The dual origin of lexical perseverations in aphasia: Residual activation and incremental learning

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Lexical perseveration (LP), the inappropriate repetition of a previous response, is not uncommon in aphasia. Two underlying mechanisms have been proposed: the "residual activation account" (Cohen & Dehaene, 1998) posits that a response is repeated because it has residual activation, whereas the "learning account" (Oppenheim, Dell, & Schwartz, 2010) proposes that a response is repeated because the connections from the semantic features (e.g., *pet*) to the lexical item (e.g., "cat") have been strengthened. Thus, when the same feature is activated by a different stimulus (e.g., "dog"), the earlier response may be repeated. Both accounts predict a decreasing likelihood of LP as the distance between the perseveration and its source increases, but only the learning account predicts that LP should be more sensitive to the number of intervening items (lag) than to time. Empirical data from the blocked cyclic naming task have confirmed this prediction (Hsiao, Schwartz, Schnur, & Dell, 2009). However, this task (a) involves many repetitions of the same items, and (b) groups items into semantically-related blocks, two characteristics which may encourage semantically-related perseverations. Using a very large set of picture naming trials with no items repeated within a session and at least 12 items between semantically-related pictures, we tested the predictions of these theories in seven individuals with aphasia: the residual activation account predicts perseveration of recent responses (highest probability at lag 2; Hsiao et al., 2009) regardless of their relationship to the current target, while the learning account predicts semantically-related perseverations even at long lags.

Participants were included if they had semantic-to-lexical mapping problems as evidenced by a predominance of lexical (as opposed to phonological) errors on the Philadelphia Naming Test (PNT, $N = 175$; Table 1). All participants completed an additional long picture naming task ($N = 444$ pictures on two occasions for a total of 888 trials) over 5–6 sessions. Chance was calculated once using a lag-2 window and once using a longer window encompassing all trials before the LP. Table 1 shows perseveration rates and lags over all trials (total $N = 1063$). Two findings were noteworthy:

1. Two distinct types of LPs were identified (Figure 1a): unrelated LPs with short lags (*Mdn* = 6) consistent with residual activation, and semantically-related LPs with long lags (*Mdn* = 36) consistent with learning.

2. The proportion of the LP types identified in (b) was predicted by the overall severity of the participant's deficit, as shown by strong Spearman correlations between PNT error rates and both the ratio of semantically-related to unrelated LPs ($r = -.929$, $p = .007$; Figure 1b) and the ratio of short- to long-lag LPs ($r = .929$, $p = .007$; Figure 1c).

The results suggest two origins for LPs in aphasia: one due to residual activation of recent responses, and one due to incremental changes to semantic-to-lexical connections. As the weights of these connections get weaker, the proportion of LPs attributable to residual activation of recent responses increases.

References

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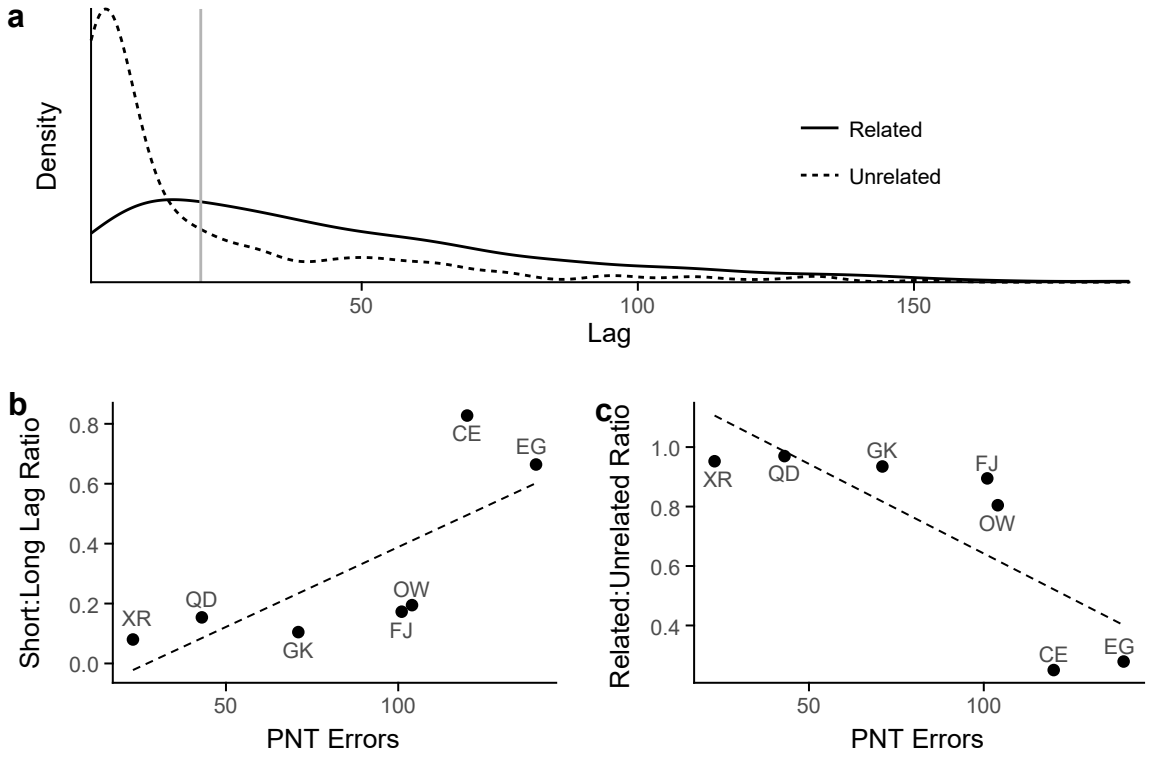

Figure 1. (a) Distributions of the lags for semantically related and unrelated perseverations. The vertical line indicates the mean distance between semantically-related items. Below, the relationship between PNT error rates (i.e., deficit severity) and (b) the ratio of short to long lags, (i.e., lags shorter than the median for unrelated perseverations vs. longer than the median for semantically-related perseverations), as well as (c) the ratio of semantically-related to unrelated perseverations.

	PNT (N = 175)			**PNT + Long Naming Task (N = 1,063)**			
Participant	*Total Errors*	*PNT Perseverations*	*Mdn Lag*	*Total Perseverations*	*Lag-2 P-Value*	*Long-Lag P-Value*	*Mdn Lag*
XR	23	0	—	3.95%	1.000	.005	42.0
QD	43	7	58.0	6.21%	.905	.072	35.5
GK	71	12	55.5	13.36%	.772	.043	39.5
FJ	101	27	36.0	12.89%	.992	.004	35.0
OW	104	16	36.5	18.34%	.600	.177	33.0
CE	120	18	2.5	17.45%	< .001	.047	4.0
EG	140	67	17.0	34.09%	< .001	.300	10.0

Table 1. Summary of participants' performance, perseveration rate, and perseveration characteristics on the PNT and the long picture naming task.