

Abstract

We classified and analyzed the speech errors of 15 individuals during the acute recovery stage from aphasia. Results from the regression analysis revealed that 3 error types were prognostically significant for recovery of language function at 8 months. Semantically-related errors and target-related neologisms produced initially were associated with good outcome, and conversely “no responses” with poor outcome. Initial speech errors systematically converted to “smarter” errors at eight months. Our results support Bhatnagar’s et al’s (2004) observation that lexical deficits and their sequential resolution are correlated to the changing physiology of the brain as it recovers.

Are speech errors produced initially prognostically significant at 8 months post stroke?

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Introduction

Analyzing word errors of individuals with aphasic is one method of investigating the underlying nature of lexical disturbances. Errors guide the direction of treatment and give us clues about the neurological mechanisms that support semantic-lexical retrieval for speech production. Although it is known that naming errors in general decrease over time we are compelled to give special consideration to these initial errors and their prognostic value. We hypothesized that particular speech errors produced initially after a stroke are prognostically significant and associated with the recovery of language. This work is informed by Bhatnagar et al.’s (2003) speculation that the acute recovery from aphasia fits a sequential direction of error types. Bhatnagar observed that lexical deficits and their sequential resolution are correlated to the changing physiology of the brain as it recovers. We classified and analyzed speech errors during the acute recovery stage from aphasia in an effort to confirm or refute our hypothesis.

We present the results of an error analysis performed at the initial week and approximately eight months post of 15 adults who suffered a left hemispheric stroke. Responses on a fixed number of stimuli from the Boston Naming Test (BNT) were classified according to Martin, Dell, Saffran, and Swartz (1994). A regression analysis was performed to determine if initial error types were predictive singly or collectively for prognosticating the recovery of language at approximately 8months after a stroke. The classification of errors was as follows:

- 1) Correct
- 2) Semantically related to the target (semantic paraphasias)- inaccurate words that are semantically related to the target, such as “carrot” for “pumpkin.”

- 3) Semantically related description with no attempt to name such as “little kids eat it” for ice cream.
- 4) Semantically and phonologically related to the target such as “soup” for spoon.
- 5) Phonologically related to the target (formal paraphasias)- word or non-word errors with < 50% of sounds in the word transposed such as “cork” for “fork” or “datur” for “guitar.”
- 6) Target related neologisms such as “pow” for “saw”.
- 7) Abstruse neologistic errors- such as “balbit” for “flower.”
- 8) Unrelated lexical error such as “thermometer” for “telephone”
- 9) No response

We hypothesized that abstruse neologisms on initial exam would be associated with severe naming deficits at the second assessment. Semantically-related errors and phonological errors would be associated with less-severe naming deficits 8 months post. Despite the inability to name, many individuals with aphasia are receptive to phonological cues and we hypothesized that these individual would exhibit less-severe naming deficits at eight months post stroke.

Our hypothesis at 8 months post stroke include:

- 1) Speech errors made at the initial assessment are significantly related to prognosis as measured by performance on naming tasks.
- 2) An individual’s receptivity to phonological cues immediately after their stroke is an indication of good prognosis and recovery of language at approximately 8 months after stroke.
- 3) Formal paraphasic errors and semantically–related errors (made initially) are associated with good prognosis and recovery.
- 4) Abtruse neologisms and no responses (made initially) are associated with poor prognosis.
- 5) During recovery of language there will be a systematic conversion of errors to “smarter error types,” that is errors that are related to the target semantically or phonologically.

Methods

Subjects

The Boston Naming Test (BNT) and the Western Aphasia Battery were administered to 15 patients admitted to a university medical center within approximately one-week after their stroke. Patients were reassessed approximately 8 months post stroke. The mean age of our entire population was 57.82 years (SD=13.40), with a mean time post onset of 7.8 months (SD=2.3).

Statistical Analysis

Across all 15 patients 523 responses were transcribed and classified by the examiner and verified by a second rater at the initial assessment and again at the end of the acute recovery phase of recovery, approximately 8 months. 396 errors were produced and

classified initially and these errors were reclassified at 8 months. These group results were applied to a regression analysis. The dependent variable, correct responses on the second administration of the BNT, was regressed on the independent variables, all error types, to determine if particular naming errors were associated with recovery of naming ability at eight months.

Results

The final equation ($b_{\text{constant}} + b_{\text{semantically related}} + b_{\text{target related neologisms}} + b_{\text{no response}} =$ correct responses on the BNT at approximately 8 months post) was obtained in a backward regression. This equation explained 79% of the variance in BNT scores at 8 months. Table 1 shows the results thus far.

Table 1

	B	SE b	Beta	T	Sign T
Semantically-related responses	2.38	.41	.69	5.79	.0001
Target-related responses	12.90	3.35	.47	3.84	.002
No responses	-2.27	.95	-.29	-2.37	.03
Constant	22.61	6.00		3.7	.003

Note: Adjusted R Square= .79; F= 19.57; Sign. < .0001

The constant regression coefficient, 22.61, represents the average score on the BNT (at 8 months) when all the independent variables are zero. The hypothesis that semantically-related errors were significantly associated with improvement in naming at 8 months was supported. Each semantically-related error produced initially was associated with an improvement in the naming score (correct response) by 2.38 points. Each target-related neologism was associated with a 12.9 increase in the naming score at 8 months. Target-related neologisms were more predictive of recovery from aphasia than formal paraphasias.

An additional significant finding was that for each “no response” initially there was an associated –2.27 points on the 8-month naming score. “No responses” on the BNT were inversely correlated to improvements at 8 months.

The ability to accept phonological cues initially was correlated to good prognosis and recovery of language as measured by the BNT at 8 months post. ($r=.60$; $p<.01$). This hypothesis was supported by our findings.

The error analysis and conversion of errors during the acute recovery phase from aphasia is presented in Table 2. The number of correct responses increased from 240 to 410 at eight months. The “no responses” error type decreased from 87 to 20. The largest number of error types initially was in the no response category but by 8 months the largest category of errors were “smarter errors, that is, ”semantically-related” errors.

Table 2. Error Analysis of at one week and 8 months post for 15 participants with aphasia

	One-week	8 months
Named correct	240	410

Formal paraphasias	4	7
Semantic-related responses	76	55
Semantically & phonologically related to target	9	1
Target related neologisms	5	1
Phonologically related to target	22	4
Unrelated lexical substitutions	62	23
Abtruse neologisms	18	2
No response	87	20
Number of responses scored	523	523

Discussion

Our results on 15 individuals recovering from aphasia indicate that initial speech error types give meaningful information about prognosis that is vital to our patients, their families, and rehabilitation specialists. This information is not reflected in the actual score on the BNT but on error analysis. The regression equation shows that particular errors produced initially are associated with outcome from aphasia. “No responses” were significantly correlated with poor recovery and semantically-related errors and target-related neologisms were associated with good recovery of naming ability. Our results support Bhatnagar’s hypothesis that there is a sequential resolution from aphasia that is reflected in the conversion of error types initially to “smarter” errors at eight months.