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New word learning in aphasic patients: Dissociating phonological and semantic components

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Introduction

The focus of much investigation in aphasiology has been on assessment of spared vs. impaired performance, with relatively less investigation of spared vs. impaired (re)learning ability. Clearly, however, improved understanding and treatment of aphasia depends on assessment of both. The aim of the present work has been to develop a framework for systematic investigation of learning abilities related to word learning. Here, we present results from a study that examined phonological learning, expressive word learning, and receptive word learning abilities of individuals with aphasia. The aims were, first, to assess these learning abilities, and second, to identify predictors of each, as a step to better understanding of such learning.

Method

Participants

Twenty individuals (10 male, 10 female; age 35–81 years) with aphasia participated in this study. Nineteen of the participants' aphasia resulted from a LCVA and one from a RCVA. The aphasia classifications (based on the Western Aphasia Battery, Kertesz, 1988) included: Anomia (7), Conduction (3), Wernicke's (2) Broca's (8). In addition, 10 controls subjects (6 male, 4 female; age 29–79 years) were included in the study.

Tasks, stimuli and procedures

Phonological learning. Each participant was auditorily presented with nonwords of one, two, and three syllables. Presentation of the stimuli was divided into seven blocks. In each of these blocks half the nonwords were completely novel, appearing nowhere else during the experiment (''unique'' nonwords). However, half of the nonwords in each block recurred from block to block (''repeating'' nonwords). Nonword repetition performance on the unique nonwords thus provided a baseline measure of nonword repetition, while any improvement in performance on repeating nonwords provided a measure of phonological learning. Through all the blocks and for all stimuli, the participant's task was simply to repeat each nonword, immediately after its presentation.

Expressive and receptive word learning (expressive recall and receptive recognition). In both the expressive and receptive word learning tasks, each participant was visually presented with a drawing of a novel object, together with an auditorily presented novel ''name'' for the object (Gupta, 2003). The participant's task was to learn the pairing during these exposure trials, the structure of which was identical for the two tasks. Each set of exposure trials was followed by a set of test trials. In expressive recall test trials, the participant's task was to produce the name when cued with the drawing of the object. In receptive recognition the task was to pick out the correct drawing when cued with the auditory name. The expressive and receptive word learning tasks each consisted of three blocks of exposure and testing, followed by a final test. In each task, the targets were four name–picture pairs, with the names being 2 syllables in length.

Other measures

Four other measures were also obtained for the aphasic individuals: (1) Nonword repetition accuracy (also obtained for control subjects); (2) digit span; (3) composite semantic processing scores (CompS); and (4) composite phonological processing scores (CompP). The CompS and CompP scores were derived from performance on standardized and laboratory-developed measures (Martin and Saffran, 1997).

Results

Pattern of impairment

Performance for participants with aphasia was significantly or almost significantly lower than that of control subjects in all three learning measures: phonological learning (4% improvement vs. 11% improvement, $p = .07$); expressive recall (6% correct vs. 27% correct, $p < .01$); receptive recognition (34% correct vs. 77% correct, $p < .001$). Performance was also impaired on Nonword Repetition (42% correct vs. 74% correct, $p < .0005$).

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Patterns of relationship

As observed in other impaired and nonimpaired populations, a correlation between digit span and nonword repetition accuracy was obtained in the aphasic group ($r = .531$, $p = .0147$), suggesting that the underlying relationship between performance in these tasks remains robust under aphasic impairment.

The relationship of performance in each of the three learning tasks to the four putative predictors (nonword repetition accuracy, digit span, CompS, and CompP) was assessed by multiple regression analysis. A regression of expressive recall performance on these predictors yielded no significant predictors, and did not explain a significant proportion of the variance. However, as performance in expressive recall was virtually at floor for the aphasic group, this result is difficult to interpret.

However, a double dissociation was obtained between receptive recognition and phonological learning. Correlational analysis indicated that CompS was highly predictive of receptive recognition ($r = .769$, $p < .0001$) but not of phonological learning ($r = .379$, $p = .1002$), while CompP was highly predictive of phonological learning ($r = .673$, $p < .005$) but not of receptive recognition ($r = .203$, $p = .3951$). Separate multiple regression analyses of receptive recognition and Phonological Learning on the four predictors confirmed this double dissociation. CompS (but no other measure) was highly predictive of receptive recognition, whereas CompP (but no other measure) was highly predictive of phonological learning. Each regression model explained a significant amount of the variance in the criterion variable (adjusted $R^2 = .624$, $p = .0007$ for receptive recognition, and adjusted $R^2 = .407$, $p = .0168$ for phonological learning).

Discussion

The present work introduces experimental tasks that provide a systematic means of assessing phonological learning, receptive word learning, and expressive word learning, and that are sensitive to impairment of such learning in aphasic individuals. Additionally, the present results yield a double dissociation such that receptive word learning appears critically dependent on the integrity of semantic processing/representations, and phonological learning critically dependent on the integrity of phonological processing/representations. These results clearly demonstrate that the double dissociation in aphasic processing between semantics and phonology is mirrored in aphasic learning.

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