Platform Session 3: Sentences and Sequences

80. Different Mechanisms for Role Assignment for Functional and Lexical Categories

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A major component of sentence processing is the assignment of words to their correct semantic roles and arguments, so that TOM receives the agent role and the subject argument in the sentence TOM GREETS SALLY. Verbs vary in the set and number of roles and arguments they can take and the set of syntactic structures that they can be expressed in. In contrast, it has been observed, cross-linguistically, that prepositions and other grammatical constituents (e.g., quantifiers) differ from verbs in that their arguments can only be expressed within specific syntactic structures. For instance, English locative prepositions like IN, ON, or UNDER typically occur with the verb "to be". These prepositions denote spatial relations and entail figure/ground role distinctions. For example, in THE PEN IS ON THE BOOK, PEN (the figure) takes the subject argument, whereas BOOK (the ground) corresponds to the reference object. These differences between verbs and functional categories have motivated the proposal that argument assignment involves different mechanisms for these word classes (e.g., Baker, 2003; Croft, 1991). Specifically, for verbs, argument assignment is based on information within the lexical entry, while for at least some other grammatical categories, it relies critically on information associated with the specific syntactic structures they are expressed within. In this work, we report evidence from an aphasic, English-speaking individual (GFE) that provides clear support for this proposed distinction.

GFE is a left-handed, college educated male who suffered a left-hemisphere stroke. He had difficulty identifying figure and ground in locative sentences, as evidenced by frequent role-reversal errors. For example, when asked in a forced-choice task to point to the picture of a circle on the square, GFE chose the picture of the square on the circle (35/96 trials, 36%). GFE produced similar role-reversal errors when verbally describing the same scenes (circle on square > "The square is on the circle"). Additional testing ruled out difficulties in understanding spatial terms or a general spatial deficit. Like locatives, English comparatives occur with to be verbs (TOM IS TALLER THAN SALLY). GFE also made role-reversal errors with comparatives, both in comprehension and production tasks, despite preserved access to adjective meaning. However, in striking contrast, role-reversal errors were rarely produced with role-reversible verbs. For example, when presented with pictures of a boy greeting a girl and a girl greeting a boy, GFE made role-reversal errors only 5% of the time. With locatives and comparatives, role-reversal error rates were 36% to 29%.

GFE's error pattern contrasts with the one typically observed in agrammatic patients, who produce role-reverse errors with verbs. The finding of selective role-reversal difficulties with locatives and comparatives but not verbs fits well with those linguistic accounts that draw a distinction between verbs, which can directly assign roles to arguments, and grammatical classes such as locative prepositions, for which role assignment depends on the required syntactic structures.

References
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Presented by: **Miozzo, Michele**

81. The Role of Phonological Working Memory in Sentence Comprehension: The Interaction Between Type of Processing and Output and Input Buffer Deficits

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Introduction

This study explored the nature of the relation between phonological working memory (pWM) impairment and sentence comprehension, focusing on sentence comprehension in conduction aphasia. The two main comparisons made were between sentences that require semantic-syntactic reactivation and sentences that require phonological reactivation, and between input-buffer conduction aphasia (repetition) and output-buffer conduction aphasia (reproduction) (Shallice, Rumiati, & Zadini, 2000; Shallice & Warrington, 1977).

Method

The participants were 14 individuals with conduction aphasia and 214 control participants without language or memory impairments. All participants had pre-morbidly full control of Hebrew, and at least 12 years of education. Ten recall and recognition span tasks were used to measure their pWM capacity. To assess phonological output buffer we used a full transcription of spontaneous speech, repetition of words and nonwords, picture naming, and various phonological manipulation tasks such as spoonerism and sound deletions. To exclude a deficit in the early auditory processing stage, we also included auditory rhyme judgment tasks and auditory discrimination tasks. Experiments 1 and 2 tested the comprehension of relative-clauses, which require semantic-syntactic reactivation, using sentence-picture matching of 168 relative-clauses, and plausibility-judgment of 80 relative-clauses. Experiments 3 and 4 tested phonological reactivation, using a paraphrasing task for sentences with lexical ambiguity in which the disambiguation requires re-access to the word-form (148 sentences), and rhyme judgment (184 sentences). The distance between a word and its reactivation site was manipulated in terms of number of words/syllables, number of intervening arguments, and the number of intervening embeddings.

Results

All the participants with conduction aphasia showed very limited recall spans compared to the control group. Two participants performed similarly to the controls in recognition spans, suggesting a selective output buffer deficit, further supported by their error pattern in naming, repetition, spontaneous speech, and phonological manipulation tasks. Of the remaining 12 participants, 7 showed phonological errors in the output tasks in addition to limited recall and recognition spans, suggesting a mixed (input and output) conduction aphasia, and 5 participants had pure input conduction aphasia, with limited recall and recognition spans but without phonological errors in the output tasks. Although their pWM was very impaired, the twelve individuals with input-buffer deficit comprehended relative-clauses well and without distance effect. They did, however, have difficulties understanding and judging sentences that required phonological reactivation, but only when the phonological distance was long (Figure 1). The participants with output conduction aphasia comprehended well and not different from the healthy controls.

Conclusions

The results suggest that pWM is not involved in sentence comprehension when only semantic-syntactic reactivation is required. It does support comprehension in very specific conditions: when phonological reactivation is required after a long phonological distance. The results also show that a pWM deficit only in the output-buffer does not affect the comprehension of sentences of any type.

References

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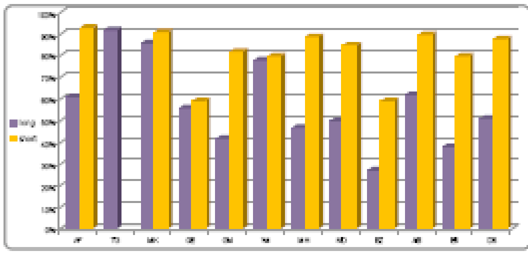

Figure 1. Individuals with input or input-output conduction aphasia: %correct on sentences with an ambiguous word that require phonological reactivaton.

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82. Position Representation in Spelling and Verbal Working Memory

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Producing word spellings involves working memory (Glasspool, 1998). In this research, we ask: Does orthographic working memory use the same representations and processes as are used in other working memory domains? Previous research reveals a number of similarities between orthographic and verbal working memory. For example, both exhibit a serial position function where more errors are produced towards the middle of the string than at either edge (Glasspool, 1998). However, this similarity is difficult to interpret as it may be coincidental (Glasspool, 1998) or only superficial. Indeed, when the serial position functions are analyzed carefully, consistent differences are found between spelling and verbal working memory (Wing & Baddeley, 1980). In the research reported here, we compare orthographic and verbal working memory using a novel procedure we have developed to test if order is represented the same way in orthographic (spelling) and verbal working memory.
In prior work we developed analysis tools for investigating the representational system used to represent the order of elements in any type of sequence (Fischer-Baum, McCloskey & Rapp, 2007). These analysis techniques are applied to perseveration errors – items intruded into a spelling from a previous response – and they allow us to compare different systems for the representation of order. Briefly, for perseveration errors, the analysis considers the position of the perseverating letter in the source word and the target word and evaluates which type of representational system best accounts for the relationship between source and target position.
For this report, we analyzed perseveration errors made by both individuals with acquired dysgraphia (n=2) and unimpaired subjects (n=200), in both (1) spelling-to-dictation and (2) verbal serial recall tasks. We applied the analysis techniques to evaluate which of various candidate representational system best explain the position maintained by perseveration errors made in these tasks. We consider the following representational systems: Start, End, Center, Closest-End, Both-Ends, Preceding-Element and Following-Element. The results indicate that both verbal working memory and spelling employ a representational scheme that represents the positions of elements in a sequence relative to both the start and the end of the sequence. This was found to be the case for both the individuals with acquired impairments and the unimpaired subjects. These results provide clear support for the hypothesis that orthographic and verbal working memory make use of the same representational system for order.
Our analysis addresses a core property of any working memory system: how order is represented. As order is represented the same way in orthographic and verbal working memory, we raise the possibility that both-edges representation is a general order representational system for sequences from different domains.

References
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Presented by: **Fischer-Baum, Simon**

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83. Selection for Position: The Role of Left Inferior Frontal Gyrus (LIFG) in Sequencing Nouns

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LIFG patients famously show syntactic deficits. They also show greater interference in serial recall and semantic blocking studies. Conceivably, both deficits could arise from inadequate biasing of competitive interactions during language production. To test this hypothesis, we manipulated "positional" interference during multiword naming by priming one of the nouns in the same or different position. We hypothesized that LIFG patients would show heightened interference compared to controls. Based on previous results (Schnur, Schwartz, Kimberg, Hirshorn, Coslett & Thompson-Schill, 2009) we also predicted that damage to dorsal BA 44 might be particularly relevant.

Participants
Four patients with substantial damage to LIFG (BA 44, 45 and 47) and minimal damage to posterior language areas participated. All were proficient in single word naming (Philadelphia Naming Test: 88-95% accuracy). Six healthy controls (age: 52-70) also were tested.

Methods
On each trial, participants named two pictures shown on a computer using a simple "x and y" phrase. Pictures disappeared upon speech onset, encouraging concurrent planning of the two nouns. Each session contained 2 blocks. Each block contained 200 naming trials. This included 40 3-trial sets ("triads") in which one of the nouns repeated. On the first two trials of the triad, the repeated noun always appeared in the same position (first or second, 50% each). On the critical third trial, it either stayed in the same position ("consistent") or switched ("inconsistent").
We measured naming latency from digital recordings. We calculated baseline RTs from 120 non-repeat trials in each block (80 fillers and 40 first trials in triads). For the critical trials, normalized RTs were calculated as (RT-Baseline)/Baseline. This controlled for baseline RT differences across participants. Our interference measure was (Normalized RT on inconsistent) minus (Normalized RT on consistent) trials. Patient means were calculated from two sessions, control means from one session.

Results & Discussion
Two patients (TB, CBD) showed heightened interference effects in RTs (>1 SD) compared to controls; the remaining two (MD, UT) did not (Fig. 1a). On non-repeat trials, the former group made more omissions (Fig. 1b) but fewer errors overall when animacy was a useful cue for sequencing (Fig. 1c). As predicted, damage to dorsal BA 44 separated the former from the latter (Fig. 1d).

Our results extend the biasing competition hypothesis for LIFG to a sequencing task, and indicate a more precise anatomical locus. Damage to dorsal BA 44 (border of 44 and 6) identified a subgroup of LIFG patients who showed greater positional interference and overall difficulty with multiword naming. These results suggest that LIFG's role in syntax may include selection for position.

References
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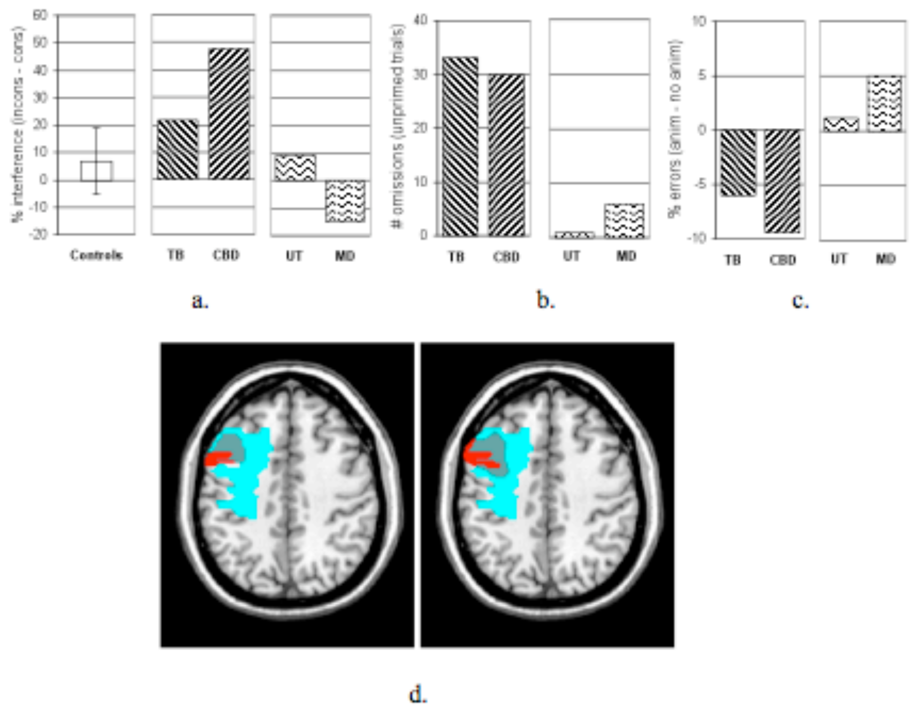

Fig.1. All measures result in clustering of (TB and CBD) versus (UT and MD): a. Residual RT scores on inconsistent position minus consistent position trials. Larger difference indicates greater interference. Error bar = 1 SD; b. Number of omissions on unprimed trials. One word omitted in an attempted multiword utterance; c. Percent error on trials where ordering is consistent with animacy (animate is first) minus error on trials with no helpful animacy cues (both nouns inanimate or animate is second); d. Axial slices showing lesions of TB and MD (left); CBD and MD (right). MD (blue) has a larger lesion volume overall, but TB and CBD (red) have damage to dorsal BA 44, at the border of BA 6. UT's lesion is confined to ventral LIFG and does not extend to this slice.

Presented by: **Thothathiri, Malathi**