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Evidence from Paraphasia

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**Conceptual mechanisms underlying noun and verb categorization:
evidence from paraphasia¹
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0. Introduction

Sapir (1949) noted that nouns and verbs constitute one of the most basic distinctions made in language. He based this fundamentality on the pragmatic function they serve. As he put it, "There must be something to talk about and something must be said about this subject of discourse once it is selected." People suffering from aphasia, however, often encounter great difficulty producing content words which severely impairs their ability to communicate. This disability is called anomia. Several studies of aphasia have found evidence of selective dysfunction for nouns or for verbs. Some patients have greater difficulty accessing nouns, while other patients have greater difficulty accessing verbs. The fact that either nominal or verbal word categories may be selectively affected by aphasia indicates that nouns and verbs are differentiated in the cognitive processes involved in lexical representation and access. In other words, the distinction between nouns and verbs must have a fundamental cognitive basis.

This paper addresses the structure and plasticity of lexical categorization. In particular, I will show evidence that noun and verb category differences are, at least in part, conceptually based. The lexicon has been envisioned as being like a dictionary, where non-redundant semantic and syntactic information is stored. An alternative view of the lexicon is that of a complex network of conceptual associations which, taken as a whole, incorporates encyclopedic knowledge of the world. Based on lexical substitutions made by ten Wernicke's aphasic patients, I will argue that the lexicon must be organized in the form of a complex network of conceptually motivated associations. In other words, the categorical distinction between nouns and verbs must be conceptually motivated rather than simply being due to grammatical category coding in the lexicon.

An analysis of aphasic substitution errors should indicate which structures of the lexicon are the most resistant to damage. In this manner, the most fundamental aspects of lexical categorization can be uncovered. To make a case for the conceptual basis of grammatical category representation, I will show that nouns and verbs are differentially affected by the dysfunction. The prediction is that if the lexicon is derived from a network of associations, then the majority of the lexical substitutions should be related to the target word in a number of diverse ways. Furthermore, an analysis of aphasic lexical substitutions should indicate what type of associations are preserved by the dysfunction and are sufficiently salient for the substitution to occur. Cognitive linguistic theories have established certain mechanisms such as schematization, metaphor, and metonymy as being central to categorization and the formation of associative links in the lexicon. As such, these same mechanisms should drive the production of lexical substitutions. Lastly, if noun and verb categories are derived from conceptual structures rather than being stipulated in the lexicon then there should be systematic differences between noun and verb substitutions involving the above mentioned cognitive mechanisms.

This paper is divided into two parts. In the first half, I will show that the vast majority of lexical substitutions made by the Wernicke's patients are semantically driven. In the second half, I will discuss the types of associations which appear to be the most productive in aphasic lexical substitution. I will also

explore the relevance of schematicity, metaphor, metonymy, and frame semantics to aphasic lexical substitutions.

1. Frequency analysis of lexical substitution in the Given/New task

The respective difficulty of using nouns or verbs appears to correspond to different aphasic syndromes: Broca's aphasics have trouble describing actions (McCarthy & Warrington 1985; Miceli, Silveri, Villa & Caramazza 1984; Bates, Chen, Tzeng, Li, & Opie 1991); whereas Wernicke's aphasics show the greatest word-finding difficulties with object names (Caramazza & Hillis 1991; Gleason, Goodglass, Obler, Green, Hyde & Weintraub 1980; Baxter & Warrington 1985; Goodglass, Kline, Carey, & James 1986). Physiologically, the noun/verb dissociation appears to correspond to anterior and posterior cortical damage, respectively (Goodglass 1976).

Although most aphasic syndromes involve some anomia, it is primarily associated with Wernicke's and anomic aphasia, typically involving posterior cortical damage. Language production difficulties attributed to anomia involve both lexical omission and substitution. When a patient is unable to access a word he may omit it. For example, one patient described the target structure: 'A dog is on the car' as "the car is under, we'll assume that". Alternatively, the patient may substitute it with another word, a symptom called *paraphasia*. Paraphasic substitutions may involve (a) semantically vague words, such as calling a 'present' "something good"; (b) substitutions which are related in some way to the target, such as calling a 'cat' a "cow"; and (c) substitutions which bear no apparent relation with the target, such as calling a 'mouse' a "key". The patient might also attempt to paraphrase the target word (*circumlocution*) such as referring to 'crying' as "tears going down". In some cases, however, the intended meaning is not recoverable; the patient simply produces unrelated word strings (*jargon*). For example, one patient described the target structure 'A boy is skiing' as "mister wind wonder wind no that's oh ... frit tear sair. I know exactly what I want to say and its not doin' it. Stay ss ... wind uh wind uh chair ss sairs ...". In this study, I will focus on paraphasic and circumlocutionary lexical substitutions.

1.1 Method: The responses of ten Wernicke's patients in a language production task involving the description of events portrayed in a series of line drawings were compared with those of a control group of ten non-aphasic elderly subjects.

1.1.1 Subjects: All ten patient subjects became aphasic as a result of a stroke and were diagnosed as Wernicke's aphasics. Although the patients varied with respect to the scope of the lesion, it encompassed the left temporal-parietal region in all ten cases. The patients were between the ages of 50 and 75 and had 11-18 years of education. The control group consisted of ten elderly subjects who were between the ages of 64 and 78 and had 14-22 years of education.

1.1.2 Task: The Given/new task, developed by MacWhinney and Bates, consists of nine sets of picture triplets, each consisting of a similar scene in which all but one of the elements remain constant: in some triplets the subject or object is changed (e.g., A {bear, mouse, bunny} is crying), in other triplets the action is changed (e.g., A boy is {running, swimming, skiing}). The subjects were asked to describe what they saw in each series of three pictures. In order to compare the production of nouns and verbs, each instance of a noun or verb produced was counted.

Sequences of repeated words were counted as one. Pronouns used for the first mention of a nominal were counted as semantically vague substitutions. Pronouns which were of the wrong gender or number were counted as semantically similar substitutions. Circumlocutions/jargon which could not reliably be related to any of the target words were not counted. Neologisms (word-blends and non-words) were not counted, as they do not constitute lexical (real-word) substitutions.

1.2 Results: The elderly control subjects' responses are compared with Wernicke's patients' responses in Table 1. The first column shows the means for the percent correct (correct responses/all responses) and the error rate (errors/target-opportunities). Both factors show that the Wernicke's patients tended to miss the verb targets more often than the noun targets. This result is somewhat surprising since studies which contrast Wernicke's patients with Broca's patients have found that Wernicke's patients have greater difficulty with nouns. However, the elderly subjects also had slightly greater difficulty with the verbs than with the nouns. It is possible that these results reflect the greater conceptual complexity of verbs. In addition, 49% of the correct Wernicke's noun responses were pronouns as compared to 2% of the Elderly control subjects. This suggests the possibility that the Wernicke's patients were able to resort to using pronouns in order to avoid making errors for nouns, whereas there were fewer opportunities to avoid verbs in such a manner.

The second column contrasts the two main error types, omission and substitution, as a factor of the total incorrect responses. It shows that, although substitution was far more common for both subject groups, the Wernicke's patients erred by omission more often than the elderly control subjects.

Table 1: Mean percentages and rates of subject responses

		all responses		incorrect responses	
		% correct	error rate	% omitted	% substituted
Wernicke's	noun	0.62	0.66	0.18	0.82
	verb	0.42	1.07	0.19	0.81
Elderly	noun	0.94	0.06	0.04	0.96
	verb	0.92	0.08	0.09	0.91

In order to determine the nature of the substitution errors, they were divided into four types: phonologically similar to the target, semantically similar to the target, both phonologically and semantically similar, or unrelated. The results are shown in Table 2. An example of the phonologically similar items would be calling a 'rabbit' a "robber". In most cases, the subjects were aware of the inappropriateness of the word and continued to attempt to produce the target. Semantically similar words were usually from the same general semantic category such as calling an 'apple' a "strawberry". Also included in this group were inappropriately used pronouns and semantically vague terms such as referring to a 'donut' as "those things". The subjects rarely attempted to correct the semantically related errors. An example of substitutions which are both phonologically and semantically similar is calling a 'cat' a "cow". The unrelated items were words for which there was no obvious relationship between the word and target such as referring to a 'flower' as a "key" and to 'crying' as "smashing".

Table 2 shows the percentages for each substitution type as a factor of the total number of substitutions. The semantically related substitutions were by far the

most common. They comprised 73% of the noun substitutions and 79% of the verb substitutions. Phonologically related substitutions were a distant second for noun substitutions, whereas phonological similarity played a less important role in verb substitution. Note that, unlike nouns, there were no verb substitutions which were both phonologically and semantically related. Unrelated substitutions were more common for verbs than for nouns.

Table 2: Wernicke's mean percentages for each substitution type

	related substitutions			unrelated substitutions %
	% phonologically related	% phonologically & semantically related	% semantically related	
nouns	0.17	0.03	0.73	0.05
verbs	0.09	0	0.79	0.12

The robustness of the semantically related substitutions found for all ten Wernicke's patients shows that the disruption of lexical access occurs at a point where semantic relations between words are available. The occurrence of phonologically related lexical substitutions suggests that both semantic and phonological information must be concurrently available. The relatively small number of unrelated substitutions underscores the importance of semantic relatedness in lexical substitution.

Table 3 shows the breakdown of semantically related substitutions by the degree of semantic schematicity. The first column shows the percentage of substitutions which were semantically more specific in meaning than the target word, such as referring to a 'table' as a "bridge table" and to 'eating' as "biting". The results show that verb substitutions tended to be more semantically specific than the target verb more often than noun substitutions did. The second column shows that noun substitutions were drawn from a similar level of schematicity as the target more often than verb substitutions. The third column shows the percentage of substitutions which were more semantically schematic than the target word, such as referring to a 'dog' as an "animal" and to 'giving' as "doing". The results show that verb substitutions tended to be more semantically schematic than the target verb more often than noun substitutions were. Overall, the noun substitutions tended to be drawn from a similar level or higher level of schematicity than the target noun, whereas the majority of the verb substitutions were drawn from a higher level of schematicity than the target verb. The last column shows the percentage of semantic substitutions which appeared to be perceiverations of a prior target item. For example, for the target group: 'A cat is on the {table, bed, chair}' one patient referred to the 'bed' as a "table" right after having described the cat being on the table. It is interesting to note that semantically related perceiverations occurred much more often for nouns than for verbs; this difference was statistically significant (.016). This indicates that once nouns are lexically accessed they remain accessed longer than verbs do.

Table 3: semantically related substitutions with respect to degree of schematicity

	Semantically related substitutions			
	% specific	% similar	% schematic	% percev.
nouns	0.08	0.39	0.39	0.14
verbs	0.19	0.19	0.61	0.01

All of the noun targets were concrete nouns which are perceptually autonomous, whereas as verbs are inherently relational and hence are perceptually dependent on the entities which are interacting. Gentner (1981) has suggested that this *perceptual* difference between concrete nouns and verbs denoting overt physical actions may correspond with relative *conceptual* autonomy. This may account for the greater durability of nominal notions once they are lexically accessed.

To sum up, the results from Table 1 show that the error rate for verbs was greater than the error rate for nouns. This was attributed to the greater semantic complexity of verbs. The results from Table 2 show that the majority of the substitutions were semantically related. Thus, the disruption of lexical access must occur at a point where semantic associations are accessible. The results from Table 3 show that schematicity plays a distinctive role in noun and verb substitutions: verb substitutions are drawn from higher levels of schematicity at a greater rate than nouns are. It was also suggested that once concrete nouns have been accessed, they remain accessed longer than verbs do. These findings show that nouns and verbs are differentially affected by aphasia in a manner which implicates the influence of semantic/conceptual processing. If grammatical category coding were completely independent of semantic/conceptual processing the above findings could not be accounted for.

2. Lexical Categorization and Network Associations:

For the remainder of the paper I will discuss the different types of associations linking the substitutions discussed in the previous section with the target words. In particular I will explore the relevance of frame semantics, metaphor, and metonymy by looking in greater detail at the types of associations that occurred in the lexical substitutions.

The relevance of lexical categories to aphasic disorders has long been acknowledged. There are many reports of patients who have particular difficulty in accessing words belonging to specific semantic categories such as concrete versus abstract words (Warrington & Schallace 1979; 1984), living things versus inanimate objects (Damasio 1990), fruits and vegetables (Hart, Berndt, & Caramazza 1985), body parts, letters, and color names (Goodglass, Klein, Care & James 1986), as well as the grammatical category distinction mentioned above: Broca's aphasics tend to have greater difficulty with verbs, whereas Wernicke's and anomic aphasics tend to have greater difficulty with nouns.

Eleanor Rosch pioneered the study of categorization which provided the foundation for the notion of semantic categories linked together in complex networks. Based on her research of basic levels, Rosch identified the following operational definitions for object categorization: attributes in common, motor movements in common, objective similarity in shape, and identifiability of averaged shapes.

2.1 Nouns: Table 4 shows noun substitutions which corresponded with Rosch's operational definitions: shape, attributes in common and motor movements in common. I found that all three factors were quite productive as sources for lexical substitution. The attributes in common that appeared to be operative in these substitutions were salient physical features and similarity of function. Of the two, salient physical features proved to be a more productive source for substitution. For the most part, targets were substituted by items from the same semantic category. The notable exception to this trend were the substitutions which focus on a salient physical attribute of the target such as referring to 'tears' as "water" and to a 'donut' as a "hole".

Table 4: Types of associations between noun substitutions and their targets with respect to Rosch's operational definitions for object categorization

Overall Shape		Attributes in Common		Motor Moves in Common	
man	BOY	1. Salient Physical Attributes		truck	
girl		water	TEARS	van	CAR
mother	LADY	hole	DONUT	car	
pot	JAR	wet	WATER	cot	CHAIR
horse		cone	ICE CREAM	muffin	
zebra	DONKEY	square	BLOCK	toast	
bear		2. Similar Function		bread	DONUT
dog	RABBIT	bicycle	TRUCK	cookie	
dog	CAT	prize	PRESENT	sandwich	
dog	BEAR	car	TRUCK	auto, car	TRUCK

Target words are in upper-case letters

Table 5 shows other factors which were found to be relevant to aphasic lexical substitutions. The use of a representative individual to refer to basic level entities is a form of metonymy: the individual stands for the whole category. The Easter Bunny was particularly productive; a rabbit was referred to as the Easter Bunny on several occasions by more than one patient. The occurrence of antonymic substitutions, such as calling a 'dad' a "son", shows that opposites are closely associated. The last two examples on Table 5 show that an association between the target and the substitute can be established by the immediate context. These two examples indicate that semantic association is a dynamic process which the patient can draw upon when faced with the deficits imposed by aphasia.

Table 5: Other factors identified in noun associations

Representative Individual		Antonymic Relationship		Pragmatic Association	
Easter Bunny	RABBIT	dad	SON	baby	GIRL
Mickey	MOUSE	girl	BOY	child	DOG
Ridey Locks	BEAR	father	MOTHER		
Association Established by Context					
Attribute in common: similar function					
ladder	STOOL	(used for standing on to reach up high)			
Schematic word substituted for target					
gift	FLOWER	(an object which is given)			

Metaphor and metonymy also played an important role in establishing associations which were made explicit by the lexical substitutions. Examples are

shown on Table 6. As can be seen, metonymic association was far more productive for nouns than metaphoric association.

Table 6: Noun metaphoric and metonymic associations

Metonymic Associations		
American college in the swim Mickey	ENGLISH	(location for language)
	EDUCATION	(location for event)
	WATER	(action for location)
	MOUSE	(token for type)
stool, chair bench	TABLE	(adjacent objects)
Metaphoric Associations		
trip	MISTAKE	(physical mapped to abstract)

The examples in Tables 5 and 6 show that a minimalistic lexical structure would not account for many of the aphasic lexical substitutions. A dictionary-like lexicon could not account for culturally and contextually motivated associations.

2.2 Verbs: In analyzing the verbs, I was curious to see if Rosch’s operational definitions for objects could be adapted to verbs. The outcome can be seen in Tables 7 and 8. When a patient was unable to express the action with a simple verb, the patient most often focused on a salient component of the event. As can be seen from Table 7: Attributes in Common, an object which is closely associated with the action was quite productive in verb substitution, both alone and in relation to its motion and path. Thus, ‘crying’ was expressed as “have eyes” and as “water coming through his eyes”. Motor movements in common, shown on Table 8, also proved to be relevant for verb substitutions.

Table 7: Rosch’s operational definitions extended to verbs: associations between verb substitutions and targets - attributes in common

Attributes in Common			
1. Salient Object Involved in Action		2. Motion & Path of Salient Object	
has eyes, got tears about his eyes about his face	CRYING	water is coming through his eyes water is coming down there are tears going down he went (going) down	CRYING FALLING
water, watering water up and down swimmer of water	SWIMMING	3. Salient Subcomponent of Action	
snow with skis arms all over	SKIING HUGGING	mutual possession of DO = GIVE	
		S + IO having DO	
		S + IO holding DO	
		IO have DO with S	
		S holding DO & IO have DO	
		S holding DO & IO with DO	
		GIVING	

Table 8: Rosch's operational definitions extended to verbs: Motor movements in common

Motor Movements in Common			
swishing water	SWIMMING	jumping	RUNNING
stroking water		walking	
reaching water		holding	HUGGING
running	KICKING	pick up	

Tables 9 and 10 show other factors which appeared to influence aphasic substitutions. I found several types of associations which appear to be drawing from event frames associated with the target verbs, shown on Table 9. Several verb concepts were broken down into component events which make up the entire action, such as referring to 'eating' as "he comes and grabs and he bites x". Preceding events, such as referring to 'giving' as "offering", and resulting states, such as referring to 'spilling' as "wetting", also played a minor role.

Table 9: Event Frames invoked in verb substitutions

Event Frames	
1. Breakdown into Component Events	2. Preceding Event
<i>possession & result</i> = EAT comes and grabs and he bites x he has an x and he likes x	went for x went with x comes and sees had x; with x, got x, EATING
<i>possession & path</i> = GIVE IO has DO, DO to IO IO taking up the DO S has DO to IO	offering have DO for IO GIVING
<i>possession & instr of transfer</i> = GIVE S with DO and boy, his hand is there S with DO and dog, his hand is up doesn't have that wanders and hand...	3. Resultant State wetting SPILL, OVERFLOW spilling SWIMMING he was wet

Table 10 lists other types of associations found to play a role in verb substitutions. Antonymic relations, such as referring to 'crying' as "laughing", proved to be a source for verb substitutions as well as for noun substitutions. Nominalizations of the event also occurred. Lastly, for actions which were highly correlated with a strong emotional state, the emotional content of the event was a productive source for substitutions.

Table 10: Other relationships involved in verb substitutions

Other Types of Relationships			
1. Antonymic Relationship	3. Associated Emotional State		
laughing CRYING	x is upset; x feels bad		
taking	x is saddened/sad CRYING		
S & IO get GIVING	x likes y HUGGING		
2. Nominalization of the Event	x loves y also: KISSING		
the swim SWIMMING	x is nice to y HUGGING		
with kisses KISSING	x is pissed off KICKING		

The fact that nominalizations of the event occurred is interesting given previous findings cited at the beginning of the paper that Wernicke's aphasics have greater difficulty expressing nouns than verbs when compared with Broca's aphasics. This finding, in conjunction with the fact that the Wernicke's patients in this study tended to make more errors for verbs than for nouns suggests that reports of selective dysfunction for nouns and verbs may actually reflect finer-grained distinctions which contribute to grammatical category differences.

Both metaphoric and metonymic associations occurred in verbal substitutions, examples of which are shown in Table 11. Unlike nouns, verb substitutions appeared to be equally driven by metaphor and metonymy. The use of "hear" to mean 'understand' is an example of a well established metaphorical semantic extension from a verb of perception to refer to the mental state of 'understanding' analogous to the expression "I see what you mean". All of the examples in this table show that metaphor and metonymy are used productively by aphasic patients to make novel semantic extensions of meaning.

Table 11: Verb metaphoric and metonymic associations

Metaphoric		Metonymic	
go down	GET WORSE	<i>location for action</i>	
go up	IMPROVE	is in the water	SWIMMING
fall	FAIL	is on the mountain	SKIING
hear	UNDERSTAND	is on the hill	SKIING
read	UNDERSTAND		

3. Conclusion

Studies which have compared Broca's with Wernicke's aphasics have reported that Wernicke's patients tend to have greater difficulty with nouns than Broca's patients, which suggests a selective dysfunction with respect to noun and verb grammatical categories. A comparison of Wernicke's production of nouns and verbs, however, showed that Wernicke's patients tended to make more errors for verbs than for nouns and that they sometime substituted verbs with nominalizations of the event. It was suggested that reports of selective dysfunction for nouns and verbs may reflect finer-grained conceptual distinctions which contribute to grammatical category differences. Supporting evidence is provided by systematic difference between noun and verb substitutions.

I found that the majority of the lexical substitutions for both nouns and verbs were semantically related to the targets. An analysis of the most common types of associations that occurred showed that basic physical and semantic properties were important for establishing and utilizing association links between words. For nouns the most relevant properties were physical attributes such as shape and salient physical features. For verbs the most relevant properties were relational substructures in the event frame such as motion, path, and an object inherently involved in the action. All of the substitutions discussed in this paper are indicative of the richness and diversity of semantic networks which draw upon encyclopedic knowledge structures.

Cognitive mechanisms such as schematization, metaphor, metonymy, and event frames all proved to be productive sources for lexical substitutions. Systematic differences between noun and verb substitutions with respect to these mechanisms indicates that conceptualization is relevant to the category-specific

affects of aphasia on noun and verb categories. Thus, noun and verb categorization must play a greater role in conceptual-semantic processing than simple grammatical-category coding in the lexicon would suggest.

NOTES

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