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Across-session Consistency of Performance and Stability of Error Constraints in Aphasic Naming

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Introduction

Naming disorders are ubiquitous in aphasia. Understanding their origin in each subject, at each disease stage is a complex task. Aphasic patients are heterogeneous, and clinical aphasia types do not account for observed differences. A subject's performance may vary in time, even across back-to-back sessions. Furthermore, although at first glance naming accuracy and error type distribution do not change substantially, we generally ignore how frequently the same stimulus yields the same type of response across different trials.

Interpreting aphasic naming behavior requires analyses at the single-case and at the *single-stimulus* level. In other words, for each stimulus and in each session, error types and response consistency must be considered, to identify the variables constraining the response.

This project is an attempt at developing a methodology that allows precisely such analyses. We report here the first preliminary results.

Participants and Methods

A naming task (n=80) was administered 3 times over <3 days to 20 unselected aphasic speakers. Responses were scored as Correct (C) or erroneous – Lexical, Formal, Mixed (ie, phonemic and semantic), or Other (unrelated word/nonword, fragment, comment, etc).

For each subject, we analysed whether the distribution of response types differed across the 3 sessions; calculated the multinomial confidence limits of the observed proportions of each response type; and quantified the agreement between the response provided to each stimulus on different trials (Cohen's k). Finally, a weighted logistic regression (Capitani and Laiacona, 2004) explored whether the type of response given to each stimulus depended on any charachteristics of the stimulus itself (eg, prototypicality, familiarity, age of acquisition, visual complexity, name agreement, frequency, phonemic length), removing the overlap between the effect of different predictors.

Results

We report data from two representative and contrasting cases. In both subjects, the overall distribution of various

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response types did not differ across sessions. Multinomial confidence limits show that APO produced more semantic than phonological errors, whereas the reverse was true for NUB. Cohen's *k* (Table 1a and 1b) shows that in both cases the agreement between the type of response to the same stimulus in sessions 2 and 3 was significantly greater than chance, and that different dimensions constrained the subject's performance (age of acquisition in APO, length in NUB).

Conclusions

This method allows detailed analyses of naming performance and a sound characterisation of each case. In APO and NUB, it pinpointed distinct constraints and showed their substantial stability. When applied to aphasics at various stages of the disease (eg, acute vs subacute vs chronic; pre-treatment vs post-treatment) it will permit to chart the evolution of the disorders underlying naming performance.

References

Capitani, E., Laiacona, M. (2004). A method for studying the evolution of naming error types in the recovery of acute aphasia: a single-patient and single-stimulus approach. *Neuropsychologia* 45, 613-623.

Table 1a. Case APO: "Lexical errors" case

(1) Across-session performance accuracy is comparable (chi-square (df=2) 2.947; p-exact=.023; ns). (2) Across-session response types are consistent (chi-square (df=8) 6.073; p-exact=0.678; ns). (3) Multinomial estimate of the probability of occurrence of various response types is consistent with APO's responses being constrained by lexical-semantic variables.

Response (n=240)	Probability	95% Confidence Limits
Correct (n=197)	.821	.752-.878
Lexical (n=33)	.137	.089-.200
Formal (n=3)	.012	.002-.042
Mixed-Other (n=7)	.029	.010-.067

(4) Observed vs. (expected) occurrence of various response types on Sessions 2-3 shows Cohen's *k* to be signficant (*k*=0.522; 95% confidence limits: 0.288-0.757; unidirectional p-exact <.0001). Therefore, some stimulus property constrains the tendency to produce a response.

Session 2	Session 3					
	C	L	F	M	O	Total
C	64 (57.8)	4 (8.6)		1		69
L	2 (8.4)	6 (1.2)	1 (0.1)	1		10
F						
M	1					1
O						
	67	10	1	2		80

(5) Stimulus features affecting Lexical errors vs. Correct responses (effects of prototypicality, name agreement, familiarity, visual complexity, and phoneme length are not significant).

	Log (Freq.+1)	Age of Acquisition
Correct (n=197)	3.83 (1.44)	69.23 (26.69)
Lexical errors (n=33)	2.78 (1.57)	40.77 (32.99)
Single effect (Student's t, df=228)	3.86 (p=.0001)	5.48 (p<.0001)
Simultaneous effect/Single effect (regr-log, chi-square, df=1)	1.14 (p=.28, ns)	5.54* (p=.018)

Table 1b. Case NUB: "Formal errors" case

Across-session performance accuracy is greater in Sessions 2-3 than in Session 1 (chi-square (df=2) 7.065; p-exact=0.031), but indistinguishable between Sessions 2 and 3. (2) Across-session response types are consistent (chi-square (df=8) 12.39; p-exact=0.128; ns). (3) Multinomial estimate of the probability of occurrence of various response types is consistent with APO's incorrect responses being more frequently Formal than Lexical.

Response (n=240)	Probability	95% Confidence Limits
Correct (n=128)	.533	.451-.615
Lexical (n=9)	.037	.015-.078
Formal (n=88)	.367	.029-.044
Mixed-Other (n=15)	.062	.030-.111

(4) Observed vs (expected) occurrence of various response types on Sessions 2-3 shows Cohen's *k* to be signficant (*k*=0.287; 95% confidence limits: 0.103-0.471; unidirectional p-exact <.001). Therefore, some stimulus property constrains the tendency to produce a response.

Session 2	Session 3					
	C	L	F	M	O	Total
C	34 (28.2)	1	11	1		47
L	2 (8.4)	1	1			4
F	10		13 (8.13)	1	1	25
M				1		1
O	2		1			3
	48	2	26	3	1	80

(5) Features of the stimulus that constrain its association with a Formal error as opposed to a Correct response. The effects of frequency, prototypicality, name agreement, familiarity, visual complexity, age of acquisition are not statistically significant.

	Length (Phoneme Number)
Correct (n=138)	5.90 (1.83)
Formal errors (n=88)	6.42 (2.10)
Single effect (Student's t, df=224)	-1.96 ($p<.05$)