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Predictors of naming decline after dominant temporal lobectomy: Age at onset of epilepsy and age of word acquisition

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Abstract

This study examined factors affecting object naming decline in patients who have undergone anterior temporal lobectomy (ATL) and the correlation between age of word acquisition and loss of specific object names postoperatively. The Boston Naming Test (BNT) was used to assess changes in object-naming performance in patients who underwent ATL. Correlation analyses were performed by group (dominant or nondominant ATL) on individual items from the BNT to determine if age of acquisition of object names had an effect on postoperative word loss. The influence of age at onset of seizures on naming decline was examined in the dominant ATL group. Only patients who had undergone dominant ATL experienced significant clinical and statistical declines after surgery. Among the patients who underwent dominant ATL, those with late age at onset of seizures declined significantly more than those with early-onset seizures. When individual object names were examined, age of acquisition of words predicted whether words were lost or gained after surgery.

Keywords: Boston Naming Test; Anterior temporal lobectomy; Age of acquisition; Language; Epilepsy

1. Introduction

Anterior temporal lobectomy (ATL) is an effective treatment for patients with medically intractable focal epilepsy. Although resective surgery usually results in elimination or reduction of seizures, ATL in the language-dominant hemisphere is associated with object naming declines [1–5]. Previous studies have demonstrated that the age at which seizures begin predicts postoperative confrontation naming decline [2–4,6]. Even when variables such as education, Full Scale IQ (FSIQ), chronological age, preoperative object naming ability, and resection technique are considered, later age at seizure onset has the highest correlation with naming declines following dominant ATL [2,4,7].

Although most studies of naming decline have focused on predicting which patients will experience postoperative dysnomia, a study by Bell and co-authors in 2000 is unique to the epilepsy literature in that characteristics of the object names were examined to determine which names were most likely to be lost following ATL [1]. These authors used the Boston Naming Test (BNT) [8] to examine declines in naming performance after left ATL in a sample of 47 patients with left hemisphere language dominance. They investigated the relationship between properties of object names, including (1) word length, (2) word frequency, (3) age of acquisition, and (4) semantic category (living and nonliving), and the percentage of patients who could no longer name the object. Of the four categories tested, age

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of acquisition (AoA) was the only variable with a significant independent effect on pre- to postoperative naming decline.

These results are consistent with other studies that have examined the impact of different variables on the speed of lexical decision and picture naming latencies in normal adults. Past studies have demonstrated a strong effect of word frequency on object naming speed; however, these studies have not taken AoA into consideration. Although AoA and word frequency share variance, recent studies have demonstrated that the independent effects of word frequency disappear when the variance due to AoA is considered. In 1992, Morrison et al. [9] reanalyzed the Oldfield and Wingfield [10] data that showed a significant correlation between word frequency and object naming speed. Morrison and co-workers found that word frequency no longer had an independent effect on naming speed when AoA was held constant, but that AoA did exhibit an independent effect when word frequency was held constant. In subsequent studies, AoA has been found to have a strong independent effect on picture naming speed [11–15], visual lexical decision speed [16,17], and auditory lexical decision speed [14,17,18]. Recent studies have also found that AoA is related to confrontation naming declines experienced by elderly patients [15] and those with brain injury, degenerative dementia, and aphasia [19–24].

In the present study, we investigated factors associated with postoperative naming decline in patients with epilepsy, including age at onset of seizures, side of resection, and age of acquisition of the object names. We examined the prediction that patients with a later age at onset of seizures who underwent dominant ATL are more likely to experience postsurgical dysnomia than those with an earlier onset of seizures. Using the BNT to measure object naming performance and the AoA norms established by Bell et al. [1], the relationship between the words that patients lost postoperatively and the AoA of each word was examined. Thus, the purpose of the present study was to determine if AoA predicts which words are lost following dominant ATL for patients with early and late onset of temporal lobe seizures. This study is unique in that AoA as a predictor of decline was examined in separate groups of epilepsy patients with both early- and late-onset seizures.

2. Methods

2.1. Subjects

This study was approved by the Medical College of Wisconsin Human Subjects Committee and followed institutional guidelines for human subject research. Subjects for this study included 120 patients (54 left, 66 right) who underwent ATL as a treatment for medically intractable focal epilepsy. Patients with structural lesions (e.g., tumors or vascular malformations) were excluded from the study. Thus, all patients in the study had pathology results consistent with gliosis, with at least 80% of the patients having pathological reports of mesial temporal sclerosis. It is likely there were more patients with mesial temporal sclerosis that was not read because the pathologist did not perform cell counts. Of these patients, 47 underwent dominant ATL (46 left ATL patients with left hemisphere language dominance as determined by the intracarotid amobarbital procedure (IAP) [see below] and 1 right ATL patient with right hemisphere Wada IAP dominance) and 73 underwent nondominant ATL (8 left ATL patients with right hemisphere language dominance as determined by the IAP and 65 right ATL patients with left hemisphere language dominance as determined by IAP).

All subjects had a presurgical Full Scale IQ (FSIQ) or Verbal Comprehension Deviation Quotient (VDQ) $\geqslant 70$ on the Wechsler Adult Intelligence Scale—Revised (WAIS-R) [25]. In addition, all patients took the BNT [8] prior to and 6 months following ATL. As the patients' ages ranged from 15 to 66, they were beyond the age at which all BNT words should have been acquired according to the norms established in Bell et al. [1]. Patients underwent tailored ATL with electrocorticography, and, when the resection was on the dominant hemisphere, intra- or extraoperative stimulation mapping of eloquent cortex was conducted. There were no significant differences between the dominant and nondominant ATL groups on demographic variables (age, sex, education, handedness), seizure variables (seizure frequency, age at onset of seizures), or intelligence (FSIQ, VDQ, or Perceptual Organization Deviation Quotient (PDQ)) (Table 1).

Language dominance for each patient was determined by calculating a language lateralization index (LI) using the IAP. The IAP language LI is calculated by scoring language responses on measures of counting, comprehension, naming, repetition, and reading during each injection of 75 to 125 mg sodium amytal into the internal carotid artery. The percentage of correct responses during the inject left/test right condition is subtracted from the percentage of correct responses in the inject right/test left condition [26]. Scores range from +100 (completely left hemisphere dominant for language) to −100 (completely right hemisphere dominant for language). For the present study, patients with an IAP LI $\geqslant 30$ were categorized as having left hemisphere language dominance, whereas patients with an IAP LQ $\geqslant -30$ were categorized as having right hemisphere language dominance. Patients with an IAP LI between −30 and 30 were considered to have bilateral representation of language. The eight patients with bilateral language were excluded from this study.

Additionally, the dominant ATL group was divided into two groups based on age at onset of epilepsy or the precipitating event for the epilepsy. Early onset was defined as first seizure or precipitating event at or before

Table 1
Mean (SD) demographic, cognitive, and seizure variables for the dominant and nondominant groups

	Dominant group ($n = 47$)	Nondominant group ($n = 73$)
Age	36.68 (10.89)	37.16 (11.36)
Sex		
Women	23	47
Men	24	26
Education (years)	12.67 (2.37)	13.30 (2.69)
Handedness		
Right	39	62
Left	7	10
Mixed	1	1
Seizure frequency[a]	11.18 (19.27)	15.57 (28.00)
Age at onset[b]	8.89 (9.76)	12.47 (11.92)
Full Scale IQ	92.51 (12.12)	93.07 (12.85)
VDQ[c]	91.70 (11.21)	95.10 (13.69)
PDQ[d]	97.67 (11.43)	95.54 (13.33)

[a] Seizure frequency = frequency of all seizures – frequency of simple partial seizures.
[b] Age at onset is the age at either the first seizure or a precipitating event, whichever was earlier.
[c] VDQ, Verbal Comprehension Deviation Quotient.
[d] PDQ, Perceptual Organization Deviation Quotient.