The neural correlates of proper noun retrieval have been investigated through neuroimaging and lesion approaches. Neuroimaging studies investigating proper noun naming in neurologically healthy individuals have demonstrated the importance of the left anterior temporal lobe (ATL) to the integrity of proper noun naming (Gorno-Tempini, 2001; Grabowski, Damasio, & Tranel, 2000; Nakamura, et al., 2000; Tranel, 2009; Tsukiura, et al., 2002), while studies investigating proper noun production in individuals with left temporal lobe lesions have demonstrated a link between left ATL damage and proper noun retrieval deficits (Damasio, Grabowski, Tranel, Hichwa, & Damasio, 1996; Tranel, 2006, 2009; Tranel, Damasio, & Damasio, 1997; Tranel, Feinstein, & Manzel, 2008; Tsukiura, et al., 2002). Though patients with left temporal lobe epilepsy have mostly normal linguistic abilities, they consistently demonstrate deficits in proper noun retrieval (i.e., famous faces and places; Glosser, Salvucci, & Chiaravalloti, 2003; Griffith, et al., 2006; Seidenberg, et al., 2002; Viskontas, McAndrews, & Moscovitch, 2002).

Though a direct link between left temporal lobe epilepsy and proper noun retrieval deficits has repeatedly been demonstrated, speech-language pathology services to remediate these deficits are limited and lacking an efficacious treatment program. To that end, we sought to investigate whether epilepsy-induced proper noun recall deficits could be mitigated through a treatment-induced neural reorganization of the network subserving proper noun retrieval. A multitude of aphasia studies have demonstrated the ability to reorganize linguistic networks through treatment and, as a result, ameliorate linguistic deficits following stroke (Crosson, et al., 2007; Crosson, et al., 2009; Fridriksson, et al., 2007; Meinzer, Harnish, Conway, & Crosson, 2011; Pulvermuller, Hauk, Zohsel, Neininger, & Mohr, 2005). The aim of our treatment, therefore, was to promote the reorganization of proper noun networks supporting proper noun retrieval, thereby shifting focus away from the left ATL, with the goal of improving proper noun retrieval in a patient with temporal lobe epilepsy.

Our treatment was rooted in a parallel distributed processing model of language (Plaut, 1996) and aimed to redistribute the networks supporting proper nouns to semantic, phonologic, articulatory-motor, and orthographic networks across the left hemisphere. We hypothesized that by strengthening these subcomponents that already partly support proper noun retrieval, we could make the networks of the ATL less critical to the process of proper noun naming, thereby mitigating proper noun naming deficits. We predicted that an individual with left temporal lobe epilepsy, who receives intensive, linguistically distributed training on famous faces (FF) and famous places (FP), will demonstrate increased accuracy on trained items, and that these gains will be maintained 3 months later.

Methods

Participant

Our participant was a 61 year-old right-handed male with left temporal lobe epilepsy, who contracted epilepsy (left temporal EEG onset and left mesial temporal sclerosis) at age 50. He demonstrated difficulty in retrieving the names of FF and FP (70% accuracy) as measured by the Tranel corpus of famous faces and places (Tranel, 2006; Tranel, et al., 1997). He demonstrated language within normal limits as measured by the WAB Aphasia Quotient (97.9/100)(WAB-AQ) (Kertesz, 1982) and mildly impaired common noun naming as measured by the BNT (50/60) (Kaplan, Goodglass, Weintraub, & Segal, 1983). A list of his relevant neuropsychological and language scores is provided in Table 1.

Design and Outcome Measure

A single-subject repeated probe design was employed. Prior to beginning treatment, proper noun naming probes were administered 6 times to establish baseline stability and were administered repeatedly during the course of treatment, upon treatment completion and 3 months later. Repeated probes were scored on-line as correct or incorrect. Incorrect productions included incorrect names, null responses, circumlocutions, and phonologic paraphasias.

Treatment Stimuli

Treatment stimuli were selected from a corpus of 220 pictures of FF and FP, which was administered to the patient to determine naming accuracy. Only items that the participant reported as familiar were considered in stimuli selection. A random 20 items which the participant was consistently unable to name were divided into two groups: trained (n=10) and untrained (n=10). Control stimuli consisted of untrained proper nouns and low frequency common nouns.

Treatment Program

Therapy was delivered by the first author for 2 hours/day over 5 days. The treatment procedures were as follows:

1)A picture of a FF or FP was shown to the participant, who was prompted to name it.
2)Semantic features of the item were provided.
3)Two additional picture exemplars of the item were shown.
4)The number of syllables, followed by the initial phoneme of each word in the name, were provided.
5)The total number of phonemes and each phoneme in the name were provided.
6)The picture was shown with the written name, and the participant was asked to write and repeat the name three times.

Whether or not the correct name was provided in step 1, each subsequent step was completed. The same procedure was followed for each item. As treatment progressed, the participant was permitted to provide the semantic and phonologic features. When errors were probable, the experimenter reclaimed the active role to promote errorless learning.

Results

Intra-class correlations computed on 20% of the data yielded an intra-rater reliability of .977 and an inter-rater reliability of .970.

Overall accuracy results showed a positive effect of training after therapy (Effect size (ES)=3.179). More importantly, results showed a positive effect of training on maintenance of trained items (ES=3.543). As expected, treatments gains did not generalize to untrained items as demonstrated by non-significant effect sizes when comparing baseline performance on untrained items to performance immediately after treatment (ES=.753) and to performance 3 months after treatment (ES=1.076) (Figure 1). Language test scores (BNT, WAB, Common Nouns) at acquisition and maintenance time points did not differ significantly from baseline scores (Table 2).

Discussion

The results of this study demonstrate that the learning of proper names can occur despite disruptions to the left ATL, a region that is undeniably involved in the integrity of proper noun naming. Our treatment successfully targeted specific proper nouns through a linguistically distributed training approach. This conclusion is supported by improved proper noun naming of trained items immediately after treatment, and no change to untrained items. The maintenance of these gains 3 months after treatment completion demonstrates that learning that occurred during the training phase can be solidified into more permanent knowledge despite continued disruptions to the left ATL.

We suggest that our treatment, which took advantage of undamaged linguistic networks, promoted the reorganization of proper nouns to networks outside of the left ATL. The observed gains in proper noun retrieval were likely due to the distributed nature of our treatment, which took advantage of linguistic networks outside of the ATL and sought to incorporate these networks into the representation of proper nouns. The outcome was decreased reliance on the left ATL; therefore, continued disruptions to the ATL had less impact on proper noun retrieval.

Our case study suggests that linguistically-distributed language therapy can lead to marked improvements in proper noun retrieval. Patients with temporal lobe epilepsy are a largely underserved population in regards to speech-language pathology services. Our treatment program has the potential to advance rehabilitation research and treatment protocols for this population. The results of this study need to be replicated in a larger sample and in individuals with more severe proper noun naming deficits to further determine the effectiveness of this novel treatment approach.

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Table 1

Pre-treatment neuropsychological and language scores

Test	Test Subtype	Score
Wechsler Memory Scale-III (Wechsler, 1997) Scale Scores	Logical Memory Immediate	11
	Logical Memory Delay	12
	Verbal Pairs Immediate	13
	Verbal Pairs Delay	13
	Faces Immediate	9
	Faces Delay	13
Rey-O Complex Figure	Copy	55
	Recall	48
Boston Naming Test (Kaplan, et al., 1983) Raw score out of 60		50
Western Aphasia Battery (Kertesz, 1982)	Aphasia Quotient	97.9

Table 2

Language test scores during baseline, post-treatment, and maintenance phases

	Baseline	Immediate post-treatment	3 months maintenance
BNT	50	53	53
WAB	97.2	97.9	98.2
Common Nouns	123	121	125

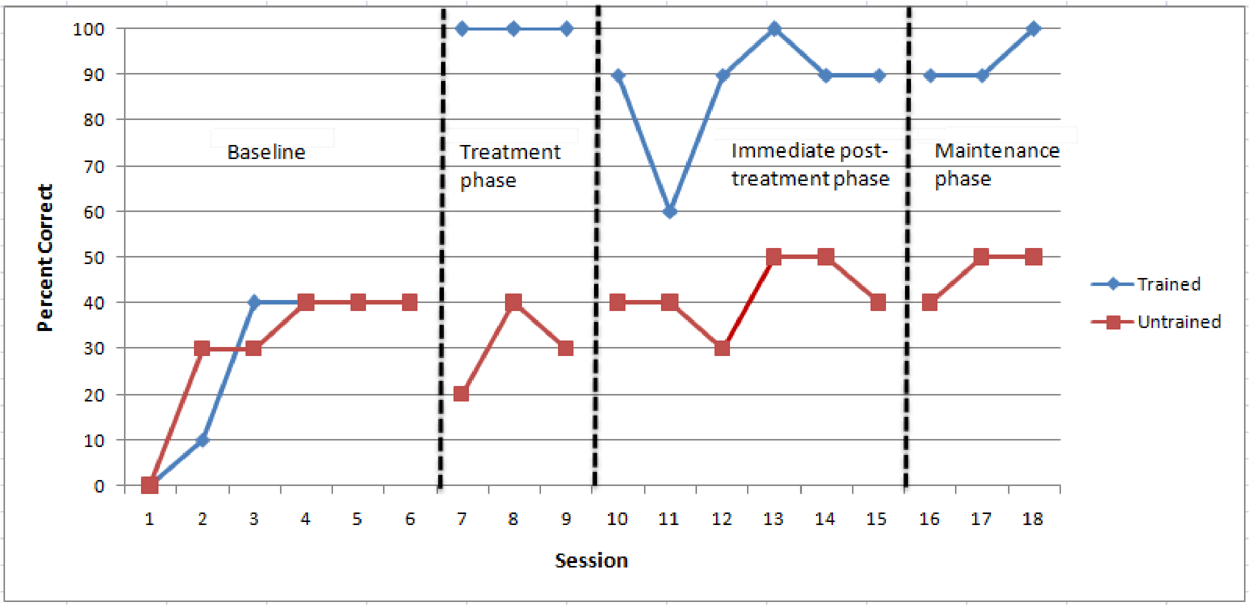

Figure 1. Repeated probe data (percent accurate) for trained and untrained FF & FP during baseline, treatment, immediately post treatment termination, and 3 month maintenance phases.