

CONFERENCE ABSTRACTS

Abstracts for Oral Presentations (open papers) – in order of presentation:

Day 1:

Right, but Not the Left Prefrontal Cortex is Necessary for the Suppression of Unwanted Memories

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When confronted with an unwelcome reminder, people often exclude the unwanted memory from awareness, a process that causes forgetting. This suppression-induced forgetting (SIF) can be measured using the Think/No-Think task (TNT) task. Imaging work indicates that suppressing retrieval engages the right dorsolateral prefrontal cortex (DLPFC), a region critical for inhibitory control, but no work has examined whether right-DLPFC is necessary for suppression. We adapted the TNT task for patients with frontal lesions (n=46). Strikingly, whereas patients with left-PFC lesions showed robust SIF, those with right-PFC lesions showed none, and this interaction was significant. These findings highlight the necessary and selective role of right DLPFC in enabling inhibitory control over memory, and support the broader role of right-PFC in inhibitory control.

Semantic and episodic memory: shared mechanisms support controlled retrieval of representations. Evidence from neuropsychology

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Semantic cognition is known to be supported by two interactive components: semantic representations (semantic memory) and mechanisms that regulate retrieval (cf. 'semantic control'). Long-standing neuropsychological studies have revealed a clear dissociation between semantic and episodic memory. This study explores if the same dissociation holds for control processes that act on episodic and semantic memory, or whether both types of long-term memory are supported by the same executive mechanisms. We addressed this question in a case-series of chronic post-stroke semantic aphasic patients who had difficulty retrieving both verbal and non-verbal conceptual information in an appropriate fashion following lesions of left inferior frontal gyrus (LIFG). We observed parallel deficits in semantic and episodic memory: (i) the patients' difficulties extended beyond verbal materials to include picture tasks in both domains; (ii) both types of retrieval benefitted from cues designed to reduce the need for internal constraint; (iii) there was little impairment of both semantic and episodic tasks when control demands were minimised; (iv) there were similar effects of distractors across tasks. Episodic retrieval was highly susceptible to false memories elicited by semantically-related distractors, and confidence was inappropriately high in these circumstances. Semantic judgements were also prone to contamination from recent events. These findings demonstrate that patients with deregulated semantic cognition have comparable deficits in episodic retrieval. The results are consistent with a role for LIFG in resolving competition

within both episodic and semantic memory, and also in biasing cognition towards task-relevant memory stores when episodic and semantic representations do not promote the same response.

Neural Correlates of the Representational Richness and Context-Driven Diversity of Word Meaning

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This study used functional neuroimaging to evaluate two accounts of established differences in the neural correlates of semantic processing of concrete and abstract words (e.g., house vs government). The first claims that differences reflect the degree to which the referent concepts are grounded in sensorimotor experience (measured, for example, by the accessibility of associated visual imagery). The second claims that it reflects abstract words having more variable, context-dependent meanings (they are more 'semantically diverse'). We contrasted semantic activations to four sets of words that varied orthogonally in respect to these properties within a full factorial design. The analysis revealed that all words activated a common network of established semantic regions albeit to different degrees. Further, we observed independent effects of both 'imageability' and 'semantic diversity' that suggests that both variables are relevant to the functional organisation of the semantic system.

Mapping Lesion Structure with Behaviour Structure in Stroke Aphasia

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Whilst voxelwise lesion-symptom mapping methodologies were widely used, damage to any given voxel is not random but constrained by the neurovasculature. This results in neural structures to be damaged in a collinear manner. We aimed to uncover the underlying structure of the lesion profile in chronic post-stroke and relate it to language and cognitive impairments. We applied principal component analysis with varimax rotation to 70 T1-weighted images. We identified 17 territories that mapped very closely to sub branches of the middle cerebral artery as identified in angiography studies. Finally, we used these territories and performed stepwise regression to predict behavioural factors scores for phonological, semantic and speech output abilities.

An unusual case of temporal-lobe necrosis: impact on semantic and episodic memory

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The role of the anterior temporal lobes (ATLs) in semantic representation is still much debated. One view is that they serve as a 'hub', providing transmodal representation of general semantic information. Alternative accounts suggest they are specialised for specific knowledge, including unique entities and/or social concepts. We present a highly unusual case of a patient with severe bilateral ATL necrosis following proton-beam therapy for brainstem chordoma. The patient presented with dense anterograde and retrograde amnesia. Performance was impaired on stringent tests of general semantic knowledge, but most striking deficits were for unique entities and social concepts. This unique case provides compelling evidence that, in addition to their role in general semantic knowledge, the ATLs are critical for knowledge of specific entities and social concepts.

The role of event boundaries in the encoding of naturalistic events

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How is continuous real-life experience transformed into memory for discrete events? Event Segmentation Theory suggests that moments of prediction error are interpreted as event boundaries and drive encoding. Using functional magnetic resonance imaging (fMRI), we set out to reveal whether occurrence of event boundaries drives encoding, with a specific focus on the hippocampus. First, using short film clips as memoranda, we found that hippocampal activity time-locked to the offset of events is linked to subsequent memory, potentially reflecting the encoding of a bound representation to long-term memory. Notably, when distinct clips were presented in immediate succession, the hippocampus responded at the offset of each event, suggesting hippocampal activity is triggered the occurrence of event boundaries (transition between events). However, while brief film clips mimic several aspects of real-life, they are still discrete events. To determine whether event boundaries drive hippocampal activity in an ongoing experience, we analysed brain activity of over 200 participants who viewed continuous, naturalistic films in two independent experiments, finding that the hippocampus responded both reliably and specifically to shifts between scenes. Taken together, these results suggest that during encoding of a continuous experience, event boundaries drive hippocampal processing, potentially supporting the transformation of the continuous stream of information into distinct episodic representations.

The MNESIS model: memory systems and their reciprocal relations

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The Memory NEo-Structural Inter-Systemic model (MNESIS; Eustache and Desgranges, *Neuropsychology Review*, 2008) is a macromodel based on neuropsychological data which presents an interactive construction of memory systems and processes. Largely inspired by Tulving's SPI model, MNESIS puts the emphasis on the existence of different memory systems in humans and their reciprocal relations. The more integrative comprehension of brain dynamics offered by neuroimaging has contributed to rethinking the existence of memory systems. Understanding the concept of memory by dividing it into systems at the functional level is still valid, but needs to be considered in the light of brain imaging.

We reinstate the importance of this division in different memory systems and illustrate, with neuroimaging findings, the links that operate between memory systems in response to task demands that constrain the brain dynamics. During a cognitive task, these memory systems interact transiently to rapidly assemble representations and mobilize functions to propose a flexible and adaptive response. We will concentrate on two memory systems, episodic and semantic memory, and how they interact during autobiographical memory and future thinking. This MNESIS global framework may help to get a general representation of human memory and its brain implementation with its specific components which are in constant interaction during cognitive processes.

States of motivation prioritise hippocampal dynamics during learning and consolidation

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An adaptive memory system prioritises salient over less salient information. Several studies have shown how rewards influence learning of specific stimuli, but little is known about how motivational states affect learning and retention. In a series of behavioural and fMRI studies, I will show evidence of how states of high motivation (e.g. via reward or curiosity) prioritises learning and memory consolidation for motivationally relevant and incidental information. During both encoding and post-learning rest periods, we found that the hippocampus plays a critical role in prioritising information learned during states of high motivation. The findings highlight the crucial role of how motivational states modulate learning and consolidation mechanisms.

Day 2

Mobile Technology as Cognitive-Behavioral Aids for Workers with Autism: Results and Practical Applications from a Community-Based Randomized Controlled Trial

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I will discuss results, lessons learned, and practical applications derived from a fifty subject RCT utilizing Apple iPod Touch devices to support workers with autism. This study, which has been published in the Journal of Autism and Developmental Disorders, found that an individualized intervention incorporating reminders, task sequencing supports (including video modelling), text messaging and other applications reduced the need for human job coaching support by 50% for people with autism on their first job trials. I will present case study examples and provide guidance in strategies for implementing the use of mobile technologies as cognitive-behavioral aids for vocational, community, and home-based support.

Subarachnoid Haemorrhage of Unknown Origin: A Mixed-Method Approach and Systematic Review

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Clinical outcomes, cognitive assessment, and neuropsychological evaluation in patients with subarachnoid haemorrhage of unknown origin (SAH-UO) are often interpreted as benign, however, diffuse cognitive deficits have been reported within this cohort. To this end, the present study consists of three distinct yet interlocked projects: 1) A systematic review of cognitive outcomes in SAH-UO; 2) patients treated in the National Centre for Neurosurgery in Ireland at Beaumont Hospital (n=15) were interviewed about their experience, and the data has been analysed using interpretative phenomenological analysis; 3) the same cohort underwent detailed assessments of cognitive function. Results will be presented as a case series, compared to normative data, contextualised by domain-based impairment with considerations for network-based cognitive impairment.

Acute dopamine replacement therapy withdrawal disrupts working memory for facial expression of anger in Parkinson's disease patients

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Previous studies using traditional facial expression recognition tasks have shown that transient withdrawal from Dopamine Replacement Therapy (DRT) in Parkinson's disease (PD) patients impairs the recognition of facial expression of anger while leaving recognition of other expressions intact. To better understand the nature of this deficit, we used a "What-was-where?" working memory (WM) task in PD patients ON/OFF dopaminergic medication. The task allowed us to disentangle participants' performance on different dimensions of WM including identification, binding, precision and speed of recall using facial expression of emotions.

PD patients (N=17) first viewed three identical faces expressing different emotions (happy, neutral, angry) which appeared at random locations. Following a short or long delay, a semantic cue indicated which item needed to be retained in memory. The emotional valence significantly affected recall, with worst performance on most dimensions of WM for angry faces in the OFF session. Happy faces were much better recalled than angry faces. Although there was a main effect of medication, different components of the WM for happy faces were not affected as much by being OFF dopaminergic medication as angry faces.

The findings will be discussed in relation to the functional role of the ventral striatal dopaminergic system which has been shown to be active during both expression and recognition of aggressive emotions such as anger, as well as motivation and reward processing. The results have potentially significant implications for improving PD patients' quality of life and social interaction with others. Future studies might start to better understand the opposing role of dopamine in both anger and happiness.

A reading app to improve ease of reading in posterior cortical atrophy

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Introduction: ReadClear is an application-based aid designed to assist reading in posterior cortical atrophy (PCA), particularly by minimizing the impact of symptoms of visual disorientation, visual crowding and oculomotor apraxia.

Methods: ReadClear was developed with people living with PCA and tested in a randomized, double-blind, placebo-controlled clinical trial (N=19). The main outcome measure was subjective experience of reading.

Results: Global subjective experience of reading was statistically superior after using ReadClear than sham ($p = 0.018$, effect size $d = 0.51$). ReadClear benefits were noted particularly on measures of concentration and enduring fatigue.

Discussion: ReadClear is an assistive technology tool, purpose-designed to provide a practical solution to prolong reading for individuals with PCA and potentially other dementia-related reading impairments.

Plasticity versus chronicity: 40 years stability of perceptual and cognitive impairment after encephalitis

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What is the long-term trajectory of recovery in patients with structural brain damage? The traditional view is that after an initial period, the mature brain has little capacity to repair or reorganize. More recently, it has been suggested that the central nervous system is still plastic but these observations are largely based on normal learning. We report a patient who suffered bilateral ventromedial damage after encephalitis in 1971. He was seen regularly in the eighties, and we recently re-assessed his colour processing and semantic memory deficits. His impairments have remained unchanged for more than 40 years. We suggest cautiousness when extrapolating the concept of brain plasticity, as observed during normal learning, to plasticity in the context of structural brain damage.

Neuropsychological Assessment of Dementia: more than just test scores

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Neuropsychological tests with robust psychometric properties provide the cornerstone of cognitive assessment. Appropriate normative data are essential. Nevertheless, test scores in isolation have the potential to mislead. This is particularly so in the assessment of dementia. Patients have a combination of interacting cognitive difficulties and test failures may arise for reasons that have little to do with the cognitive function supposedly being assessed.

In this talk I argue that whilst traditional neuropsychological tests may indeed be sensitive to the functions that they are designed to address, no test has absolute specificity. I show, through illustrations from patients, the importance of i) qualitative evaluation and ii) neuropsychological profiling across cognitive domains in the interpretation of test performance. Neuropsychological assessment is more than a set of test scores.

Abstracts for Poster Presentations (open papers) – in alphabetical order:

Day 1:

Aberrant hippocampal resting-state functional connectivity explains amnesia following limbic encephalitis

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Hippocampal amnesia has shed ample light on the neuroanatomical foundations of episodic memory. Limbic encephalitis may provide a human model of hippocampal amnesia. We predicted that disruptions in hippocampal functional connectivity occur after hippocampal damage, and that these may offer a better explanation of amnesia following limbic encephalitis. Compared against healthy controls (n=67), patients (n=35) showed hippocampal atrophy that was focal within the medial temporal lobe (MTL). Nevertheless, patients' memory scores only correlated with their reduced inter-hippocampal resting-state functional connectivity. Our results highlight the explanatory capacity of functional connectivity vis-à-vis MTL volumes in amnesia. Functional disturbance at rest may thus clarify inconsistencies in the hippocampal amnesia literature.

Cerebellar structural and functional abnormalities in hippocampal atrophy due to limbic encephalitis

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Cerebellar contributions to cognitive function have attracted attention in the last few decades. Nevertheless, whether the cerebellum plays a role in episodic memory remains unknown. We assessed cerebellar structure and function in relation to hippocampal atrophy and amnesia due to limbic encephalitis. Compared to healthy controls (n=67), patients (n=35) showed reduced volume in HVIIa Crus I, confined within a default-mode network region. This region's volume reduction correlated with hippocampal atrophy and predicted episodic memory (Doors and People) in patients, unlike hippocampal volumes. Patients also showed reduced functional differentiation between default-mode and somatomotor cerebellar networks. The strength of this differentiation predicted recall memory scores. Abnormalities beyond the MTL may result from hippocampal atrophy and may explain amnesia, rather than hippocampal volumes.

The contribution of the left angular gyrus in combinatorial processes during narrative reading

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We used functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS) to pinpoint the role of the left angular gyrus (AG) for combinatorial processes during a narrative reading task. fMRI revealed that the AG was sensitive to integration processes, irrespective of the semantic content of the information to be integrated. Hence, we hypothesized that the AG might support integration of episodic details of the narrative (who, what, and where information). Online TMS was delivered over the AG during the narrative reading task followed by a memory task. AG stimulation improved performance for both integration and recollection of episodic details

presented in the narrative. These results suggest a causal link between AG and successful processing of episodic information during narrative reading.

The Interplay of Episodic and Semantic Memory in Stroke Aphasia

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Semantic Aphasia (SA) patients show relatively intact semantic knowledge, alongside disrupted semantic-executive mechanisms. They show an overreliance on automatically activated items, alongside difficulties controlling and guiding retrieval to be context/task appropriate. This study examined the influence of strong, pre-existing knowledge on the formation of new episodic memories. Participants were shown familiar/unfamiliar nursery rhymes and asked to recognise what they had seen amongst distractors. In relation to controls, patients showed an overreliance on pre-existing memory, where familiar rhymes were recalled significantly more accurately. They were significantly worse with stronger distractors, and showed little consistency across conditions at an item-by-item level. This supports the hypothesis that executive-semantic deficits may impact on domains beyond semantic cognition, such as episodic memory.

Autobiographically Significant Concepts within Older and Younger Adults

Rachel J. Lambert¹, Michael Hornberger, Louis Renault¹

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Previous investigations in Autobiographically Significant Concepts (ASC) have shown that when general semantic concepts, such as famous names, become associated with a personal episodic memory, these concepts evolve and become more episodic in nature resulting in superior recognition memory. This study furthers this research by investigating ASC in older (65-85 years) and younger (18-35 years) adults, and determining the impact of the following variables on AS enhancement: time of memory, associated factual knowledge, familiarity of the concept and emotional salience. Early analyses revealed that participants had faster reaction times and higher accuracy for famous faces associated with a personal memory. These faces were also associated with higher familiarity, emotional response and factual knowledge.

Recollection and familiarity following limbic encephalitis: a case study

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SA is a 54-year-old maths teacher who presented with partial retrograde memory loss and everyday recognition memory failures following limbic encephalitis. Standard neuropsychological assessment failed to capture significant memory impairments despite subjective complaints. We were therefore motivated to explore the relationship between objective and subjective judgements associated with memory in an experimental paradigm. The inclusion/exclusion task was administered to SA and controls to estimate the contributions of recollection (R) and familiarity (F) to recognition memory using the process dissociation procedure, and subjective judgements of R and F were also collected for all endorsed items. The pattern of SA's performance is discussed with reference to potentially separable components of recollection as a result of brain injury.

Allocentric spatial memory performance predicts intrusive memory severity in posttraumatic stress disorder

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Posttraumatic stress disorder (PTSD) is characterized by distressing trauma-related memories. According to dual representation accounts, intrusive memories arise from poor hippocampal-dependent contextual encoding and amygdala-mediated up-regulation of sensory representations during the traumatic event. While sensory representations are assumed to rely on egocentric encoding of the scene, contextual representations require additional allocentric processing. T1-weighted images of 33 PTSD patients were acquired to assess relationships between structures within the ventral visual stream and intrusive memories. We also tested whether allocentric spatial memory is associated with intrusive memories. Initial regression analyses revealed that allocentric spatial memory was negatively correlated with intrusive memory severity. Clinical implications of our findings suggest that enhanced allocentric processing of the traumatic memory could attenuate intrusive symptoms in PTSD.

Feature-weighted retrieval of memories with affective content

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Empathy is the process by which we become aware of the emotional states of others. Episodic memory is thought to play a vital role in empathic processing, yet research into this remains sparse. The present study investigated if levels of dispositional empathy mediated memory of emotional and non-emotional items from narratives with either a positive, negative or neutral outcome for the protagonist. Results show that high empathy individuals remembered significantly more emotional details, especially from narratives with a positive valence. Additionally, those scoring high for psychopathy, narcissism and Machiavellianism, all of which are associated with empathy deficits, remembered more non-emotional details. Taken together, these findings shed light on contribution made by episodic memory and emotion to empathic processing.

Overnight memory consolidation of foreign language vocabularies in children

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Aim: Current literature suggests sleep helps children learn new words and nonsense syllables. However, the effect of sleep on their ability to learn words in a foreign language is under-researched. This study aims to address this topic.

Methodology: Using a customised Ipad game, English-speaking children learned animal names in Finnish and were tested on recognition (N = 19) and recall (N = 12), before and after 12 hours of sleep and wakefulness, in a within-subjects design.

Results: Recall improved significantly after sleep [$n_p^2 = 0.314$]. Recognition did not [$n_p^2 = 0.006$].

Discussion: Learning occurred overnight, possibly attributable to the neocortical-hippocampal dialogue that occurs during sleep. The methodology used could provide a novel way of measuring clinical outcomes for sleep interventions.

Day 2

The downsized hand in Personal Neglect

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Personal neglect (PN) has been related to a body representation disorder, with PN patients showing difficulties in identifying differences between left and right hands. However, the metric representation of the hands has not been systematically addressed. We conducted two experiments looking at the perceived hands' width (Exp. 1) and fingers' length (Exp. 2) of 11 right-brain damaged patients (five with PN) and a group of healthy controls. Exp. 1 showed that PN patients perceived their left hand significantly smaller than their right hand whilst right hand was equally distorted in both patients' groups. In Exp. 2, PN patients showed a significantly larger underestimation of fingers' length for both hands. These findings provide further insight into the underlying mechanisms of PN.

Behavioural comparison of primary progressive aphasia and post-stroke aphasia using principal components analysis

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Language impairments caused by stroke (post-stroke aphasia (PSA)) and neurodegeneration (primary progressive aphasia (PPA)) have overlapping symptomatology and nomenclature, yet there have been few direct comparisons between them. The aim of this study was to compare linguistic and cognitive impairments in non-selective cohorts of PSA and PPA. We applied principal components analysis (PCA) to explore the underlying structure of the variance in behavioural scores. Similar phonological, semantic and fluency-related components were extracted from separate PCAs for PSA and PPA. A combined-PCA for all data highlighted varying degrees of overlap within and between PSA and PPA on all extracted components. Less overlap on the fluency component could suggest differences in the application of the fluent/non-fluent scale in PSA and PPA.

Enhancing semantic performance with repetitive transcranial magnetic stimulation over the anterior temporal lobe: frequency- and task- specific effects

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Abstract: Converging evidence indicates that the anterior temporal lobe (ATL) is the transmodal hub for semantic representation. Repetitive transcranial magnetic stimulation (rTMS) investigations utilizing the 'virtual lesion' approach have established the brain-behavioural relationship. However, there has not been much attention that rTMS can be a tentative tool in cognitive enhancement on semantic representation. Here, we tested rTMS protocols to achieve semantic performance enhancement. Our results demonstrated that facilitatory 20Hz rTMS over the ATL produced faster RT in a semantic task, compared to the inhibitory 1Hz rTMS (slower RT) and sham TMS. Our findings suggest that 20Hz rTMS can be a beneficial intervention for semantic enhancements in healthy

individuals and potentially can be used for patients with semantic impairments as a therapeutic tool in cognitive rehabilitation.

The Angela Project: Improving diagnosis of young onset dementia

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The Angela Project is dedicated to Angela, who waited 3 years to receive her diagnosis of dementia; she was 51 years old. Delays and difficulties in diagnosis are frequently reported by people with young onset dementia (YOD) (Luscombe, Brodaty & Freeth, 1998). To better understand how the diagnostic process can be improved for people with YOD, a Delphi method (Dalkey & Helmer, 1963) has been adopted to gather the perspectives of those receiving a diagnosis (people with YOD and their supporters; Delphi-Experience) as well as national and international expert clinicians in YOD (those giving a diagnosis; Delphi-Professional). Findings from these Delphi studies will provide key quality indicators for the diagnostic processes in YOD, and inform policy and best practice guidelines.

Multidimensionality of stroke aphasia extended – more attention to executive functions

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There is increasing interest in the interrelation of language and other cognitive functions in aphasia. However, data on attentional and executive (dys)functions in individuals with stroke aphasia are still scarce. Thus, an extensive selection of standardized neuropsychological tests was administered to 38 individuals with chronic post stroke aphasia. Their scores on these tests, together with their performance in a variety of tests measuring language function, were subjected to a principal component analysis which yielded five independent factors. Language and non-language tests were represented by two factors each, while another factor contained high loadings of language and non-language tests. These results extend our understanding of the multidimensionality of stroke aphasia and emphasize the usefulness of a thorough neuropsychological assessment in this patient group.