec apart, were used to temporarily interfere with neural information processing in the left SMG at five different time windows (i.e. at 40/80; 80/120; 120/160; 160/200; 200/240 msec post-stimulus onset). Subjects performed two reading tasks which focused their attention on either the phonological or semantic relation between two simultaneously presented words. A visual matching task served as a control condition.

Results. Stimulation at 80/120, 120/160 and 160/200 msec after stimulus onset significantly slowed subjects' reaction times in the phonological task. This inhibitory effect was specific to the phonological condition - there was no effect of TMS in the semantic nor in the visual tasks.

Conclusions. The results are consistent with claims that SMG contributes preferentially to phonological aspects of word processing. The fact that the effect began within 80–120 msec of the onset of the stimulus and continued for approximately 100 msec, indicates that phonological processing initiates early and is sustained over time. These findings are consistent with accounts of visual word recognition that posit parallel activation of orthographic, phonological and semantic information that interact over time to settle into a distributed, but stable, representation of a word.

Frontotemporal network for resolving semantic ambiguities during speech comprehension

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Objectives. Because words often have many meanings, sentence comprehension frequently involves resolving semantic ambiguities where multiple interpretations are possible. Previous work has highlighted the importance of two left hemisphere brain regions, the inferior frontal gyrus and posterior infero-temporal areas. There is, however, inconsistency regarding the specific anatomical fields involved and whether they are consistently engaged across individuals. Here, we used fMRI to investigate neural responses to a new set of well-matched ambiguous and unambiguous sentences and to address these questions.

Methods. 20 native British English monolinguals were scanned whilst listening to ambiguous and unambiguous sentences and signal-correlated noise (baseline condition). Their task was to listen carefully to the meaning of each sentence and make relatedness decisions to the visual word that appeared after the sentence on occasional catch trials.

Results. Greater signal for ambiguous than unambiguous sentences was seen in two left-hemisphere clusters. One was centred in pars triangularis with activation extending primarily in the posterior direction to the precentral gyrus while the other was centred in posterior occipito-temporal sulcus with activation extending both laterally to ITG and ventrally to fusiform gyrus. All subjects (except one) showed ambiguity-related activity within 11mm of the group peak of both clusters.

Conclusions. These findings highlight the role of inferior frontal and posterior inferior temporal regions for understanding ambiguous sentences. The consistency across subjects of these regions' involvement in ambiguity processing emphasises the importance of including them in neurocognitive models of language comprehension.

Semantic word category processing in degenerative brain disease

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Objectives: There is general agreement that perisylvian language cortex and some adjacent extrasylvian regions play a major role in lexical and semantic processing; but the role of additional, more widespread, brain areas in the semantic processing of different word categories remains controversial. We investigated word processing in two groups of patients whose neurodegenerative diseases preferentially affect specific parts of the brain to determine whether their performance would vary as a function of semantic categories proposed to recruit those brain regions.

Methods: Cohorts with (i) Semantic Dementia (SD), who have anterior temporal-lobe atrophy, and (ii) Posterior Cortical Atrophy (PCA), who have predominantly occipito-parietal atrophy, performed tests of lexical decision (LD) and immediate and delayed serial recall (ISR, DSR), on words from five different semantic categories: colour (e.g., *crimson*), form (*rectangle*), number (*thirteen*), spatial prepositions (*between*) and function words (*moreover*). For LD, sets of pseudo-word foils matched the target words in length and bi-/tri-gram frequency. There was good word-frequency matching between the two visual word categories (colour and form) and across the three other categories (number, prepositions, function words). Age-matched healthy individuals served as controls.

Results: In LD, SD patients were significantly impaired relative to controls for all 5 categories, but had poorest performance on the colour words, and colour was the only category for which they were significantly impaired relative to the PCA group. Conversely, colour was the only LD category for which PCA cases did not differ from controls, and their worst performance was for spatial prepositions. In ISR, the SD patients were reliably impaired relative to controls only on words from the colour category, and they were just significantly *better* than controls on the number words. For DSR, the SD cases were impaired relative to controls on both colour and form words, which can be attributed to word frequency; but their performance approached a significant impairment relative to the PCA group only on colour words. ISR performance in the PCA cases did not differ significantly from controls for any category, but in DSR, a mild deficit on spatial prepositions approached significance.

Conclusions: The patterns of performance on two different word-processing tasks as a function of semantic category (a) demonstrate the essential role of word meaning in 'non-semantic' tasks like lexical decision and serial recall, and (b) suggest that specific extra-sylvian regions of the brain are pertinent to the processing of different semantic categories of words.

The Role of Premotor Cortex in Speech Perception

Katya Krieger-Redwood, Shane Lindsay, Gareth Gaskell, Beth Jefferies

Objectives: This study sought to elucidate the role of the premotor cortex (PMC) in the perception of spoken language, using TMS. Given the debate in the literature over the necessity of the PMC in the perception of spoken language, the use of rTMS is used to establish whether the PMC is necessary for semantic understanding of spoken language *as well as* explicit phoneme judgment tasks, which has previously been demonstrated (Meister et al., 2007; Mottonen & Watkins, 2009).

Methods: The current study used rTMS (10 minutes, 1 Hz, 60% of motor threshold) to three sites, the PMC, posterior superior temporal gyrus (pSTG) and occipital pole (OP), to modify performance on two tasks, involving phoneme and semantic judgments (n=15).

Results: TMS modified performance in the PMC for phonological judgments but not for semantic judgments and disrupted performance was seen in the phonological and the semantic task for TMS to pSTG; additionally, TMS to OP, an irrelevant control site, had no effect on performance across tasks.

Conclusions: These results confirm previous research that PMC is recruited in explicit phonological judgments, while adding to this literature by crucially showing that PMC is not essential for mapping to meaning. This reflects the neuropsychological literature where some studies have demonstrated a dissociation between word comprehension and explicit phoneme discrimination tasks (Blumstein et al. 1977; Miceli et al., 1980). The pSTG results demonstrate that semantic decisions can be slowed by TMS, while OP confirms that the TMS effects are site specific (TMS did not affect task performance on).

The Advantage Of Sentence-Action and Action-Sentence Compatibility

Marika De Scalzi, Jennifer Rusted, Jane Oakhill

Objectives. It has been shown that when participants are asked to make sensibility judgments on sentences that describe a transfer of an object toward or away from their body, they are faster to respond when the response requires a movement in the same direction as the transfer described in the sentence. This is the Action-Sentence Compatibility Effect (ACE). This study aimed to investigate first whether the ACE could be replicated in volunteers with probable dementia of Alzheimer's Type (pDAT), and second whether the ACE is bi-directional (can a movement toward or away from the participants' body prime comprehension of transfer sentences?).

Methods. In Experiment 1, young, older, and pDAT participants were tested on an adaptation of the Sentence Sensibility ACE Paradigm. In Experiment 2, the same paradigm included an arm movement that participants had to perform in order to see a sentence appearing on screen.

Results. All groups were faster to respond when the direction of the response movement matched the directionality implied by the sentence. In Experiment 2, participants were faster when the direction of the movement preceding the sentence matched the directionality of the sentence.

Conclusions. Results suggested preservation of the neural systems for action engaged during language comprehension in pDAT. They also suggested that the ACE is bi-directional, as understanding transfer sentences assisted motoric performance, and *vice versa*. Conditions under which comprehension in pDAT can be facilitated in real life or clinical settings may be identified.

Contributions of Motor and Theory-of-Mind Systems to Language Understanding

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Research from the past decade has shown that language comprehension and action share a common neural substrate. However, it is unclear at what level during language comprehension the neural motor system becomes important. While some claim a direct association between to the word-form, others have argued for a linkage at a conceptual level.

Objectives. The aim of the present study was to investigate a) whether the neural motor system is sensitive to semantic action knowledge beyond the word-form level and b) whether this involves additional communicative processes like a theory of mind.

Methods. Subjects listened to implied requests for action while during an fMRI scanning session. Implied requests are speech acts in which access to an action-concept takes place although it is not explicitly encoded in the language. For example, the utterance “It is hot here!” in a room with a window is likely to be interpreted as a request to open the window. However, the same utterance in a desert will be interpreted as a statement.

Results. Regions in the medial SFG and the IPL were sensitive to both action execution and implied requests. Also, regions in the mPFC and left-lateralized TPJ, which constitute part of the classical theory of mind network showed sensitivity to implicated requests.

Conclusions. The current findings suggest that language and action share a common neural substrate at a conceptual level beyond the lexical word-form. Additionally, the data suggest that the classical theory-of-mind network contributes to language understanding when pragmatic demands are high.