Poster Session 2: Memory

45. Treating Phonological Short-Term Memory Impairments with Computer-Assisted Treatment: Results from Seven Cases.

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Introduction
Impairments in verbal short-term memory (VSTM) are common in aphasic individuals. Studies with aphasic participants have provided evidence for the involvement of VSTM in language comprehension (Van der Linden & Poncelet, 1998). Although very rare, rehabilitation studies of phonological short-term memory deficits have yielded encouraging results (Majerus et al., 2005). Here we report exploratory results of a computer-assisted treatment (CAT) designed to improve storage capacity of phonological information in participants with verbal short-term memory deficits. We also examined the relationship between performance on span and sentence comprehension tasks.

Methods
Participants
Seven individuals (aged 19-59) with outstanding phonological short-term memory impairments participated in the study. All had suffered left brain injury and initially presented aphasia. One was recruited from the inpatient service (2 months post-injury) and the remaining six were outpatients (1 month to 8 years post-injury).

Procedure: evaluation and CAT material
Patients were examined at baseline and at post-tests with a selection of four span tasks: forward digit-span, Corsi block-tapping task, number-repetition and pseudoword-repetition. In the number-repetition task, stimuli (n=168) were controlled for syllable length (4 to 17 syllables). In the pseudoword-repetition task stimuli (n=144) were matched for syllable frequency and length. Half of the items of both lists were used for CAT. Three control tasks of oral comprehension were used: Token Test, Oral Text Comprehension, and a task of negative sentences comprehension.
Four patients underwent therapy on both numbers and pseudowords (crossover design); three patients worked on numbers only. Therapy duration was established by a self evaluation of progress by the patients themselves (varied from two to six weeks).
Two specific and interactive computer-assisted therapy programs were developed on alphabetical (CAT-pseudowords) and numerical (CAT-numbers) material. The task consisted of immediate and/or delayed keyboard writing of material presented orally and/or visually.

Results
After CAT-numbers (for the 7 patients) a significant improvement was observed in the number-repetition task, in forward digit-span, and in oral text comprehension (for 3 patients only). Performance on the other tasks remained stable. After CAT-pseudowords, a significant effect was observed in pseudoword-repetition for the 4 patients, and performance remained stable on the other tasks. Without reaching significance (three patients tested only), the performance in the Token Test improved by 11% and 31% for 2 patients.

Conclusions
The present data suggests that CAT for phonological short-term memory impairment is effective and may be material-specific. These results need to be replicated and extended with other participants with phonological short-

term memory deficits.

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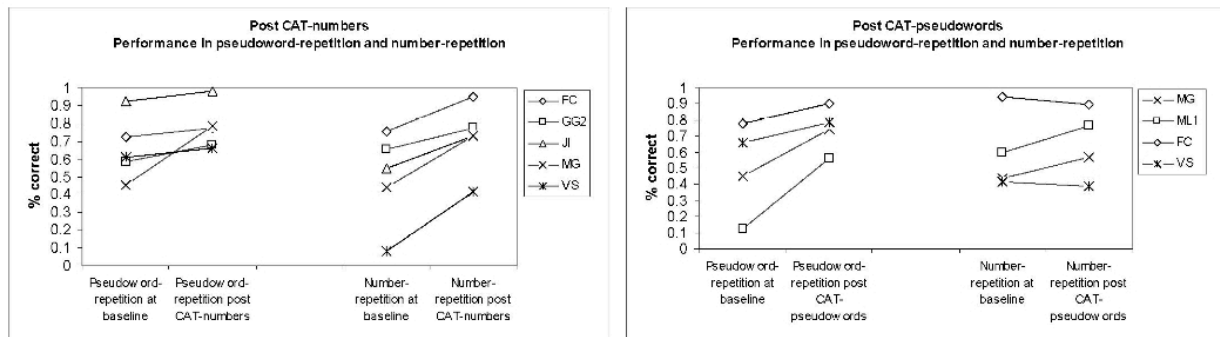
Presented by: **Di Pietro, Marie**

46. Using Item Response Theory to Examine the Effects of Short-Term Memory Demands on Minimal Pair Discrimination

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Recent studies of word processing impairments in aphasia have focused on temporal aspects of language processing. Martin (2006), for example, reported data from a phoneme discrimination task that included a 5-second interval between presentation of two stimuli. For some participants, performance improved after the interval, but for others, it became worse. Directly comparing percent-correct scores in the two conditions is informative, but raises psychometric issues that deserve closer inspection, including the fact that percent correct scores are demonstrably nonlinear. Item response theory (IRT) (Embretson and Reise, 2000) offers a framework in which items from different tests may be calibrated to a common interval scale. The purposes of this study were (1) to evaluate whether phoneme discrimination performance in aphasia demonstrates adequate fit to the 1-parameter logistic (1-PL) model and (2) to evaluate the impact of common interval scaling on the identification of STM effects in individual cases.

We analyzed data from 72 individuals with aphasia on two versions of a 160-item word and nonword minimal-pair phoneme discrimination task (including some data from Martin, 2006). Seventy-one participants were tested with a 1-second unfilled delay between the stimulus words (1-sec UF) and 56 were tested with a 5-second unfilled delay between the words (5-sec UF).

To evaluate the model, we used mean-square item fit statistics. To establish fit criteria, parameter estimates obtained from the data were used to simulate a distribution of fit statistics under the null hypothesis that the data fit the model, and a 95%CI was obtained. For each statistic,

To examine effects of STM demand, person scores were estimated separately for the two conditions. A significantly higher score in the 1-sec UF condition indicates a detrimental effect of the 5-second delay, which can be interpreted

as poor ability to maintain activation of the target. A higher score in the 5-sec UF condition indicates that the 5-second delay benefits performance, suggesting slowed target activation. A cross-plot of the person ability estimates is presented in Figure 1. The estimates correlated at 0.61, >0.99 when disattenuated for measurement error. Model standard errors were used to conduct independent t-tests (α=0.05) between the 1-sec UF and 5-sec UF score estimates for each participant. Eight (14.5%) of these comparisons were significant, with 4 participants scoring lower on the 5-sec UF items and 4 participants scoring higher.

The present analysis has two advantages over direct comparison of percent-correct scores. First, IRT-based scores provide an interval measure of performance change, in addition to a test of statistical significance. Second, the procedure does not require that the same items be given in both delay conditions, provided that the item difficulty estimates have been previously established.

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Presented by: **Hula, William**

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47. Metamemory, Phonological Memory and Word Relearning in People with Aphasia: A Preliminary Investigation

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There are only a few published studies that have examined the relearning abilities of people with aphasia, which are important for the treatment of these individuals given the enormous reorganization ability of the brain. To our knowledge, only one study investigated the phonological aspects of word relearning (Gupta, Martin, Abbs, Schwartz, & Lipinski, 2006). There are no studies, however, that have explored the roles of both metamemory and phonological memory capacity of word relearning in people with aphasia, which are important for learning novel linguistic information. The current study investigated the potential interaction between metamemory (measured by Judgments–of–Learning) and phonological memory (measured by nonword repetition and digit span) in the novel word learning abilities of people with aphasia.

Six people with aphasia and 10 healthy controls were exposed to four different aliens presented in the form of a slide show. Each slide had the picture of an alien with pre-recorded audio narrative describing them. The subjects had a total of five exposures to each of the alien names. The exposure phase was followed by the Judgments–of-Learning (JOL) phase in which subjects had to judge the total number of aliens they would remember from the exposure phase (global JOL ratings), and also the percentage of accuracy with which they would recognize the name of each alien (item-by-item JOL ratings). Following the JOL ratings, all subjects completed a Post-Exposure Recognition for the four alien names. In this phase, the subjects were asked to identify the alien named by the examiner from an array of five aliens (4 from the exposure phase and 1 unexposed alien). This was followed by phonological memory tasks, which included digit span and nonword repetition.

A multivariate analysis of variance revealed that people with aphasia performed poorly when compared to healthy controls on digit span [$F_{(1,14)}$ = 33.8, $p < 0.001$, $\eta2 = 0.019$] and nonword repetition [$F_{(1,14)}$ = 50.237, $p < 0.001$, $\eta2 = 0.782$]. They did not significantly differ on novel word learning [$F_{(1,14)}$ = 0.273, $p > 0.05$, $\eta2 = 0.019$], and metamemory measures which included global absolute predictions [$F_{(1,14)}$ = 0.170, $p > 0.05$, $\eta2 = 0.012$], and item-by-item absolute predictions [$F_{(1,14)}$ = 0.017, $p>0.05$, $\eta2 = 0.019$]. There was also a positive correlation between metamemory measures and nonword repetition among people with aphasia ($p < 0.05$). Overall, the findings here indicate that people with aphasia have some ability to learn novel words. The findings also suggest that people with aphasia have an unimpaired metamemory. Therefore, more efficient learning of novel lexical items can be

improved in aphasics by allocating more time to words that are judged as not well-learned (low JOLs) and less time to words that are judged as well learned (high JOLs). The positive correlation between metamemory and nonword repetition (a measure of phonological memory) indicates a common neural substrate subserving them.

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Presented by: **Ramachandra, Vijayachandra**

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48. Effects of Memory Load and Typicality of Semantic Category on Semantic Processing in Aphasia

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Background
This study explored the hypothesis that impaired performance on semantic tasks in persons with aphasia (PWA) is based on difficulty accessing semantic representations and maintaining their activation in verbal short-term memory (STM) for the period of time required to perform these tasks (Martin, 2005). In a category judgment task, we varied the number of semantic items to be compared, the typicality of category exemplars, and the visual array. We predicted that performance would decline as the number of semantic items to be compared increased and the typicality of category membership decreased.

Method
Fifteen adults with aphasia and 15 age-and educationally-matched controls participated. The task was to determine if two items in a visual array were from the same semantic category. Memory load was tested by varying the number of items to be compared: two, four, or six. The typicality of category membership was also varied in three ways: typical-typical (TT), typical-atypical (TA), and atypical-atypical (AA). There were two stimulus conditions: (1) pictures and (2) spoken with written words. Also, there were two visual array conditions: (1) split screen (two horizontal rows) and (2) circular. Items belonged to one of six categories: animals, vehicles, body parts, clothing, instruments, and fruit. Stimuli were controlled for word length, and frequency.

Results
There were main effects of load for PWA and the control group (f(2,28)=48.40, p<.001; f(2,28)=20.596, p<.001), typicality (f(2,28)=10.079, p<.001; f(2,28)=8.527, p<.05), and picture vs. word presentations (f(1,14)=6.437, p<.05; f(1,14)=5.882, p<.05). Performance was better on 2 than 4-item, and on 4 than 6-item trials for PWA (t(14)=5.596, p<.001; t(14)=6.886, p<.001) and for the control group (t(14)=4.468, p<.001; t(14)=2.882; p<.05). The effect of visual array was not significant for PWA (f(1,14)=3.937, p=.067), or for the control group (f(1,14)=1.777, p=.204). There were no significant interaction effects for the PWA group. The magnitude of difference in performance was significantly greater for PWA than the control group for load conditions (f(2,56)=25.949, p<.001), and approached significance for typicality (f(2,56)=2.265, p=.08). The magnitude of difference in performance between TT and AA conditions was significantly greater for PWA than for controls (t(28)=2.295, p<.05).

Discussion
For persons with and without aphasia, the processes required for semantic judgments are sensitive to: differences in short-term memory load, typicality of semantic category membership, and picture vs. word presentations. The effect that these factors have on semantic processing is more profound, and therefore debilitating, for PWA than for the control group.
The finding that performance was worse on word than picture versions for PWA supports the hypothesis that the nature of semantic impairment in aphasia is not related to the degradation of the semantic or phonological representations themselves, but in accessing and maintaining the activation of these representations.

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Figure 1: Proportion Correct with Increasing STM Load
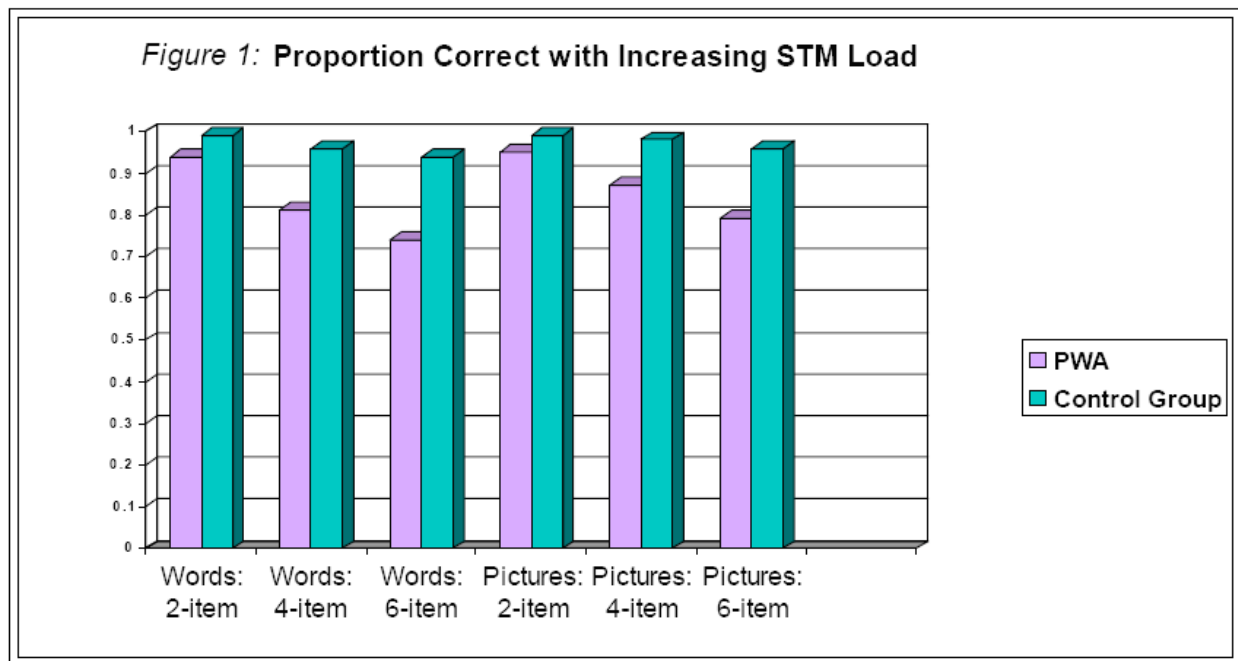
Presented by: **Kamen, Rachel**

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49. Analysis of Sentence Repetition in Aphasia (part 1): System for Coding Responses

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Introduction
A novel system for coding sentence repetition errors was developed for use in aphasia. The purpose of the coding system was to give a more complete description of error patterns, allowing a deeper understanding of the difficulties with sentence processing/repetition demonstrated by persons with aphasia (PWA). The system was developed and tested on data collected between 1987 and 2003 from the performance of PWA on a sentence repetition task reported by Saffran and Marin (1975). These sentences were chosen because the structure and content were varied enough to maximize the range of potential difficulties for our coding system.

Parameters and Procedures
Each morpheme of each target sentence was listed individually down the leftmost column of the coding form (Figure 1). The subject's utterance was transcribed in IPA and each morpheme was numbered. When a morpheme in the utterance corresponded to a morpheme in the target sentence, its number was placed on the appropriate row. Corresponding morphemes could be "correct", or they could be "substitutions". If entered as a "substitution", the number was also entered into all appropriate error-type columns. If no corresponding morpheme exists, an omission

would be entered for this row. Although there may have been multiple attempts at a single target, each target morpheme could only correspond to one morpheme of the participant's utterance. We coded further attempts under the "additions" column.

Analysis

After coding, the next step is to extract the desired information. We created an excel macro that determined which error-type columns were associated with each "substitution". The error-types can be analyzed individually, or grouped into classes such as "semantically related errors" and "order errors".

Next, we can extract error information based on properties of the targets. Each target morpheme can be characterized for frequency, part of speech, function in the sentence (subj/verb/obj/etc.), and position in the sentence. Thus errors can be analyzed based on both error-type and properties of the target item. For example, semantically related errors occur in earlier positions in the sentence than omissions (t(26)=3.053, p=.005).

Finally, we can look at subject factors and item/error-type factors together. Each subject can be characterized based on aphasia type, extent of lesion, and performance on other language tasks. These measures can then be correlated with performance on the sentence repetition task. For example, as semantic ability increases errors tended to occur in later positions of the sentence (r(28)=.535, p=.003).

Discussion

In studies currently underway, this coding system has revealed greater rates of errors at earlier positions of the sentence in individuals with more severely impaired access to semantics. This pattern is consistent with the hypothesis that the semantic system contributes to the primacy effect in sentence repetition. The coding system also identified a pattern of semantic and omission errors that could be a useful diagnostic marker; the former were associated with better access to semantics than the latter.

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Analysis of Sentence Repetition in Aphasia (part 1): System for coding responses

Figure 1. Sample of coding form for analysis of sentence repetition responses.

Patient's Sentence: people1 follow2ing3 /kɔr/4ly5 in6 the7 ancient8 /entʃ/9 people10

Sentence 1

	Corresponding Morpheme				Phonologic		Semantic							Part Of Speech		Order			
	CORRECT	SUBSTITUTION	OMISSION	ADDITIONS	Formal	Literal	Synonym	Categorical	Associative	Contextual	Mixed Error	Tense/Infl Error	Expletive Replacement	Correct POS	Incorrect POS	Perseveration	Anticipation	Correct Relative	Incorrect Relative
The			The																
people	1													1				1	
file		2			2				2		2			2				2	
ed		3										3		3				3	
calm		4						4										4	
ly	5													5				5	
into		6			6		6							6				6	
the	7													7				7	
ancient	8		9		9									8			9	8	9
cathedral		10												10	10				10

Presented by: **Gruberg, Nicholas**

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50. Analysis of Sentence Repetition in Aphasia (part 2): Semantic Influence on Position and Type of Errors

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Introduction

This study examined the influence of semantic processing on patterns of recall and errors in a sentence repetition task for individuals with aphasia. In a seminal study of a person with phonological STM impairment, Saffran and Marin (1975) demonstrated that a reliance on semantic representations in sentence repetition led to production of paraphrases of the target sentence. Martin & Saffran (1997) demonstrated an association between semantic impairment and reduced primacy effects in word span tasks. Based on these findings we hypothesize the following:

(1) Individuals with more severe semantic impairments will more likely lose target words/morphemes altogether, producing an omission, while individuals with more intact semantic abilities will more often retain some semantic trace of the target, producing a semantic substitution.
As semantic ability increases:
a. The proportion of semantic substitutions should increase.
b. The proportion of omissions should decrease.
(2) Given the relationship between semantic impairment and reduced primacy effect, we expected that the strength of the semantic system would disproportionately affect performance on items early in the sentence.
a. More severe semantic impairment should predict earlier errors.
b. Omissions should occur later than semantic substitutions.

Participants

Participants included 29 individuals with aphasia resulting from left CVA (at least 1 year post onset). Because our

aim was to assess the impact of semantic processing on sentence repetition we selected participants with good semantic ability relative to phonological ability, which could provide an alternative means of repetition. We excluded 5 participants whose phonological z-scores were at least one point above their semantic z-scores.

Task
Participants repeated 20 sentences (varied for length and complexity) adapted from Saffran and Marin's (1975) study.

Scoring
A novel error coding procedure was used to analyze performance in the sentence repetition task in terms of type and position of errors. We used six measures of input lexical-semantic processing to establish estimates of lexical-semantic ability measured as z-scores.

Results
As semantic ability increased: (1) the proportion of semantic substitutions increased (β=.450, t(28)=2.62, p=.014), (2) the proportion of omissions decreased (β=-.553, t(28)=-3.45, p=.002), and (3) errors tended to occur in later positions of the sentence (β=.535, t(28)= 3.287, p=.003). Also, semantic substitutions tended to occur earlier in the sentence than omissions (t(26)=3.053, p=.005).

Discussion
Better semantic z-scores predicted proportionally more semantic substitutions and fewer omissions. This result suggests that semantic substitutions and omissions in repetition could serve as diagnostic markers for semantic processing ability. Within sentences, semantic substitutions tended to occur earlier than omissions. Additionally, individuals with better semantic z-scores tended to make errors later in the sentence, and performed better on early items than individuals with lower semantic z-scores. This pattern confirms the hypothesis that the semantic system provides support for the primacy effect in sentence processing.

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Presented by: **Gruberg, Nicholas**

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51. The Independence of STM Deficits and the Shifting Component of Executive Function

Allen C., Martin R.
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Hoffman and colleagues (2009) proposed that semantic STM deficits in aphasia result from disruption to a domain-general semantic control system, the operation of which is reflected in performance on global tests of executive function (EF) such as the Wisconsin Card Sorting Test (WCST). Martin and Allen (2008) argued that the causation may go in the other direction, as they found that patients' phonological STM capacity predicted performance on the WCST, which has a verbal STM component (Dunbar & Sussman, 1995). However, STM was uncorrelated with performance on another EF task, the Tower of Hanoi (TOH), argued to contain a visual-spatial component (Handley et al., 2002).

Because of the complexity of standard EF tests like the WCST, it is valuable to focus on simple tasks that tap mainly

one aspect of executive function. Martin and Allen (2008) found that both semantic and phonological STM deficits were related to impaired performance on simple inhibition tasks. The present study examined the shifting component of executive function, which involves the ability to switch tasks sets.

Five aphasic patients with reduced STM capacities but normal single word processing were tested on a cued task-switching paradigm, which has minimal STM demands. On the nonverbal shifting task, a cue appeared before each trial indicating whether to respond to the color or shape of the upcoming object. In the verbal task, the cue indicated whether to respond to the size or animacy of the referent of an upcoming written word. Switch costs were calculated as the difference in RTs and errors between switch and non-switch trials. Shift costs for all but one of the patients were within the range of controls on verbal and nonverbal tasks.

The results indicate that STM deficits do not derive from a disruption of the shifting component of EF and contrast with the findings on inhibition. Thus, they are consistent with theories emphasizing the importance of inhibition in STM (Zacks & Hasher, 1988), rather than executive function in general (Hoffman et al., 2009).

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Presented by: **Allen, Corinne**

Poster Session 2: Written Production

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52. Patterns of Breakdown in Spelling in Primary Progressive Aphasia

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Introduction
Primary Progressive Aphasia (PPA) has recently been divided into three clinical subtypes. Progressive Nonfluent Aphasia (PNFA) is characterized by impaired grammatical sentence production and motor speech with spared word comprehension. Semantic Dementia (SD) is characterized by deterioration of word and object meanings. Logopenic Progressive Aphasia (LPA) is characterized by poor sentence repetition and word retrieval, with spared word and object meanings and motor speech.
Dysgraphia is often among the earliest symptoms of PPA. Distinct patterns of spelling impairment might predict the subsequent course of language deterioration. We sought to identify which cognitive processes underlying spelling were impaired in 17 patients with PPA, based on detailed analysis of performance across tasks and stimulus types.

Methods
Diagnosis was based on history, neurological examination, brain MRI, brain SPECT or PET scan, battery of language tests, and neuropsychological battery. Spelling evaluation included written spelling to dictation of 326 words and 34 pseudowords, oral spelling of 42 words and 20 pseudowords, delayed copy transcoding of 42 words and 20 pseudowords; and written naming of 30 objects and 30 actions. We evaluated (with chi squared tests) effects of word frequency, concreteness, word length, grammatical word class, lexicality (words vs pseudowords), and "regularity" by controlling for the other variables. Errors were categorized as: phonological plausible error (PPE), phonologically implausible nonword (PIN), semantically related word, phonologically similar word (PSW), partial response, or unrelated word (UW).

Results
Among 15 patients, we identified 4 patterns of spelling that could be explained by damage to one or more cognitive processes underlying spelling. Eight patients (4 unclassifiable, 2 with LPA, 2 with SD) had dysgraphia explicable by impaired access to lexical representations, with reliance on sublexical phonology-to-orthography conversion (POC), characterized by a predominance of PPE's, effect of regularity; and/or pseudowords spelled more accurately than words (see Table 1). Two patients showed this pattern initially, and later showed a reduction in PPEs and increase in PINs. One patient (with PNFA) showed dysgraphia explicable by impaired access to lexical representations and complete disruption of sublexical POC, characterized by the absence of PPEs and inability to spell pseudowords. Errors included omissions, unrelated words, PSW, semantically related words, and PINs. She had spared word comprehension, indicating that the problem was in accessing lexical representations rather than lexical-semantic representations. Five patients (3 with LPA, 2 with SD) showed dysgraphia explicable by impaired access to lexical-semantic representations and/or lexical representations with partially spared sublexical POC mechanisms, characterized by a predominance of PIN and PSW, with <25% PPE's and other errors. One patient (with PNFA) showed dysgraphia explicable by impairment of the graphemic buffer, characterized by production of mostly PINs and significant effect only of word length.

Discussion
Any cognitive process underlying spelling can be affected in PPA, but sublexical POC mechanisms and the graphemic buffer appear to relatively spared early in the course of LPA and SD. Patients with PNFA showed no PPEs, but evidence of damage to the graphemic buffer or POC and lexical mechanisms.

Presented by: **Sepelyak, Kathryn**

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53. Accessing allographic representation of letters but not their graphemic identity

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Case Report
This study documents the case of a 69-year-old woman (VA), who, following a left posterior brain lesion, showed an extremely severe deficit in reading and writing letters, words, and numerals. She had a right homonymous hemianopia, a mild right hemiparesis and a limb ideomotor apraxia. VA did not show perceptual deficits, visual agnosia or unilateral visuospatial neglect. VA's speech was fluent, unaffected by paraphasias, but with occasional perseverations, hesitations, anomias and circumlocutions; her repetition and auditory comprehension were unimpaired; picture naming was only 13/80 correct but improved almost to ceiling on phonemic cueing. She was submitted to an exhaustive evaluation of reading and writing abilities.

Results

The main findings in VA's case may be summarized as follows: 1) VA maintained spelling competency for words suggesting that the access to the orthographic structure of words was spared; 2) the preserved ability to recognize shape (among letters, numbers and Aramaic graphemes) and canonical orientation of letters indicates that VA could access the representation of letters and numbers as visual objects with particular features. No low level perceptual deficit can be advocated to account for this performance; 3) VA displayed an essentially preserved ability in lowercase-uppercase matching, suggesting that she could access, at least in the form of the task used for this study, the representation of abstract letter identities independently of their visual forms; 4) nevertheless VA was completely unable to name words, letters and Arabic numbers and could not match spoken letters or, to a lesser degree, numbers to their graphic form.

Conclusions
A rather similar patient has been described in a case of optic aphasia (GV) by Miozzo and Caramazza (1998). However the two patients cannot be easily compared. GV, unlike VA, did not seem to be able to match upper case to lower case, but a probably more difficult task was used in his case. Another crucial point that makes the comparison hard is that in GV matching spoken letters to their visual form was not performed.
Our findings suggest that VA could only access allographic representation of letters from visual input but not their full identity; she also could not access graphemic identity from spoken input and use this graphemic information in orthographic and phonological output. An independent stage in reading where the canonical form, position and allographic alternatives are stored seems to be preserved in this patient.

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Presented by: **Volpato, Chiara**

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54. Processing of Compound Nouns in Deep Dysgraphia: Limitations to Orthographic Autonomy

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It has been demonstrated that writing may be independent of phonology, for example, in subjects with deep dysgraphia (e.g., Rapp et al., 1997). However, orthographic autonomy has not been demonstrated convincingly for stimuli other than simple nouns (cf. Bub & Kertesz, 1982). The present study assessed writing of compound nouns in a deep dysgraphic subject.
The subject, MD, suffered from Broca's aphasia with deep dyslexia and dysgraphia (Bormann et al., 2008). Nonword writing was impossible (0% correct), and semantic errors occurred in writing to dictation. Thus, MD was relying almost exclusively on his lexical-semantic writing routine. Three experiments were carried out to assess whether compound nouns are really processed independently of phonology.
In experiment 1, MD correctly wrote 28 of 45 compound nouns but only ten out of 45 length-matched simple nouns (ChiSquare(1)=14.7, p <0.01). The distribution of his segmental errors respected morphological boundaries (fig. 1). In experiment 2, MD was better at writing compounds without a linking element (47/100 correct) in comparison to compound nouns with a linking element (12/100 correct; ChiSquare(1)=29.45, p<0.01). In German, compounds frequently combine their morpheme constituents by means of a linking element ("Bauer-n-hof"). Also, more morphological errors were observed for target words with linking elements (ChiSquare(1)=19.22, p<0.01) as MD tended to delete the linking element (e.g., writing "Sonne-n-brille" ["sun glasses"] as "Sonnebrille").
Across all responses, the majority of his lexical errors (semantic or formally related) affected morphemes, but not compounds as a whole: In the whole corpus, there were 39 errors of which nine were ambiguous (morpheme or whole word substitution). Thirty lexical errors affected a single morpheme only (e.g., writing "oil cinema" in response to "oil film").

However, there was evidence of a conscious strategy based on oral output mediating MD's writing of compounds as he occasionally wrote the second morpheme first. In experiment 3, two lists of 27 compounds were compiled. One list consisted of 'easy-difficult compounds' (Schiffsreise [lit. "ship journey", "cruise"]) while the other consisted of 'difficult-easy compounds' ("Wunderkind" [lit. "miracle child", "prodigy"]). MD wrote the first morpheme more often for the 'easy-difficult' compounds (ChiSquare(1)=17.12, p <0.01) and second morpheme more often for 'difficult-easy' compounds (ChiSquare(1)=9.64, p<0.01).

Although MD's writing of simple words was independent of phonology, he nevertheless appeared to use a strategy to support spelling of complex words (i.e. separating the compound in speaking and then writing its morphemes). This suggests that phonological information may be necessary to guide writing of complex words and, probably, phrases and sentences. Comparable limitations to 'orthographic autonomy' have been discussed previously by Bub and Kertesz (1982).

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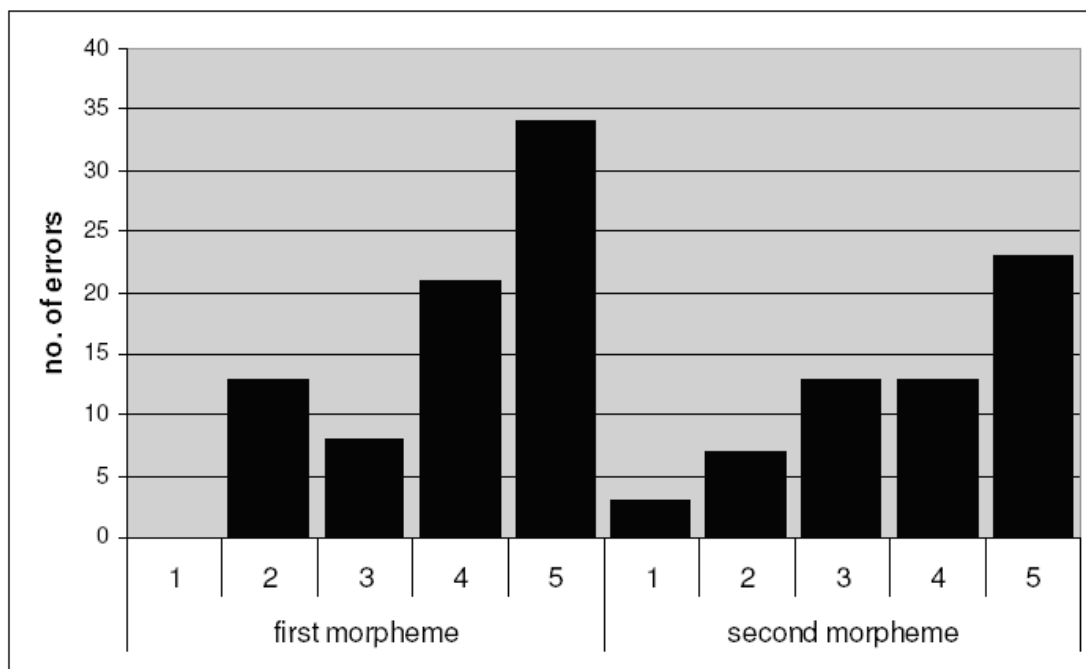
Presented by: **Bormann, Tobias**

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55. Visuospatial Agraphia: A Case Report

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Manipal University

Introduction
Visuospatial skills are necessary for the proper formation of letters and words. Spatial orientation must interact with graphemic output in order that letter components (strokes) can be properly formed by the system of graphemic output programming. Disruption of this ability has been termed as 'visuospatial agraphia'. This condition is characterized by reiteration of strokes, inability to write on a straight line, and insertion of blank spaces between graphemes (Roeltgen, 2003). In this report, a subject with visuospatial agraphia is presented who did not exhibit these classic features.

Case Report
A 52-year-old right-handed medical nurse presented with sudden onset of difficulty in writing. At onset, she experienced difficulty signing in the hospital attendance register. Subsequently, the medical examination revealed normal sensory skills and motor power. The MRI scans revealed altered signal intensity in the high posterior parietal areas of the left hemisphere. The Kannada version (Karanth et al., 1991) of Western Aphasia Battery revealed normal linguistic performance (Fluency, AQ=9; Auditory Verbal Comprehension, AQ=8.8; Repetition, AQ=9.2; and Naming, AQ=8.1). The praxis section of WAB was performed flawlessly by the subject. Oral reading and reading comprehension were intact. The ability to spell words was well preserved. On tasks of copying, dictation, and spontaneous writing (in Kannada and occasionally in English), her performance was highly compromised (See Figure to compare post-morbid performances with pre-morbid). Interestingly, she could correctly key in the letters of English words (e.g. banana) using a computer keyboard and she also performed fairly well on copying of cursives. Further, Mrs. P. was required to write spontaneously as well as to copy in Kannada with her left hand. However, written output was highly illegible and paralleled right hand performance. On administration of Addenbrook's Cognitive Examination (Mathuranath et al., 2000), she performed effortlessly on all the subtests except the visuospatial section (see Figure).

Discussion
The subject apparently showed normal linguistic performance and preserved reading, spelling, and typing skills in the presence of severely compromised written output. The written output was characterized by illegible and poorly formed letters. Despite her poor performance on visuospatial tasks, copying of cursives was fairly preserved. In addition, she was able to write on a straight line without many involuntary reiterations and blank spaces between the letters. These observations reveal that visuospatial agraphia may manifest as poorly formed letters in the absence of reiterations and blank spaces between letters with relatively preserved cursive writing.

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A. Premorbid writing sample

Padmavathi Christensen's model

F. Writing with left hand

E. Dictation

B. Attempts to write name with right hand

Banana
Hat
face
elephant

C. Copying of English words

D. Spontaneous writing

Examiner's Model

Mrs. P.'s attempt

G. Copying of Cursives

Examiner's Model | Mrs. P.'s attempt with the right hand | Mrs. P.'s attempt with the left hand

Examiner's Model | Mrs. P.'s attempt with the right hand | Mrs. P.'s attempt with the left hand

H. Performance on Visuospatial tasks

Presented by: **Krishnan, Gopee**
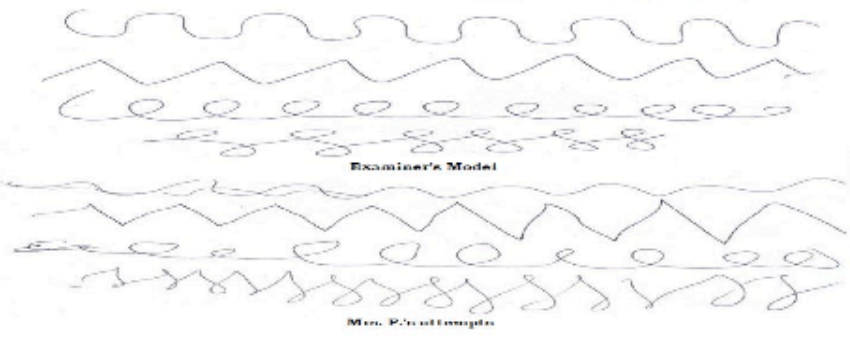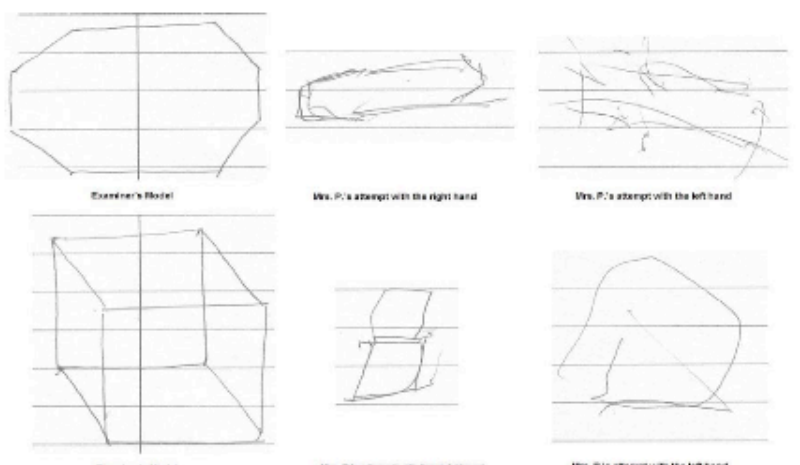
56. Retention of Music Notation "Spelling" in a Semantic Dementia Patient

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Introduction
Impaired speech, comprehension, and naming in semantic dementia (SD) reflect semantic memory loss. However, the disease can spare abilities (such as mathematical competence) which involve knowledge of concepts and symbolic representation apart from language. Music, like language, involves creativity within rule-governed structures, temporal sequencing, and communicative expression, and is represented by symbolic notation—yet music contains no words or external referents. Thus, examining retained musical ability in SD may shed light on the language-specificity of the disease's effects.

We assessed knowledge of tonal structure and its notational "spelling" in TM, a 64-year-old male SD patient and former semi-professional Baroque harpsichordist. TM is mute with no aural or written language comprehension, yet he can sight-read novel music scores and play complex works which he creatively embellishes with stylistically appropriate ornaments.

Procedures and Results
Any musical pitch can be notated in various ways. For instance, the pitch produced by the black piano key located between the white keys C and D can be notated (i.e., spelled) as either C-sharp or D-flat. Tonal context dictates which notational spelling is correct, just as sentential context in language dictates whether the spoken utterance /fit/ is spelled "feet" or "feat." A musician reading a piece in the key of D Major would be surprised by the D-flat spelling, just as a reader of fairy tales would be surprised to see Cinderella's slippers described as fitting her feat.

We created a novel musical score in two versions which would sound identical if played as notated, but one of which contained a spelling error. The scores were presented to TM during separate sessions. He sight-read both scores accurately, but was challenged by the spelling error. The "correct" and "misspelled" scores were performed at fairly even tempos of, respectively, 2.37 (±.66) sec and 2.71 (±.78) per four-beat measure; however, TM took 4.88 seconds to play the measure containing the misspelling, in contrast with 2.03 seconds for the corresponding correct measure. The Figure illustrates the duration of each beat of the relevant measure and those flanking it; the misspelled note and its correct counterpart are highlighted. We corroborated these results by assessing TM's performance from an unfamiliar score containing several misspellings. We analyzed two three-measure passages, one with four misspellings and the other with none, which were otherwise matched for technical, harmonic, and visual complexity. TM played the "correct" passage in 5.94 seconds without error, but played the "misspelled" passage in 10.35 seconds with a 20% error rate.

Conclusion
TM, a semantic dementia patient who understands neither spoken nor written language, has retained understanding of both tonal structure in music and the symbolic notation by which such structure is visually represented. Although his preserved musical abilities in the face of devastating language loss suggest separate neural substrates for music and language, his understanding of musical "spelling," an aspect of musical knowledge with language analogs, suggests that his aphasia reflects a specifically semantic impairment, while abilities that language shares with other forms of knowledge are spared.

Beat Duration in Performance of "Correct" and "Mispelled" Scores
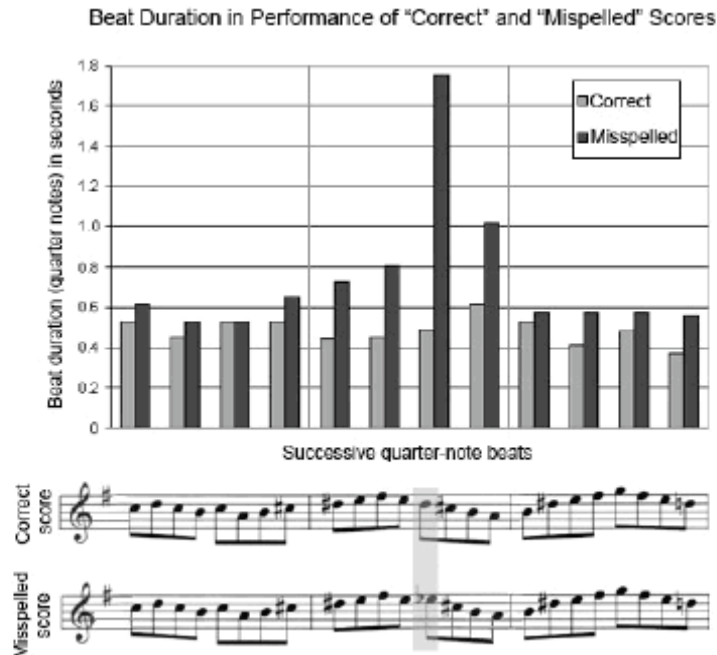
Presented by: **Koenig, Phyllis**

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57. Cross-Language Treatment Generalisation in Welsh-English Bilingual Dysgraphia

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Although there are some treatment studies of spoken language in bilingual aphasia (Miertsch et al., 2009), evidence-based treatment studies of acquired dysgraphia are restricted to monolingual speakers, usually of English. Our goal was to study the possible cross-language generalisation of treatment effects in bilingual dysgraphia, as a function of deficit type and language treated. We hypothesized that general cross-language transfer might occur in graphemic buffer disorders but might be restricted to translations of treated words in orthographic lexical disorders.

Participants
Two Welsh-English early proficient bilinguals literate in both languages pre-morbidly:
1. RON, age 59, suffered a left-hemisphere stroke in 2003. He now presents with mild anomia, moderate syntactic difficulties, phonological dyslexia and moderate dysgraphia in both languages.
2. CWS, age 61, suffered a right frontal stroke in 1994. He now presents with moderate anomia, syntactic difficulties, phonological dyslexia and severe dysgraphia in both languages.

Spelling assessment
An extensive investigation of spelling abilities revealed that: 1. RON's deficit affects primarily the graphemic buffer, with letter omissions, substitutions and reversals (e.g., "cigarette"-> GIGAREET) and a length effect.
2. CWS's deficit affects primarily the orthographic lexicon, with phonologically plausible errors ("eighteen"-> ATEEN) and a regularity effect.

Treatment study
The treatment was based on Rapp & Kane (2002), the essential difference being that we measured generalisation from English to Welsh, and, 6 months later, Welsh to English.

1. Baseline testing. Before treatment, performance was measured twice on five sets of words matched for length, lexical frequency and performance (N=24 per set for CWS; N=36 for RON): 1) English treated, 2) English untreated repeated, 3) English untreated control, 4) Welsh untreated translations of English treated words, and 5) Welsh untreated controls.
The languages in each set were swapped 6 months later for the Welsh treatment.
2. Treatment. Patients received treatment twice a week until no further improvement was observed for 4 consecutive sessions (around 20 weeks for each language). After spelling each word to dictation, patients studied cards of the correct spelling while each letter was read out to them. This procedure was repeated until a correct spelling was achieved. Words from the repeated set were dictated at each session but not treated.
3. Post-tests. The five sets of words assessed at baseline were re-assessed twice at the end of treatment.

Results and discussion
Both patients improved on treated words, but only RON, the graphemic buffer case, showed generalisation to within-language untreated words. However, neither showed evidence of cross-linguistic generalisation, regardless of which language was treated (see Table 1). The within-language results replicate Rapp & Kane (2002) and confirm that generalization patterns are linked to deficit type. However, we did not confirm our hypotheses about cross-language generalisation. This highlights that treatment effects do not automatically transfer from one language to another. New avenues for the development of treatments with more generalisation potential in bilingual populations will be presented.

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Table 1: Percent improvement between baselines and post-tests as a function of stimulus set and language treated (values in bold indicate significant improvement using McNemar test).

	RON	CWS
Phase 1: Treatment of English words		
English treated	+69%	+33%
English repeated (untreated)	+62%	+10%
English control	+22%	-4%
Welsh translations of English treated	-4%	+2%
Welsh unrelated control	+2%	+2%
Phase 2: Treatment of Welsh words		
Welsh treated	+53%	+40%
Welsh repeated (untreated)	+18%	+13%
Welsh control	+21%	-4%
English translations of Welsh treated	+14%	+4%
English unrelated control	+10%	-10%

Presented by: **Roberts, Jennifer**

Poster Session 2: Phonology, Phonetics and Acoustics-1

58. Perceptual Discrimination of Shona Lexical Tones and Hums by Left and Right Hemisphere Damaged Patients

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This study investigated the ability to discriminate Shona lexical tones and hums by left hemisphere damaged patients (LHD), right hemisphere damaged (RHD) patients and a control group. Research that has been done on the perception of lexical tones has shown that LHD patients are more impaired than RHD patients. Van Lancker (1980) proposed that the more linguistic pitch contrasts are, the more laterized they are to the left hemisphere while the less linguistic pitch contrasts are laterized to the right hemisphere. According to Van Lancker's functional lateralization hypothesis, hemispheric specialization is associated with different domains of pitch contrast, with lexical tone being the "most linguistically structured" and affect and voice quality being the "least linguistically structured." The present study tested six LHD and six RHD patients in two discrimination tasks. The two tasks measured the participants´ accuracy in making same/different judgments on pairs of hums and pairs of Shona words. The RHD patients performed significantly better than the LHD aphasic patients on both tasks. The LHD patients discriminated the lexical tones at only 59% and the hums at 61% accuracy, while the RHD patients discriminated the hums at 81 % and the lexical tones at 82% accuracy. These results are in line with what has been found in Asiatic studies that lexical tones are relatively more impaired in LHD patients in comparison to RHD patients. Despite different tonal systems between the Asiatic and Bantu languages, a unilateral brain damage also results in tonal impairment in Shona patients.

Presented by: **McLoddy, Kadyamusuma**

59. The Treatment Effects of Phonological Complexity on Apraxia of Speech: An Implicit Alternative

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Implicit treatments were applied successfully in individuals with fluent aphasia and apraxia of speech (AOS) with aphasia (Davis, Farias, & Baynes, 2009). Here mental practice, rather than overt speech, was used in training complex consonant blends. Prior research (Maas, Barlow, Robin & Shapiro, 2002) showed generalization to simpler consonant blends when treating AOS. In this design, word initial complex consonant blends were trained to assess their effects on simpler consonant blends in treatment of AOS.

Our hypotheses follow:

1. Would implicit phoneme manipulation improve production of targeted complex consonant blends?
2. Would treatment generalize to production of simpler consonant blends?
3. Would visual inspection and size effects verify the benefits of implicit treatments?

Method
Subject: SB was a 56 y/o male s/p CVA with a discrete lesion in the left insular region. AOS was the primary diagnosis at 6 months post CVA.
Intervention: This multiple baseline intervention was applied three times weekly for 1-1.5 hours. It required SB to make choices based on the mental manipulation of sounds (deletion, insertion, substitution, rhyme) without verbal output. For example, SB was asked to select the target from 4 pictures when given an auditory request " 'eak' what would it be if you added 'str' to the beginning." The foils were phonologically related to the target such as "speak," "peak," and "sneak" for the target "streak." Eleven complex consonant blends (squish, stroke) and 11 simpler consonant blends (swish, stoke) were selected for training based on 200 screening items.

Results
Clear response to training on complex consonant blends (List A) resulted in a d statistic of 5.7 on trained probes and 4.2 on untrained probes (see Figure 1). Training generalized to untrained probes of simpler consonant blends (List B) giving a d statistic of 4.8. Improvements were maintained on both complex and simpler consonant blends 6 months after training. Improvements on the Western Aphasia Battery and on auditory discrimination testing were noted.

Conclusions
Findings support the use of mental practice as a complementary technique to overt practice. Treatment for AOS is well suited to mental practice as it requires the individual to focus on inner speech, a necessary precursor to self-correction and self-monitoring for accurate overt speech. Results support prior findings that training of complex consonant blends generalized to simpler blends. An improvement in auditory discrimination may be a byproduct of mental practice, self-monitoring and correction of motor plans required for the selection of the target in implicit training.

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Presented by: **Davis, Christine**
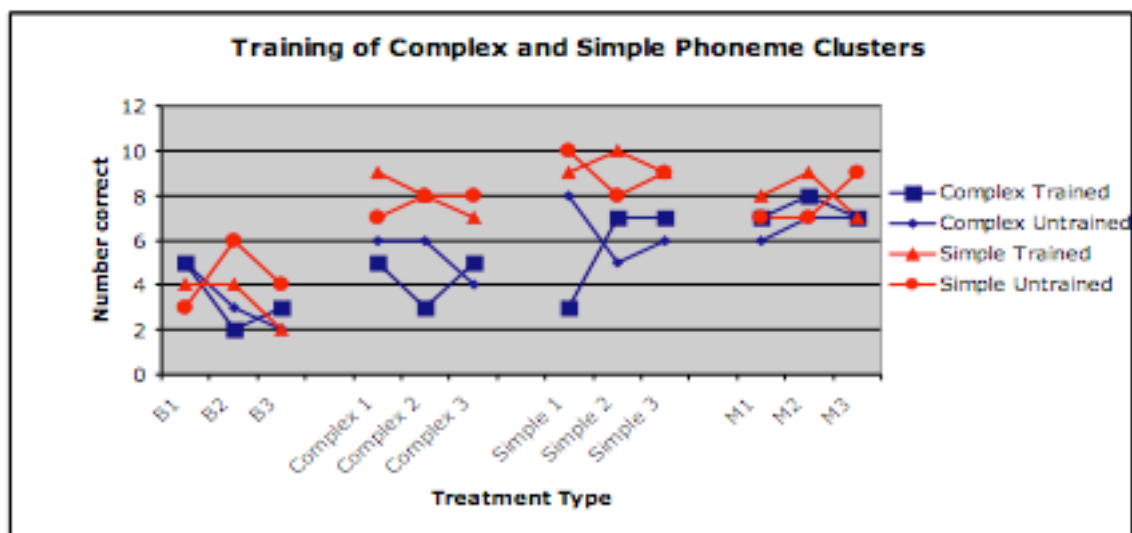
60. Acoustic Analysis of Prosody for Normal and Aphasic Discourse of Cantonese Speakers

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Background
Previous studies on prosodic problems in aphasia have focused the investigation on the sentence level. However, the evaluation should be based on connected sample as it is considered the most sensitive task to different dimensions of atypical prosody (Leuschel & Docherty, 1996). Recently, Tseng, Pin, Lee, Wang and Chen (2005) proposed a top-down, multi-layered framework, which considers all relevant levels (prosodic phrase group, breath group, prosodic phrase, prosodic word, and syllable) that constitute discourse prosody. While Tseng et al.'s model is developed based on speech samples of normal Mandarin speakers, the present paper reports a pilot study that has applied this framework to analyze discourse prosody in Cantonese-speaking normal speakers and individuals with aphasia.

Method
The subjects were two individuals with aphasia (one female of 47 years old with transcortical motor aphasia and one male aged 49 years old with anomic aphasia) and two age-, gender- and education level-matched normal individuals (one 44-year-old female and one 47-year-old male; education level was secondary or below). Each speaker partook in passage reading, picture description, story telling and monologue. The speech samples were recorded using a digital recorder and a condenser microphone in a quiet room. Broad phonetic transcription, boundary break annotation (based on Tseng et al.'s guidelines) and acoustic analysis were conducted using Praat version 5.1.02 (Boersma & Weenink, 1992-2009). The following parameters were measured: fundamental frequency, peak intensity, duration of each syllable (in millisecond), duration of each break, speaking rate and articulation rate (in syllable per minute).

Results
The speakers with aphasia showed lower speaking rate and articulation rate than the normal speakers because more and longer breaks and prolonged syllables were used. For intonation, smaller variations in fundamental frequency and intensity were observed in the speakers with aphasia compared to normal speakers. The results of some of the acoustic measures also differed according to speech tasks. In general, the speakers showed lower speech rate and smaller intensity variation in reading than in picture description, story telling and monologue.

Discussion and conclusion
The lower speech rates were probably due to word retrieval problems in the speakers with aphasia. The smaller fundamental frequency and intensity variations in the speakers with aphasia might be related to the use of more breaks, which has disrupted the overall intonation pattern. Tseng et al.'s framework is shown to be applicable for discourse by normal Cantonese speakers. It can be extended to capture the prosodic disturbance in aphasia through modification of the boundary breaks annotation guidelines and additional parameters, such as measuring the use of inappropriate breaks based on language analysis.

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Presented by: **Lee, Alice**

61. The development of a Standardized Assessment of Phonology in Aphasia.

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Statement of the Problem
Impaired phonology in adult aphasia is common and has profound and measurable consequences upon reading (de Partz, 1986; Kendall et al, 1998, 2003; Conway et al, 1998), language comprehension (Blumstein, 1998; Milberg et al, 1988), speech production (Nadeau, 2000; Kendall et al, 2003; Kendall et al, 2008; Browman and Goldstein, 1992) and working memory (Baddley and Hitch, 1974; Friedman et al, 2000). Unfortunately, there is no standardized measure of phonology for use with aphasic persons. The purpose of this research is to describe an impairment level measure of phonology in aphasia.

Methods/Procedures
Item response theory (IRT) formed the basis for development of items in 3 subtests of phonology (reading, repetition and perception).
Item Development
Reading: 69 items across 4 categories were constructed (real words, irregular words, pseudohomophones and non-words). All words were controlled for number of graphemes and phonemes, lexical and phoneme frequency, and complexity. Repetition: 113 items across 6 categories were constructed: real- and non-word repetition and real- and non-word parsing/blending. All words were controlled for syllable length, phonotactic probability and lexical frequency.
Perception: 216 items across 4 categories (real and nonword rhyme, lexical decision, minimal pairs) were constructed. All words were controlled for phoneme and lexical frequency, syllable length and phonotactic probability.

Data Collection
Thirty-seven individuals with aphasia met inclusion criteria of a single left hemisphere stroke, right-handed, monolingual English speaking, and presence of aphasia. Exclusion criteria included prior CVA, pre-existing neurological illness or severe impairment in vision or hearing and presence of developmental speech-language impairment. Tasks and stimuli were randomized and presented with an ISI of 8.0 seconds on a Dell Latitude X1 Laptop. For the reading task, participants were asked to read each word aloud. Verbal responses were recorded digitally for subsequent analysis.

Analysis
Responses were scored for accuracy and data were analyzed using WINSTEPS Rasch analysis (Bond & Fox, 2001; Linacre, 2005; 1994).

Results/Discussion
Results for item misfit, person separation reliability, person strata, Chronbach's alpha and item floor/ceiling effects are presented in Table 1. Our assessment of phonology in aphasia demonstrates a reasonable fit to the Rasch model. The reading items demonstrate good measurement qualities, good point measure correlation, and are separating people into at least 2 strata. The items in repetition, parsing and blending demonstrate adequate measurement qualities. The range of misfitting items was low (0-2), demonstrating good point measure correlation. There were significant floor effects for all tasks and one ceiling effect (real word repetition). There was a good point measure correlation for all tasks except lexical decision, for which 14 of the 36 showed correlations below .30. Future research will focus on the creation of a short form that will eliminate redundant items and the creation of new items to address the ceiling and floor effects.

Presented by: **Kendall, Diane**

62. White Matter Fiber Tracts for Phonological Processing

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Objectives
In this study, white matter fiber pathways were tracked in a large-scale fronto-parietal language network which was functionally defined by an fMRI experiment investigating different phonological transformation processes in German. In a suprasegmental transformation task, a shift of stress placement was required in transforming a pseudo-country into a pseudo-language, or vice-versa. In a segmental transformation task, in turn, a vowel segment change was elicited by having subjects transform a pseudo-noun into a pseudo-diminutive, or vice-versa.

Methods
DTI was performed in 20 subjects (mean age=34 y, range=20-69 y, 8 females). Language areas were defined based on the results from an fMRI experiment contrasting suprasegmental and segmental transformation with repetition. Fronto-parietal as well as interhemispheric pathways between these functionally defined core-regions were tracked with a probabilistic diffusion-tensor based imaging method.

Results
Connectivity between areas active during suprasegmental transformation, namely left inferior parietal lobule, intraparietal sulcus (IPS) and left inferior frontal gyrus (IFG), pars opercularis (BA 44) is provided by a dorsal pathway via the arcuate fascicle (AF) and superior longitudinal fascicle (SLF) fiber system. Areas active during segmental transformation, namely IPL, IPS and IFG, pars triangularis (BA 45) are connected in both hemispheres by a ventral pathway via the extreme capsule (EmC), while IPL and IFG (BA 44) are connected by a dorsal pathway via the AF.

Conclusions
The segregation of fronto-parietal white-matter pathways into dorsal and ventral pathways (Saur et al., 2008) suggests a functio-anatomical dissociation for different language processing routines. For phonological processing, the dorsal pathway seems to act as a fast, bottom-up route for mapping suprasegmental and segmental phonemic information from phonological working-memory in IPL to the inferior-frontal articulatory network, whereas the ventral pathway could be important for top-down modulation of phonological transformation processes through lexical-semantic information. It will be interesting to further investigate, if and how disruptions of particular subcomponents of this network are consistent with a dual pathway model for phonological processing.

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Presented by: **Kellmeyer, Philipp**

63. Tomato to Baritood: The Source of Non-Words in Jargon Aphasia

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Introduction
Some aphasic individuals produce excessive non-words, resulting in speech that sounds like jargon. The source of jargon is attributed to impairments in psycholinguistic processes such as lexical-semantic retrieval, phonological encoding, and self-monitoring (Moses, Nickels & Sheard, 2004). Few studies have systematically examined self-generated speech to identify a locus of deficit resulting in jargon production. In this study, the nature of jargon errors and their relationship to target was compared across three tasks employing lexical processes to different extents: word repetition, non-word repetition and picture naming. They all entail phonological encoding, but differ in whether they place heavy (picture naming), light (word repetition) or no (non-word repetition) demands on semantic processes. Additionally, stimulus length (monosyllabic/multisyllabic) places different demands on phonological encoding.

Methods
Three English-speaking fluent-aphasic individuals whose picture descriptions contained at least 10% of non-words participated (age:55-65 years, one female). The stimuli were 120 nouns from the Picture Naming Project (Szekely et al., 2004) and non-words created by altering these nouns. Phonological retrieval was assessed by examining production accuracy and error types (phonological/semantic relationship to target) for each task (picture naming, word repetition, non-word repetition). Integrity of phonological encoding processes was evaluated by inspecting phonemic overlap between targets and errors as a function of phoneme position within the target and allotting a graded target-error approximation score (TEAS; 1=phoneme in same position, 0.5=different position, but same syllable, 0.25=different syllable) as well as examining production accuracy sorted by word length.

Results and Discussion
All participants demonstrated greater difficulty with lexical-phonological retrieval than post-lexical phonological encoding processes as evidenced by 1) lower accuracy in picture naming than word repetition (GB=12.5% versus 77.5%; LV=2.5% versus 85%; PH=3.3% versus 25.8%), 2) more errors unrelated to target in picture naming compared to word repetition (mean=55.5% versus 13.6%), 3) poorer phonemic overlap with target (mean TEAS:0.15 versus 0.76; Table 1)
Additionally, participant PH demonstrated difficulty with post-lexical phonological encoding as indicated by 1) no influence of lexical demands on phonemic relatedness between errors and target (TEAS score; Table 1)with more unrelated errors on all tasks, and 2) significant word length effect ($\chi2$=4.1, 8.3, p<.05).
This study of jargon production presents a novel analysis procedure that enables a finer delineation of lexical-semantic and phonological processes. Results indicate that the primary breakdown occurs during retrieval of phonological information following lexical-semantic access. Hence phonological encoding proceeds with underspecified information about target word form, leading to jargon. When a clearly specified surface form of the target enters the phonological planning processes directly (as in word repetition), these individuals produce less jargon. Moreover, their jargon is a closer phonological approximation to target. However, some individuals may experience additional breakdown during phonological encoding (as in PH) which can compound the severity of jargon production.

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Table 1. Results of picture naming, word repetition, and non-word repetition for three individuals with jargon aphasia. Distribution of error types, target- error approximation score (TEAS) and the overall percent accuracy as a function of stimulus length, for each task and participant is given.

	Picture Naming			Word Repetition			Non-Word Repetition		
	GB	LV	PH	GB	LV	PH	GB	LV	PH
Error Analysis (n=120)									
Correct Responses (%)	12.5	2.5	3.3	77.5	85	25.8	33.3	49.2	1.7
Phonologically unrelated errors (%)	42.5	40.8	83.3	1.7	0.0	39.2	8.3	5.0	61.7
Phonologically related errors (%)	16.7	4.2	3.3	15.8	14.2	28.3	58.3	45.0	36.7
Semantic errors (%)	8.3	0.8	2.5	0.8	0.0	0.0	0.0	0.0	0.0
Other† (%)	20.0	51.7	7.5	4.2	0.8	6.7	0.0	0.0	0.0
Target-Error Approximation Score (TEAS)	0.3	0.1	0.1	0.9	0.9	0.4	0.8	0.8	0.3
Accuracy by Word Length									
Monosyllabic (in %; n=60)	13.3	1.7	5*	66.7	78.3	33.3*	33.3	53.3	1.7
Multisyllabic (in %; n=60)	11.7	3.3	1.7*	88.3	91.7	18.3*	33.3	45	1.7

* Statistically significant on chi-square (χ^2) test
† Other includes no responses and semantically/phonologically unrelated real word responses

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64. Phonemic Errors in Conduction Aphasia: Vowels versus Consonants.

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Introduction
A pervasive finding in the literature on phonological errors in speech is that, on average, aphasics and normal speakers make more errors on consonants than on vowels. This study focuses on phonemic substitution errors in conduction aphasia, a condition whereby the disturbance is believed to affect phonological planning. The study is conducted on speakers of Italian, a language wherein non-stressed vowels are not reduced (thus not resulting, as in English, in the production of the neutralized central vowel "schwa"), allowing us to better compute errors committed on vowels. Stress in fact has been shown to "protect" vowel production in aphasia. The aim of this study is to investigate whether vowels and consonants are categorically distinct or whether they belong to the same continuum along the parameter of sonority, whereby vowels would be at the highest sonority extreme. Only single case studies of the extremely rare condition whereby vowels are more affected than consonants have so far investigated this issue (Caramazza et al., 2000; Semenza et al., 2007).

Method and Results
Data were collected from a sample of 19 conduction aphasic patients, diagnosed via the Italian version of the Aachen Aphasia Test. Phonemic substitution errors were collected from the patients' performance in both the naming and repetition tasks from this battery. Three independent judges agreed on a transcription of patients' errors. Only errors where the target phoneme was identifiable were counted and entered the analysis. A total of 182 errors (1.7% with respect to the number of target phonemes) were collected in repetition and 96 (1.8%) in naming. As expected, patients committed significantly more errors on consonants rather than on vowels (keeping into account the relative frequency of consonant and vowels in Italian) in both tasks. This effect was found in all patients but one. Correlations were calculated for both tasks between the sonority scale for Italian consonants, the percentage

of errors for each target consonant segment, and the percentage of consonant types produced as an error. Both correlations were non-significant. Notably, sonorous consonants (i.e., /l/ and /r/) were not affected any more than other consonants (e.g., /t/, the less sonorous consonant).

Conclusion
These data argue in favor of those theories viewing consonants and vowels as occupying distinct representations rather than different places along a sonority continuum.

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Presented by: **Mori, Ileana**

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65. Lesion Sites in Acquired Neurogenic Stuttering: Implications for Neural Models of Fluent Speech

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Although the conceptualization of left hemisphere control of speech (Broca, 1863) came to be widely accepted among neuroscientists, contemporary studies (van der Merwe, 1997) seem to promote a broader concept of neural control of speech and language. A study of neural lesions associated with acquired neurogenic stuttering (ANS) might offer new data to reflect on 1) the neural bases of cognitive, linguistic, and motoric processes of speech production, and 2) neural plasticity observed in spontaneous and training-induced recovery.

The current study reports on a series of five adults who had ANS following stroke induced lesions in bilateral parietal lobe (case 1), right frontal and pontine lesion (case 2), left fronto-temporal lesion (case 3), white matter underlying left parietal and frontal lobes (case 4) and left basal ganglia (case 5). Each case was tested on speech production tasks such as extemporaneous speech, and oral reading of paragraphs. Following the widely accepted clinical criteria of sound/ syllable repetition and sound prolongation, stuttering was identified in our subjects. The occurrence of stuttering in each case is discussed in the context of contemporary neural models of speech production (Alm, 2004., Gunther, 2003., van der Merwe, 1997., Indefrey, 2007., Ingham etal, 2003), and lesion data reported in previous studies of ANS (Ludlow et al, 1987). The cases reported in the current study strongly suggest that any component process of fluent speech production can be impaired following lesion to the integrated complex, neural network that is widely distributed in both hemispheres . Hence, the lesion data reported in the current study appear to support the view of bi-hemispheric foundation for speech. However, we suggest that the currently available imaging technologies can be applied to investigate the natural history of lesion induced dysfluency and the compensatory functional support of the intact areas of the hemispheres.

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Presented by: **Balasubramanian, Venu**

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66. The Phonetic Echoes of Deficits to Lexical Access

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Introduction
Recent research suggests that the difficulty or ease of retrieving phonological information during lexical access influences the fine-grained articulatory properties of a word. Many theories assume that lexical neighbors--words that share segmental structure--become active during lexical access in production (Gordon, 2002). Baese-Berk & Goldrick (2009) report that the effect of these neighbors on lexical access is reflected in phonetic processing. Initial consonants of words with a minimal pair neighbor (cod-god) were phonetically enhanced relative to matched words lacking such a neighbor (cop-*gop). This enhancement was interpreted as arising from competition during lexical access between contrasting sounds in targets and their minimal pair neighbors (/k/-/g/).
This study examines the productions of an individual (CSY) with a lexical access deficit. This disruption to retrieval of the target's phonology should lead to increased competition between the target and its lexical neighbors--increasing the degree of phonetic enhancement in words with minimal pair neighbors.

Case study
CSY suffered an intracerebral hematoma near the left fronto-temporal-parietal junction at 51. Although he exhibited normal comprehension, he was significantly impaired in picture naming (64% correct, N = 260). A significant lexical frequency effect suggests this impairment arises in the course of lexical access. Consistent with a lexical locus, CSY is highly accurate in repetition (97%) and reading (98%)--suggesting post-lexical production processes are intact.

Method
A set of 36 word pairs with voiceless initial stops was constructed. One member of each pair had a minimal pair neighbor (cod-god) while the matched word did not (cop-*gop). These were matched for length, lexical frequency and phonotactic probability. The pairs were embedded in a set of 36 filler items. The list was presented in 3 random orders to CSY and 14 neurologically intact young adults for self-paced reading aloud. Any mispronounced item and its matched word were excluded from the analysis.

Results
As shown in Figure 1, relative to controls CSY showed a significantly greater degree of phonetic enhancement for /p/-initial words with minimal pair neighbors. The lack of a significant effect at the other places of articulation likely reflects a ceiling effect. /t/ and /k/ have longer VOTs than /p/ (Volaitis and Miller, 1992); intrinsic limits on VOT may mask any increased phonetic enhancement for these segments.

Conclusion
These data provide further support for interactive models of speech production. Interaction allows disruptions to lexical access processes to influence phonetic enhancement during articulatory planning.

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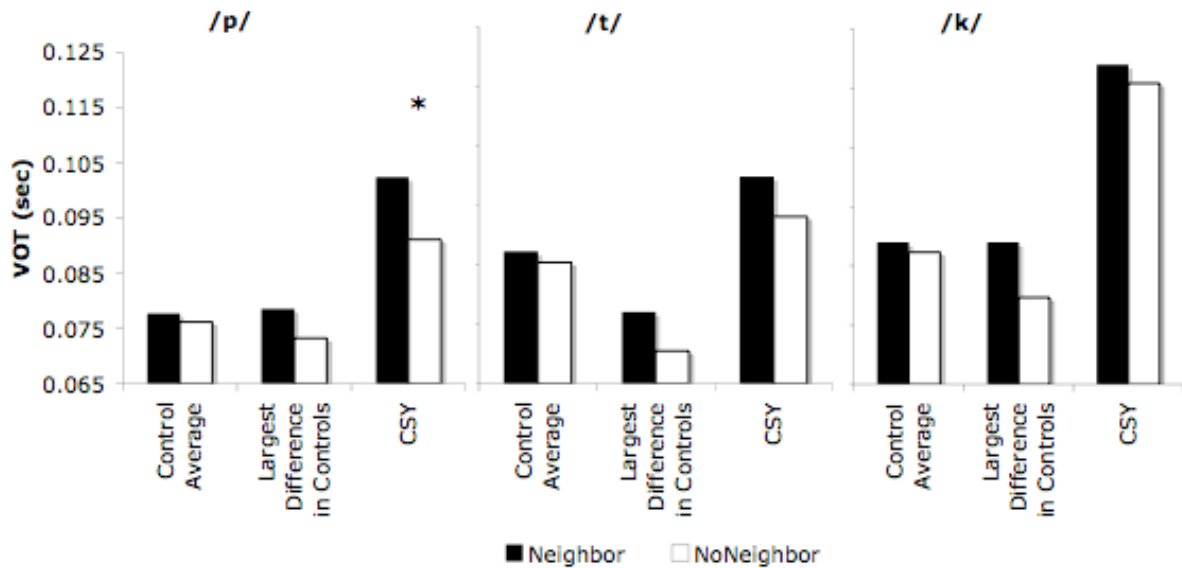
Figure 1. Average voice onset time (VOT) for initial stops at each place of articulation for words with (cod-god) and without (cop-*gop) minimal pair neighbors. VOTs are grouped by: the average VOTs for 14 controls; the individual with the largest percentage increase in VOTs for minimal pair neighbors in the control group; and CSY. To compare CSY's phonetic enhancement for words with minimal pair neighbors to controls, the percentage increase in VOTs (VOT in word with minimal pair neighbor/VOT in word without neighbor) was calculated for each participant. CSY's increase for /p/ exceeded that of all participants in the control group. Crawford & Howell's (1998) modified t-test was used to assess this difference. CSY's percentage increase was significantly different from controls for /p/ (t(13)=3.47, p < .005). For /t/, CSY's increase was not significantly different form controls, falling in the upper quartile of the control group (t(13)=.98, p < .20). CSY also showed no significant increase in enhancement for /k/ initial words. His increase fell near the median of the control group (t(13)=0.12, p <.5).

Presented by: **Goldrick, Matthew**

Poster Session 2: Noun and Verb Processing

67. Naming Proper Nouns from Sound and Vision: Analysing the Role of the Temporal Lobe with fMRI

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Belin (2006) argued for modality-specific processing in the anterior temporal lobe, namely a voice-selective area in the upper bank of the anterior superior temporal sulcus (STS) with higher activity in the right hemisphere. Other imaging studies observed increased activity in anterior temporal regions when subjects named famous faces or landmarks (Gorno-Tempini, & Price, 2001) and suggested hemispheric differences with a stronger involvement of the left temporal pole in lexical retrieval and of the right temporal pole in sensory or semantic processing of these unique entities (Gainotti, 2007). Accordingly, proper name anomia was often observed after lesions of the left temporal pole (Grabowski, Damasio, Tranel, Cooper, Boles Ponto, Watkins, & Hichwa, 2003).

Three fMRI experiments tested whether the cortex along the anterior STS is selectively activated by human voices, and whether there is a left hemispheric preference for named voices.

In experiment 1, subjects listened to short phrases spoken by famous and unfamiliar persons plus sounds of animals and musical instruments. Subjects were asked to push a button if they recognised the person, animal, or musical instrument. In experiment 2, subjects classified speakers as unfamiliar or familiar, or described or named them overtly. In experiment 3, subjects saw pictures of cartoon characters, animals, and fruit & vegetables and named or described them overtly. The data were analysed by defining regions-of-interest (ROI) in the temporal lobes (Figure 1) in each individual subject.

Human voices caused higher activity in both temporal cortices compared to other sounds. These differences gradually increased when moving from the auditory cortex (Figure 1, AC) to ventral and anterior ROIs that were activated by voices only. In all ROIs, the difference was larger in the left than in the right hemisphere. Moreover, named voices produced stronger activation than non-named voices, especially in the anterior temporal lobe and the lower bank of the STS, and these differences were more pronounced in the left hemisphere. Incompatibly to a strict view of voice-selectivity, pictures of cartoon characters also caused strong activation in temporal cortices, which was significantly stronger than for animals or fruit & vegetables. Again, the left hemisphere showed larger differences between the semantic categories than the right hemisphere did.

Thus, our results suggest that the anterior temporal lobes and the lower bank of the STS are engaged in the modality-independent processing of unique entities. Furthermore, the left hemisphere differentiated better between named and non-named voices and between unique and generic items, indicating its role in the retrieval of proper names.
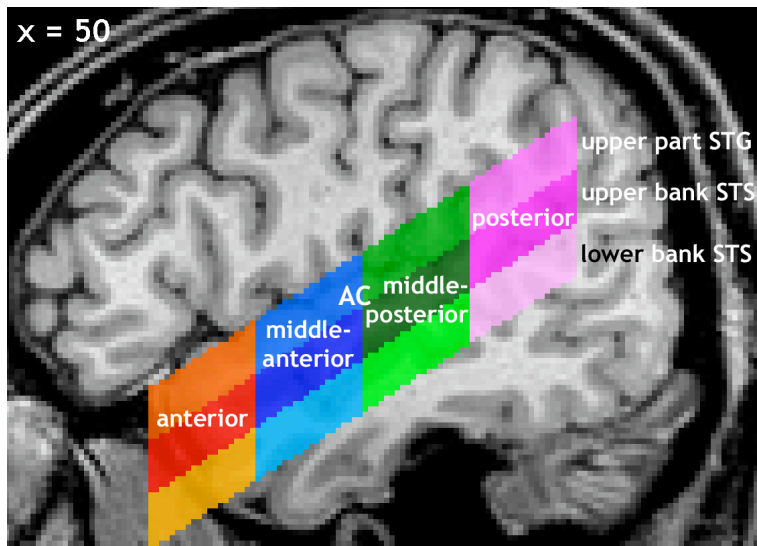
Figure 1. ROI definition in the temporal lobes.

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Presented by: **Bethmann, Anja**

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68. Verb Retrieval and the Influence (or not) of Verb Argument

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Introduction
The retrieval of verbs in aphasic speakers is thought to be affected by a number of factors. The number of arguments a verb takes has been found to be associated with ease of retrieval in agrammatic aphasia (Thompson 1997), and McCann reported an association in fluent aphasia (McCann and Edwards 2004). In this paper we report on verbs and argument structure in connected speech in two fluent aphasic speakers who participated in a verb treatment study (Edwards & Tucker 2006).

Method
Participants: JD (63 years old, 6 months post-onset) and CB (75 years old, 18 months post-onset) were diagnosed with Wernicke's aphasia based on clinical assessments.
Treatment: Treatment, which followed 3 sessions of assessment to establish base-line measures, lasted 4 months. Verb naming, sentence production and spontaneous speech were assessed before and after treatment and 3 months post treatment. Spontaneous speech samples comprised the centre 25 utterances from each of the four Aesop tales (Goodglass, Kaplan and Baresi 2001) and the analysis was based on Thompson, Shapiro and Schendel (1995). The

proportion of grammatically well formed sentences was tallied and verbs were coded for number of the optional/obligatory arguments, as complement verbs, or as copular verbs. The percentage of verbs used with the correct argument was calculated.

Results

Single verb retrieval and single sentence production improved for both participants. CB, but not JD, retrieved more intransitive than transitive verbs. Omission of arguments in the theme role contributed to CB's errors in sentence construction, but not for JD, for whom incorrect verb selection was more problematic. CB's sentence construction improved as he retrieved more obligatory arguments after treatment, while the improvement in JD's sentence production was related to moving from production of general 'light verbs' to more target verbs after treatment (see Figure 1). Both participants produced more high frequency than low frequency verbs in these tasks.

Discussion

Both participants improved after receiving the same treatment, despite differences in the degree and detail of their verb retrieval problems. This suggests that targeting verb retrieval in a systematic manner can have an effect on conditions that differ in detail. It is not known whether more targeted treatment as argued by (Webster et al 2004) would have produced even greater improvement.

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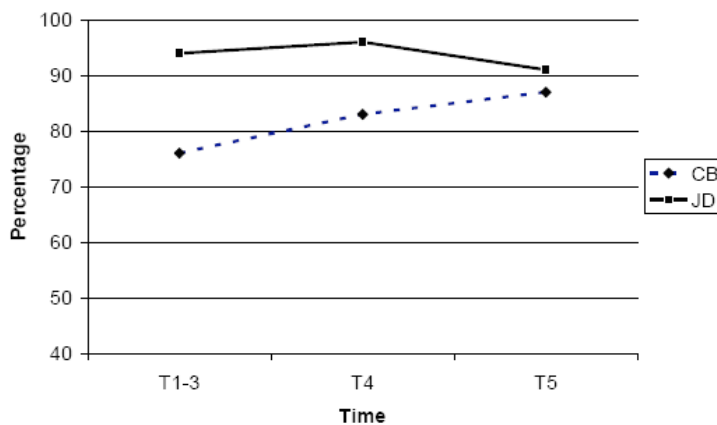
Figure 1: Percentage of verbs with correct argument structure pre- and post-treatment.

Presented by: **van Ewijk, Lizet**

69. Do Noun and Verb Processing Really Recruit Spatially-Segregated Neural Circuits?

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The functional independence of noun and verb lexical retrieval has been reported several times over the last decade (e.g., Rapp and Caramazza, 2002); however, the evidence produced so far on whether these processes recruit separate neural circuits is far less clear (e.g., Bedny & Thompson Schill, 2006; Berlingeri et al., 2008). This may be due to the lack of homogeneity in the tasks that were used in the various imaging experiments. The meta-analysis described in this study aims at disentangling the brain regions that are systematically associated with a given grammatical class from those whose grammatical class specificity is modulated by the task used.

We collected 620 activation stereotactic coordinates associated with either nouns or verbs in simple effect analyses from 22 neuroimaging studies published from 1996 to 2008. A hierarchical cluster algorithm was used adopting the Ward (1963) criterion to automatically segregate groups of coordinates into separate clusters (mean standard deviation < 7.5 mm in the x, y, and z directions for each cluster; Jobard et al., 2003). This procedure produced a set of 49 clusters, which were assessed with a binomial test for specificity for grammatical class and/or task, and with a Fisher test for task-by-grammatical class interaction.

Two clusters were associated with nouns across different tasks (Figure 1a: areas in yellow), while five were associated with verbs (Figure 1a; areas in orange); the locations of these clusters do not support the notion of the existence of spatially segregated neural circuits for nouns and verbs, as suggested in some previous work (e.g., Cappa & Perani, 2003). Five clusters showed instead a task-by-grammatical class interaction (Figure 1b), which was mainly driven by noun-specific activation in derivational tasks and by verb-specific activation in picture naming and fluency tasks: among these areas, the left inferior frontal gyrus, previously associated with verb processing alone. These results will be discussed in the light of the cognitive processes entailed by the individual experimental tasks.

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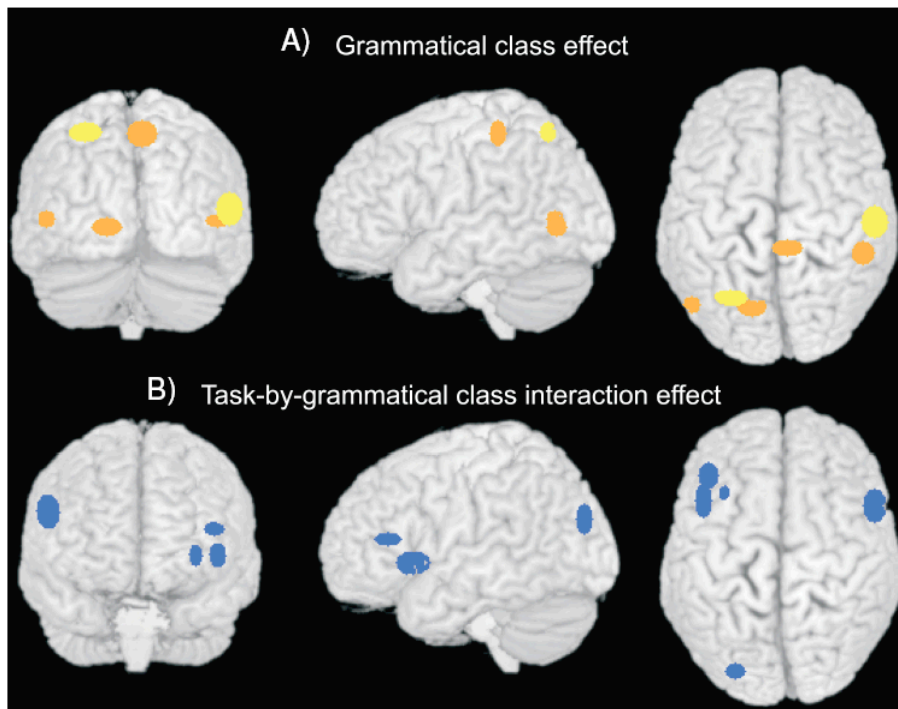
FIGURE CAPTION
(a) Clusters associated with nouns are reported in yellow, while clusters associated with verbs are plotted in orange.
(b) Clusters showing a task-by-grammatical class interaction.

Presented by: **Crepaldi, Davide**

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70. Verb Retrieval and Inflection in Aphasia: Insights from Different Verb Classes in Greek

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Previous studies on aphasia revealed two main vulnerable domains: a) verb inflection and b) verb retrieval. Verb inflection is found to be impaired in a range of languages and for various aphasia types (for Greek, Stavrakaki & Kouvava, 2003; Varlokosta et al., 2006). With respect to verb retrieval there was found an effect of verb argument structure (VAS) on agrammatic performance. Transitive verbs (Thompson, Lange, Schneider, & Shapiro, 1997) and unaccusative verbs (Thompson, 2003) were found to be more difficult to retrieve than unergative ones. The difficulties have been related to problems with the grammatical encoding of arguments (Bastiaanse & van Zonneveld, 2004).
We address the following questions: 1) are transitive and unaccusative verbs problematic for Greek-speaking aphasic patients? 2) does inflection affect retrieval?
We tested four patients, one agrammatic (AG), one anomic (AN) and two Wernicke's aphasics (W1, W2) on the following tasks:
1) Sentence elicitation with video stimuli, in which the participants were presented with videos and had to describe what was happening. Correct responses were those including (i) correct verb lemma and (ii) correct VAS retrieval.

2) Sentence elicitation and tense marking task, in which the participants were presented with the same video stimuli preceded by a phrase prompting for a specific tense/aspect (T/A) marking. They were instructed to combine the phrase and the video in order to produce a correct sentence. Correct responses were those including (i) correct verb lemma (ii) correct VAS retrieval and (iii) correct T/A marking.

In Task 1, all patients (except for W1) found unaccusative verbs the most difficult to produce. As for Task 2, AG's performance dropped remarkably in comparison to Task1, whereas the performance of the fluent patients (except for W1) improved (see Figure 1). In other words, there was a facilitative effect of verb inflection on verb lemma and VAS retrieval only for two of the fluent patients and not for the agrammatic patient.

We argue that production of unaccusative verbs is problematic across aphasia types. We claim that this is related to the mapping mismatch between the patient theta-role and the syntactic subject position. In addition, we suggest that verb inflection affects verb production, either facilitating it in fluent aphasia or hampering it in agrammatism.

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Figure 1. The patients' correct performance (%) on unergative, unaccusative, and transitive verbs in Task 1 and Task 2

Presented by: **Koukoulioti, Vasiliki**
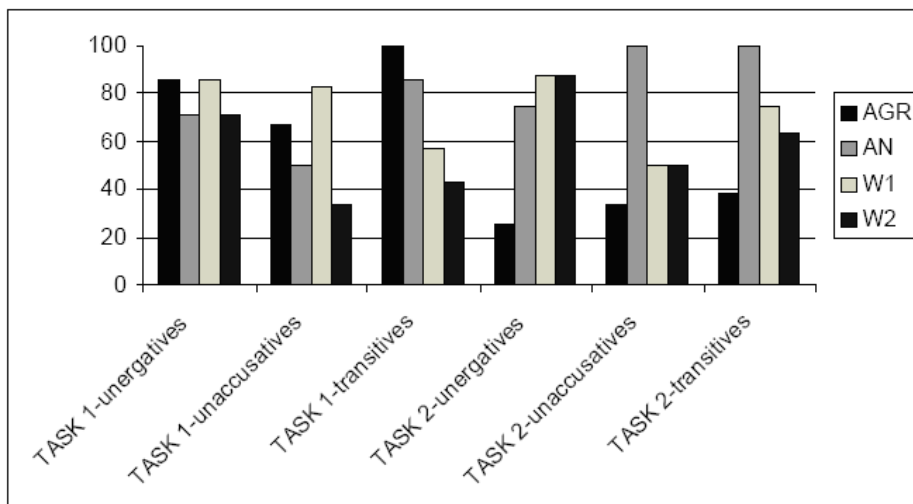
71. Improved Action Naming in a Severe, Nonfluent Aphasia Patient following Transcranial Magnetic Stimulation plus Constraint-Induced Language Therapy

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Introduction
Suppression of R pars triangularis (PTr) with slow (1 Hz) repetitive transcranial magnetic stimulation (rTMS) has been observed to significantly increase naming at 2 months post-rTMS in chronic, nonfluent aphasia (Naeser et al., 2005a; 2005b). Constraint-induced language therapy (CILT) is a program observed to improve object and action naming, where patients may only respond with verbal output (no gestures, writing, sound effects) (Maher et al., 2006). Results are presented for a severe nonfluent patient who received a second series of rTMS treatments, where CILT was administered daily, immediately post-rTMS.

Method
P003 was R-handed, college-educated, 51 Yr., F, with L intracerebral, basal ganglia bleed that resulted in severe nonfluent, global aphasia. At 6.5Yr. poststroke, she underwent the first series of ten rTMS treatments to suppress the R PTr. Her Boston Naming Test (BNT) increased from 4, pre-TMS, to 7 and 12, at 2 and 8 Mo. post-TMS (Naeser et al., 2005b).

At 12.5Yr. poststroke (5Yr.10Mo. after first rTMS series) she underwent a second series of ten, identical rTMS treatments, followed immediately by three hours of CILT (5 days/week, 2 weeks). Prior to intervention, her naming was tested on 500 color pictures (3x). During CILT, one-third of color pictures presented had never been named on pre-testing (0/3); one-third, sometimes (1-2/3); one-third, always (3/3).

To understand changes that might occur during intervention, BDAE naming subtests (Actions, Animals, Tools/Implements), and BNT were administered 12x pre-TMS; and daily, immediately post- each CILT session; and 10x post-TMS (Fig. 1). These time-series data were analyzed using a double bootstrap method: http://www.stat.wmich.edu/slab/Software/Timeseries.html.

Language outcome measures included BDAE and BNT examined at Baseline, pre-TMS (x3); and at 1 and 6 Mo. post-TMS. Significant improvement was defined >2 SD above Baseline.

Results
On the time-series analysis, there was significant improvement on BDAE Action Naming (p=.035) (Fig. 1); Tools/Implements (p=.010). On language outcome measures, there was >2 SD improvement on BDAE Action Naming (Fig. 1); Tools/Implements and Single word repetition.

Conclusions
Suppression of R PTr may have promoted less inhibition of R pars opercularis (R POp) from R PTr, via U-fibers. Improvement may have been associated with better modulation of POp, an area with mirror neurons. Improvement in verbs was observed only following the second rTMS series, with CILT. If potential for re-organizing neural networks for language exists post-TMS, then language therapy administered immediately post-TMS may promote maximal recovery.

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Figure 1. Significant Improvement in Action Naming Test Scores Post- TMS + CILT for Severe Nonfluent, Global Aphasia Patient
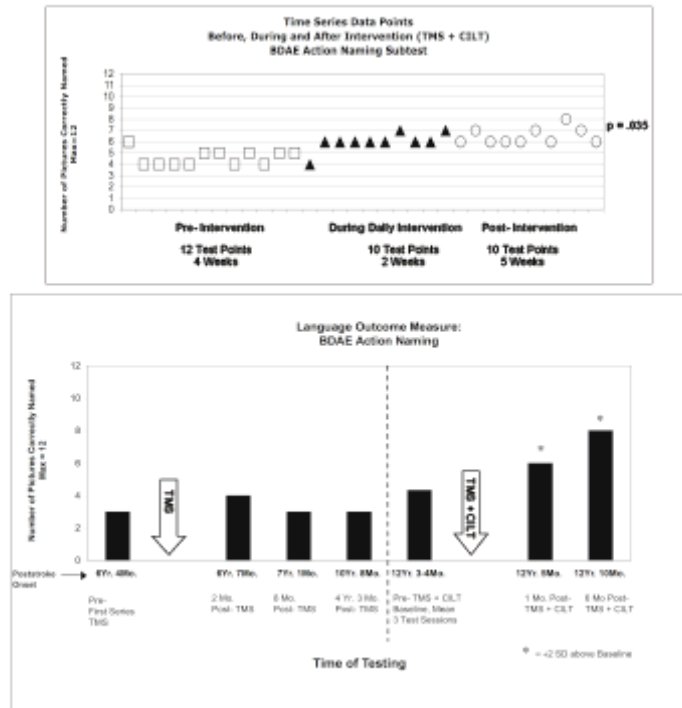
Presented by: **Naeser, Margaret**

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72. fMRI Study with Error Analysis of Overt Action Naming by People with Chronic Aphasia

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Introduction

Naming of action pictures has recently become the center of growing interest in research on normal language processing and aphasia. In an fMRI study with healthy adults, Liljeström et al. (2008) focused on the more complex perceptual characteristics of action over object pictures. They found that these affected cortical activation for silent naming, notably as increases in right middle frontal and bilateral occipitotemporal and parietal regions.

Methods

Nine stroke patients with chronic aphasia (1-10 years post-onset, 38-73 years old, 5 females) participated in this fMRI study of overt naming of 144 line drawings of actions. All patients had left frontal-insular-parietal damage, were right-handed native English speakers, and presented with anomia but good comprehension.

Behavioral Results

Voice recordings of patients' naming responses to action pictures revealed that, on average, they achieved 50% accuracy, and that their errors consisted of semantic paraphasias or descriptions (50%), omissions (40%), phonemic paraphasias (8%), and neologisms (2%).

Semantically related errors consisted of verbs denoting related actions (61%, eg., pour-->drinking), objects displayed in pictures (22%, eg., stack-->boxes), phrases (13%, eg., crawl-->on the floor), formulaic expressions (3%, eg., sneeze-->achoo), and adjectives (1%, eg., carry-->heavy). All verb types were equally likely to elicit omissions and non-verb semantic errors. Actions designated by instrumental verbs, unaccusative and unergative verbs, and non-instrumental transitive and ditransitive verbs induced object responses (eg., stir-->spoon; melt-->ice cream; march-->soldier; bite-->dog) in approximately equal proportions (20-23% errors).
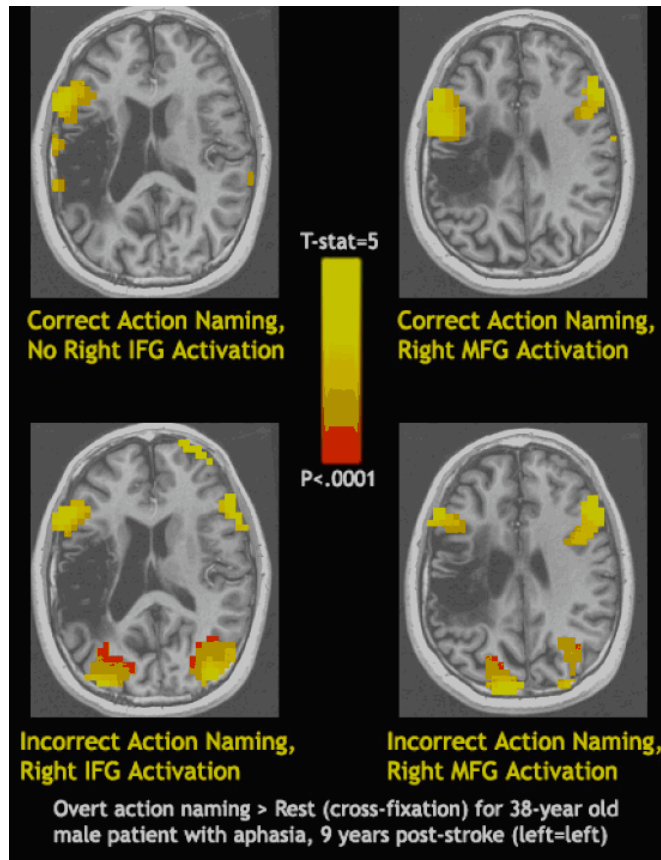
Functional Results

Contrasts of accurate and inaccurate action naming vs. rest (cross-fixation) revealed that for all patients, perilesional activation was evident for all responses. However, activation in right (contralesional) Inferior Frontal Gyrus was much more robust for inaccurate than accurate responses. These findings replicate results for object naming reported in Postman-Caucheteux et al. (to appear). Moreover, bilateral temporo-occipital and precuneus activation was much greater for action naming errors than accuracies. Critically, for some patients, activation in portions of the right Middle Frontal Gyrus was present for both correct and incorrect responses (see figure).

Implications

Our results bear on the nature of potential compensatory mechanisms of right (contralesional) frontal areas in patients with lesions affecting left frontal cortex. Since contralesional activation in the IFG was linked to action naming errors but not accuracies, it may represent an ineffective compensatory processing route. In contrast, our finding of right MFG activation for both accurate and inaccurate action naming suggests that, in conjunction with temporo-occipital and posterior parietal regions, it may support visual search and attention mechanisms required for analyzing action pictures, as proposed by Liljeström et al. Therefore, it may represent task-related rather than compensatory activation.

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Overt action naming > Rest (cross-fixation) for 38-year old male patient with aphasia, 9 years post-stroke (left=left)

Presented by: **Postman-Caucheteux, Whitney Anne**

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73. Electrophysiological Correlates of Nouns and Verbs: Effects of Task and Stimulus Characteristics

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During the last decade over one hundred studies have explored the processing of verbs, in contrast with nouns, in different populations in behavioural, lesion and imaging studies with the aim of understanding the functional underpinnings of noun-verb differences and finding the neuro-anatomical correlates of noun and verb representations and/or processing. Despite this research effort, there is still no consensus about most questions under investigation. Past studies used predominantly the picture naming paradigm that conflates noun-verb differences with differences between object and action knowledge and/or picture interpretation, or conflated grammatical class with morphological processing by using tasks that involved inflected nouns and verbs or by employing a morphological transformation task. ERP studies to date used sentences which again might introduce additional confounds unaccounted for response variables.
The main objective of the current study was to find behavioural and electrophysiological evidence for grammatical class distinctions. To that end we compared event-related potentials (ERPs) in response to (1)naming line drawings of object and action pictures,(2)lexical decision (a task that has been previously used in similar studies), and (3) grammatical class judgment task in which participants decide if a word is a noun or a verb. This is a novel task that

is expected to tap into information about the grammatical class of words directly.

20 native speakers of English participated in the study. The materials for task (1) consisted of line drawings of 100 object and 100 action pictures whose verbal labels were matched for age of acquisition (Druks & Masterson, 2000), and for tasks (2) and (3), of 47 concrete nouns and verbs 47 abstract nouns and verbs. Care was taken that all words included in the study were unambiguously either nouns or verbs.

The ERP results showed evidence for grammatical class distinction only in the grammatical class judgment task which was more pronounced for abstract nouns and verbs. No differences in ERP responses were found in the object and action naming task or in the lexical decision task.

The results showed strong evidence for grammatical class distinction only in the grammatical class judgment task in which the difference was more pronounced for abstract nouns and verbs both in the behavioural and electrophysiological tasks (see Figure 1). No clear processing differences were found in the lexical decision task or in the object and action naming task. The results highlight the importance of task and stimulus material in the investigation of grammatical class differences. We argue that differences between nouns and verbs that are due to grammatical class (and not to conceptual-semantic differences between objects and actions) can only be demonstrated in conjunction with abstract nouns and verbs, and the grammatical judgement task (albeit an effortful task) is suitable to tap such differences.

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Presented by: **Druks, Judit**

74. Differential Effect of Constraint-Induced Aphasia Therapy on Noun Related/Non-Noun Related Verb Production.

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Introduction
Jonkers and Bastiaanse (2007) found that in addition to grammatical variables that had been reported to influence verb production in aphasia (e.g., argument structure), lexical/phonological variables affected action naming performance of individuals with anomic aphasia. Their participants with Broca's aphasia, by contrast, did not show consistent differences between verbs that are phonologically related to nouns (e.g., hammer- to hammer) and verbs that have no noun relation (e.g., to eat), possibly due to great inter-individual variability in the data.

In the current study we set out to examine whether both verb types (noun-related verbs vs. non-noun-related verbs) are equally produced by individuals with Broca's aphasia and whether the two verb types respond differently to a constraint-induced aphasia therapy (CIAT) that targets verb production.

Method
To achieve these goals, three speakers with Broca's aphasia, ranging in age from 38 to 61 and in years post onset from 2.5 to 7, received CIAT which required a four-week period of intensive language therapy (2.5-3hrs/day, 3-4 days/week). During the treatment sessions, the participants were discouraged from using any communicative modalities other than oral production and were encouraged to produce verbs in complete sentences. An action-naming task, consisting of 96 items (57 noun-related / 39 non-noun-related verbs), was administered before and after treatment. During the action-naming task, a picture was shown and the participants were asked to describe in a sentence what the person in the picture was doing. Production of the target verb was considered a correct response, regardless of sentence completion.

Results and Conclusions
In the pre-treatment measurement, the participants produced noun-related verbs more accurately than non-noun related verbs; this finding was statistically significant for two participants, but not significant for one participant. Post treatment testing revealed that CIAT facilitated significant improvements in verb production (Odds ratio 2.27). Furthermore, when we compared the therapeutic effects on the two different verb types, we found that for all three participants, non-noun-related verbs benefited more from treatment (Odds ratio 3.16) than noun-related verbs (Odds ratio 1.39) (See Figure 1).

We hypothesize that a noun-related verb shares a lemma with its related noun, which may facilitate its retrieval for individuals with Broca's aphasia (who typically experience greater difficulty with verb than noun retrieval; Kim and Thompson, 2000). By contrast, non-noun related verbs do not have this advantage, and are therefore more difficult to retrieve. The emphasis on verb production during treatment may have strengthened the route to verb retrieval, facilitating particularly the retrieval of verbs that cannot be retrieved via their related noun.

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Figure 1. Differential effect of constraint-induced aphasia therapy on noun related/ non-noun related verb production
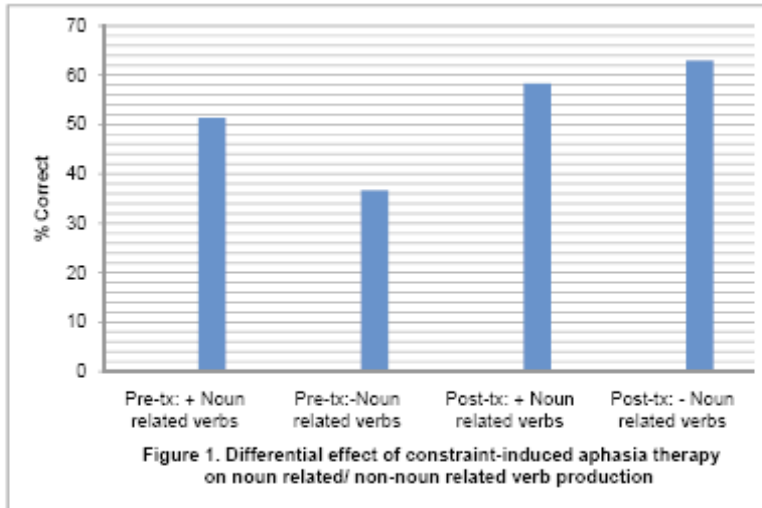
Presented by: **Park, Youngmi**

Poster Session 2: Reading

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75. Semantic Paralexias: Incidence and Underlying Linguistic Deficits in 343 Consecutive Italian-speaking Aphasics

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Introduction
Reading requires both lexical-semantic mechanisms (words) and sublexical grapheme-phoneme conversion (GPC) procedures (pseudowords). Most theories assume that the two sets of mechanisms interact (eg, the summation hypothesis). On this view, at least in some conditions the target word in reading may be selected based on converging information from lexical-semantic and GPC procedures. The interaction between lexical-semantic and GPC processes allows interpreting dyslexic patterns. In the presence of lexical-semantic damage, "functional" GPC procedures block semantically incorrect reading responses; whereas, semantic paralexias occur when GPC mechanisms are essentially "non-functional". In agreement with this account, semantic paralexias were reported in aphasics with lexical-semantic impairments and severe GPC damage, but not in aphasics with lexical-semantic damage and "functional" GPC mechanisms.
Several issues remain underspecified. Semantic paralexias were described in single-case reports, but their occurrence in large aphasic populations is unknown. In addition, even though semantic paralexias were reported more often in opaque than transparent languages (eg, in approximately 40 English-speaking subjects, but in only 3 Italian aphasics), it is not yet clear if their occurrence differs across languages as a function of orthographic transparency/opaqueness. Furthermore, while all subjects who produce semantic paralexias read aloud pseudowords very poorly, measures of GPC damage are limited to the percentage of incorrect responses, that provide only rough estimates of the status of GPC procedures.

The goal of this study is threefold: 1. to evaluate the number of aphasics who produce (SP+) and do not produce (SP-) semantic paralexias; 2. to verify if combined lexical-semantic and GPC damage is a prerequisite for these errors; 3. to quantify GPC damage necessary to result in semantic paralexias in Italian.

Materials and methods
We analyzed the performance of 343 consecutive, Italian-speaking aphasics in word-picture matching, picture naming and reading aloud tasks (words and pseudowords). We evaluated the occurrence of lexical-semantic errors to words in these tasks. The percentage of GPC rules applied incorrectly (rather than the percentage of pseudowords read incorrectly) was retained as an index of GPC status.

Results
Semantic paralexias occurred in 8/343 (2.3%) SP+ aphasics. Without exception, these subjects had combined semantic-lexical and GPC impairment. When contrasted to SP- aphasics with similar semantic-lexical damage (25-30% semantic errors in picture naming), SP+ subjects showed substantially more severe GPC impairment. On average, they applied incorrectly 73.1% GPC rules (range: 96.9-48.7%). In 28 matched SP- subjects, the corresponding figure was 7% (range: 26.3-0.4%).

Discussion
Subjects who produce semantic paralexias are extremely rare in Italian (2.3% in an unselected aphasic population). Semantic paralexias occur only in the presence of combined semantic-lexical and GPC impairment. GPC damage is always very severe in these cases, as the SP+ subject with the least severe GPC damage applied incorrectly 48.7% GPC rules. The corresponding figure for the SP- subject with the most severe GPC damage was 26.3%. The quantitative data reported here can inform computational models of reading. They provide also a large database for cross-linguistic studies on the role of orthographic transparency/opaqueness in the interaction between lexical-semantic and sublexical conversion mechanisms in transcoding tasks.

Presented by: **Miceli, Gabriele**

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76. Word Stress Assignment in Surface Dyslexia: A Case Study in Slovenian

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In this paper we report evidence in support of the distinction between lexical and non-lexical mechanisms in oral reading in a language (Slovenian) with transparent orthography/phonology mapping at the segmental level. The newest aspect of the present study concerns a relatively neglected aspect of the mapping relation between orthography and phonology: the assignment of word stress. As already noted by other studies, in a language where stress is lexically specific (such as Italian or Slovenian) the production of stress errors in oral reading is a predicted outcome in the case where the following two conditions obtain: 1) the phonological representations are not activated normally, and 2) there is relative sparing of the ability to convert orthographic strings into phonological representation by means of sub-lexical, orthography to phonology conversion procedures. On this view, the form taken by such errors would reflect the nature of the phonological knowledge that is used to assign stress to an unfamiliar phonological string.

BI was a 60 years old male, with 13 years of education, who suffered from damage of ischemic nature in the left hemisphere. At the time of testing he had recovered from well articulated fluent aphasia, but he still had problems in reading.

BI was asked to read aloud a list of 266 words two to four syllables in length (128 nouns, 37 adjectives, 60 verbs in the infinitive form and 18 function words in Slovenian, 23 highly familiar English or French words that are commonly used in Slovenian as loans, e.g. "blue jeans") and 68 non-words two to four syllables in length. All real words were read flawlessly by a group of 30 age and education matched controls.

BI read all Slovenian words slowly, without committing omissions, substitutions or other phonemic errors; when reading loans from English or French, he read them through strict grapheme-to-phoneme conversion, thus resulting in non-words. However, in Slovenian BI was at loss with the word stress. In fact he committed 39 stress errors on nouns, 8 on adjectives, 49 on verbs, 5 on function words. Importantly, a considerable proportion of these errors (up to 100% on verbs!) did not result from the application of the default strategy of putting the stress on the most frequently stressed syllable. The stress appeared instead in positions not allowed in Slovenian for that category of words. In reading verbs, for instance, BI tended to put the stress on the last syllable, which is never the case in Slovenian infinitive.

BI showed the pattern of surface dyslexia: he used almost exclusively the grapheme-to-phoneme conversion routine, resulting in non-words during the reading of the list of English words and in stress errors during the reading of Slovenian words. Errors whereby the word stress is assigned to a position that is not allowed have never been reported so far. This finding may indicate the existence of a separate stage, disturbed in BI, where allowed patterns of stress are stored.

Presented by: **Semenza, Carlo**

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77. Neural Response to Word and Pseudoword Reading after a Left Fusiform Gyrus Resection: An fMRI Investigation

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Introduction
Our understanding of neural reorganization subsequent to brain lesion and functional recovery is fairly limited, particularly in the area of orthographic processing. Findings from the neuropsychological and neuroimaging literature have attributed an important role of the left fusiform gyrus in reading (Cohen et al., 2000; but see Price & Devlin, 2004; Mechelli et al, 2003). We report on a individual with a left hemisphere fusiform resection and the results of an fMRI study of silent-reading of words and pseudowords as well as visual processing of faces and objects that allowed us to compare his activation patterns to those of a group of normal age- and education-matched control participants. This comparison allowed us to evaluate neural changes that take place subsequent to damage to critical orthographic processing areas.

Case Study
DPT underwent a resection that produced a lesion affecting the left mid-fusiform and adjacent inferior temporal cortex. In Tsapkini & Rapp (in press) we have documented the behavioral deficits compared to a group of controls . DPT showed intact visual processing with faces and objects as well as intact processing of nonwords in both reading and spelling. However, he showed evidence of lexical impairments in reading and spelling. With regard to reading , he was impaired (in latency) in reading words as well as in rapidly access the meaning of written words. Pseudoword processing was intact.
Methods and results. DPT and 8 matched control participants were scanned using 1.5T fMRI while during silent reading of words and pseudowords as well as passive viewing of faces and objects.
With regard to passive viewing of faces and objects DPT exhibited the same topography of activations as control subjects. Regarding the silent reading of pseudowords DPT exhibited the same activation as control subjects in the left fusiform, but not in the right fusiform. Whereas controls showed right mid-fusiform activation, DPT showed only posterior fusiform activation. In silent reading of words, DPT exhibited the same right posterior activation that was not observed in the controls. In addition in word reading he exhibited anterior middle temporal gyrus activation in both the right and left hemispheres This area was not activated for pseudowords for either DPT or controls. It has generally beenassociated with semantic processing (Mummery et al., 1998).

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Presented by: **Tsapkini, Kyrana**

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78. Reading Compounds in Neglect Dyslexia

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Introduction
Neglect dyslexia manifests itself with misreading of letters, words or strings of words located in the contralesional side of visual space. Thus, left-sided neglect errors produced in single word reading can be omissions and substitutions of the leftmost portion of the word. The literature reveals that errors may be influenced by the lexical status of the target. Thus, stored lexical knowledge seems to partially compensate for the attentional problem. When reading compounds, patients affected by neglect dyslexia seem to respect the boundaries between the first and the second component. Thus, in left-sided neglect, they would omit or substitute the first more often than the second component. The present study exploits this finding in order to assess the influence of "headedness." The "head" of a compound is the component that determines the morphological and semantic properties of the compound as a whole. The question arises of whether the privileged status of the head constituent influences processing and determines behavioural patterns in the breakdown of the spatial attention present in neglect.
Positional and headedness effects cannot be easily teased apart in languages like English where the head is always on the right. The present study overcomes this difficulty by using Italian, where compounds can be both right- and left-headed.

Materials and Methods
Participants: Eighteen Italian-speaking patients affected by left-sided neglect participated in the study.
Materials: Fifty-six Italian Noun-Noun compounds were used: (a) 28 transparent left-headed compounds (e.g., capobanda, band leader), and (b) 28 transparent right-headed compounds (e.g., astronave, spaceship). Length, Frequency, Familiarity and Age of Acquisition (AoA) were taken into account. Patients read aloud each word displayed on a computer screen. Noun-Noun compounds were randomly intermixed with 55 Verb-Noun compounds in a different random order.

Results
Only errors (n=416) made exclusively on the left component of Noun-Noun compounds were considered for data analysis. More errors were found with right-headed than with left-headed compounds [$p < 0.001$]. No participants made more errors with left- than with right-headed compounds and only one made an equal number of errors in left- and right-headed compounds. Logistic regression was used to further analyze the data. Coefficients were: 0.27 [$z = 2.25$, $p < 0.05$] for headedness (assuming right headedness as reference level), 0.25 [$z = 4.48$, $p < 0.001$] for familiarity, 0.0007 [$z = 2.006$, $p < 0.05$] for frequency, and -0.17 [$z = -4.57$, $p < 0.001$] for length. No effect was found for AoA because of the high collinearity with familiarity.

Discussion
These findings are rather clear-cut. Patients with left-sided neglect make omission and substitution errors on the left component of the compound. However, headedness seems to partially protect these patients' reading as they make significantly more errors when the leftmost component is the non-head compound constituent. This finding converges with recent data from aphasia and ERPs in indicating the crucial role of headedness and its neurological underpinnings.

Presented by: **Semenza, Carlo**

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79. Are Reading Strategies in Aphasia Reflected by Eye Movements?

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Introduction
Except for recent work on pure alexia (Behrmann et al., 2001; Johnson & Rayner, 2007), no research has so far attempted to analyze word based viewing time measures and local fixation patterns in acquired dyslectics. We report data on two aphasic patients whose reading performance indicated that WG relied primary on segmental and CM on lexical information take-in (De Bleser, 2000). The current study focused on the question whether their reading strategies are also reflected in eye movement parameters and whether these parameters differ from those of a control group.

Methods
Both patients as well as the control group (n=34) were asked to read six words in sequence presented simultaneously on a computer screen while their eye movements were recorded from the right eye. Stimuli consisted of 180 words, equally divided into short, middle, and long stimuli and balanced for word frequency.

Results
Total reading time. - Both patients differed significantly from controls; CM showed a significantly higher total reading time than WG.
Total number of gazes. - CM needed significantly more gazes than WG.
Gaze duration (first gaze). - Only WG's first gaze duration differed significantly from those of controls. It increased with increasing word length while it decreased in CM.
Total number of fixations (first gaze). - There was a significant increase across word length in WG and a decrease in CM.
Mean progressive saccade amplitudes. - WG's mean progressive saccade amplitudes differed significantly from those of the controls for short and long words.
Initial fixation landing position. - WG started scanning at letter position one independently of word length (see figure 1). CM showed different distributions of landing positions for short and long words.

Discussion
We were able to confirm our expectations that lexical and segmental reading strategies differ in temporal and spatial parameters of eye movements.
WG's segmental reading was characterized by scanning in small steps as reflected in short progressive saccade amplitudes and very long first pass gaze durations that increased substantially with word length. Re-inspections of the same word were quite rare, with number of passes comparable to controls. Initial saccade landing sites were centered on the first letter irrespective of word length.
In contrast, CM showed dramatically shorter gaze durations, which even decreased for longer words, combined with a dramatic increase in total reading time. It appeared that, with long words, CM tended to give up on whole word recognition during first pass reading and preferred to re-inspect words several times. This 'resignation effect' did not have an impact on first fixations and saccade landing position varied with word lengths.

Our findings underline the useful role of eye movement measurement to explore the underlying reading mechanism in acquired dyslexia. Further research is needed to corroborate our data for a larger patient sample.

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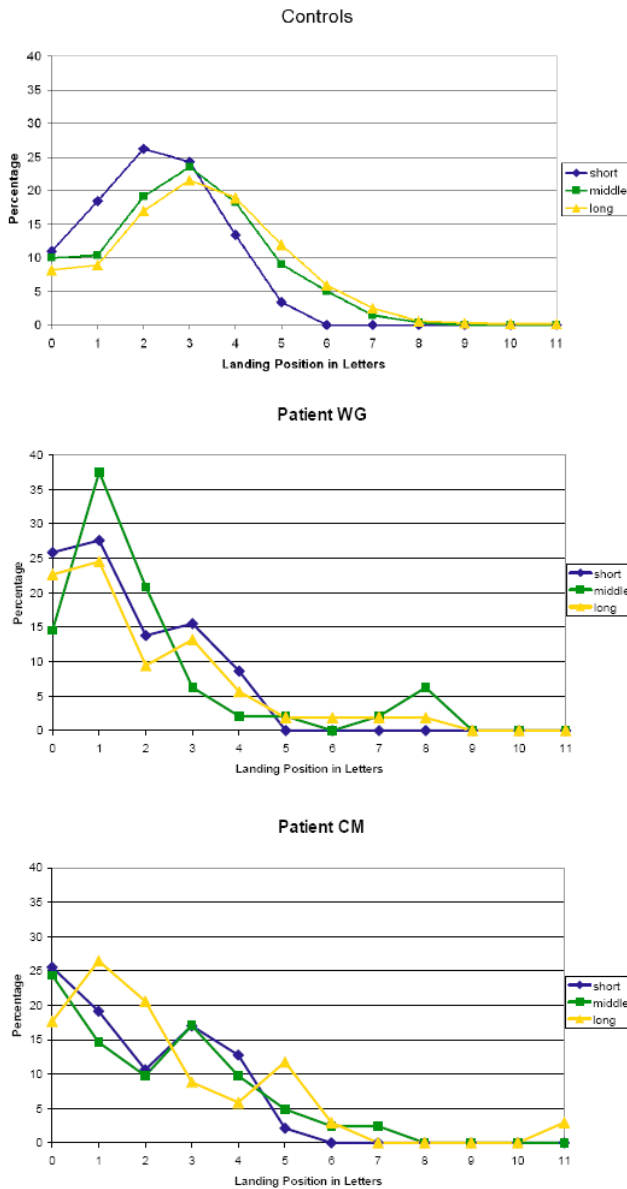
Figure 1. Initial landing site distribution for progressive saccades.

Presented by: **Schattka, Kerstin**