Effects of Contrasting Word Retrieval Treatments in Phonologic and Semantic Anomia

Many studies have examined effects of training for aphasic word retrieval impairments (e.g., Nickels, 2002). Treatment effects typically are better in individuals with phonologically-based impairments than in those with semantically-based anomia (Raymer et al., 2007; Rose et al., 2003). Fewer studies have contrasted treatments within participants to determine which methods optimize treatment outcomes. Further, most word retrieval training studies examine outcomes for picture naming, while attending less to outcomes that may contribute to general communication abilities, such as using gestures.

Two approaches that have been described to address word retrieval impairments are errorless naming training (ENT; Fillingham et al., 2005), and gestural facilitation of naming (GES; Raymer et al., 2007). ENT encourages the verbal production of target words through maximal support provided in a repetition/oral reading format, thereby avoiding the production of errors during training which induce use those error responses. Results have not been delineated with respect to semantically-based impairments. Gestural training pairs verbal and gestural modalities to enhance verbal production, along the lines of intersystemic reorganization (Luria, 1973). In a prior study, individuals with semantic anomia had more limited response to gestural training than did those with phonologic anomia (Raymer et al., 2006).

The purpose of this study was to contrast the effects of ENT and GES in individuals with semantic and phonologic anomias. In contrast to earlier studies, we amplified the treatment by doubling the length of time spent in training. Further, we adapted the training paradigm to include a phase of spontaneous generation of target words at the completion of each training session.

Participants

The study included eight right handed individuals with aphasia subsequent to left hemisphere stroke (Table 1). They ranged in age from 40-78 years and ranged 5-30 months post stroke onset. The Western Aphasia Battery-Revised and the Boston Naming Test indicated that all but one had nonfluent forms of aphasia and pronounced word retrieval impairments. Seven of eight had notable apraxia of speech. Additional experimental testing with a lexical battery revealed comprehension and naming impairments indicative of semantic anomia in 4 individuals, and intact comprehension with impaired naming consistent with phonologic anomia in 4 individuals. All provided written consent to participate in this treatment study.

Treatment Design and Methods

The study incorporated a single-participant experimental design. The daily probe task required picture naming and gesture production for 60 gestureable nouns (e.g., sleeve, brush): 24 pictures used in ENT training, 24 pictures used in GES training, and 12 untrained pictures. The picture sets were matched for word length, frequency, and baseline difficulty. The dependent variable was percent correct naming and percent recognizable gestures.

Probes were administered for 3-6 baseline sessions. Participants then were randomly assigned to two treatment orders; six received ENT followed by GES, and two received GES followed by ENT. Both treatments were devised to implement elements of errorless training, avoiding errors as much as possible in initial treatment steps, later increasing self-generation of verbal responses in final steps of the protocol. In ENT, the participant repeated the target word

three times, read aloud the word three times, and then spontaneously produced the word three times after a pause. In GES, the clinician modeled the spoken word and gesture, the participant then imitated the gesture in isolation three times, the word in isolation three times, and the word and gesture together three times before attempting to spontaneously produce the word and gesture after a pause. In both treatments, a final barrier activity was implemented after all pictures were rehearsed wherein the participant spontaneously named and provided a gesture for each training picture. Participants were seen for 2-3 one hour sessions per week for 20 treatment sessions per phase. Results were graphed and effect sizes (d) were calculated comparing post-treatment and baseline means relative to the baseline standard deviation (Busk & Serlin, 1992). Some effect sizes were estimated due to no variability in the baseline phase. An effect size of $d>2.5$ was considered notable, and $d>5.8$ was considered large (Beeson & Robey, 2007). Standardized tests (WAB and BNT) were repeated after each training phase.

Results

ENT led to improvements in naming for trained words for 7/8 participants; 4 with small effects and 3 with large effects. Three participants demonstrated generalized improvements to untrained words as well. Improvements were noted in individuals with both phonologic and semantic anomia. Little improvement was evident for gesture production during ENT, as expected.

GES led to improvements in naming for trained words in 4/8 participants, 1 with small effects and 3 with large effects. Two individuals also improved naming for sets of untrained words as well. Of those who improved in naming, 3 had phonologic anomia and 1 had semantic anomia. Remarkable improvements in gesture production were noted for 7/8 participants, 2 with small effects and 5 with large effects. Only two individuals showed generalized gesture improvement to untrained words.

Comparing performance at one month follow-up to baseline levels in six of the participants, improvements in naming remained for 4/6 individuals for ENT words, and 5/6 for GES words. Generalized naming improvements were maintained for 4/6 individuals. Improvements in gesture production were retained for 4/6 individuals, only for words trained in GES.

Standardized testing with the WAB and BNT at the completion of two training phases indicated some improvement beyond the standard error of measurement on the WAB for two individuals with phonologic anomia, largely due to increases in repetition abilities. On the BNT, 4 individuals also demonstrated improved scores, two with phonologic anomia and two with semantic anomia.

Discussion

Both ENT and GES led to improvements in picture naming, with some advantage to ENT; effects were largely maintained at one month follow-up. Small generalized naming improvements were evident after two phases of naming therapy (up to 40 sessions). Verbal production training also led to improvements in repetition on the standardized aphasia battery. Gesture improvements followed gesture training and also lasted out to one month. The one participant (811) who had no verbal gains also had a particularly severe apraxia of speech (WAB Repetition = 1.0) that accompanied his aphasia and restricted treatment effects. The positive observation is that 811 improved markedly in gesture production, which proved beneficial for his overall communication abilities.

Although earlier studies have often reported limited effects of word retrieval training for individuals with semantic anomia, we observed positive changes in some participants. Two individuals with semantic anomia (802, 808) were in the top three effect sizes reported for naming improvements following ENT. For GES as well, 808 had the third highest effect size of the eight participants. Semantic anomia can be observed in individuals with nonfluent and fluent aphasias. The two individuals with semantic anomia who improved in our naming study had nonfluent aphasia (Broca's and transcortical motor). It may be that semantic anomia in fluent aphasia (usually associated with left temporal/parietal lesions) have a poorer prognosis for naming improvement.

Patients with moderate aphasia improved in verbal production regardless of the training paradigm, although those with semantic anomia had stronger effects for ENT. Those with severe aphasia and apraxia of speech benefited more from a gestural approach that allows for improved communication despite severe verbal limitations.

Table 1: Demographic information and standardized test results.

	806	809	810	812	802	804	808	811
Age (yrs)	47	40	56	54	67	78	47	71
Education (yrs)	15	12	11	12	16	16	12	15
Gender	F	M	M	M	F	F	F	M
Time post (mos)	29	7	5	6	16	6	30	6
WAB-R AQ (max 100)								
Pre	52.8	49.3	55.3	56.5	21.0	66.8	54.0	26.8
Post	68.8	53.6	71.7	57.1	24.2	68.5	58.8	24.1
BNT (max 60)								
Pre	18	10	27	18	0	11	2	0
Post	32	7	24	23	0	18	7	0
Noun Battery %								
Picture Name	56.7	38.3	41.2	53.3	0	26.7	21.7	1.7
Sent Compl	51.7	31.7	66.7	36.7	1.7	40.0	43.3	8.3
Wd/Pic Verif	95.0	93.3	98.3	91.7	70.0	51.7	41.7	80.0
Naming impairment/	Phonologic Anomia				Semantic Anomia			
Aphasia type	Broca's aphasia +AoS				Bro+	TSA	TMA	Bro+

Table 2: Treatment effect sizes (d) (*estimated)

	Phonologic Anomia				Semantic Anomia			
	806	809	810	812	802	804	808	811
Errorless Naming Training								
Phase	1	1	2	1	1	1	2	1
ENT Set Naming (trained)	**2.64**	**3.26**	**5.19**	**8.99**	**7.09**	**3.65**	**7.86**	1.0
GES Set Naming (untrained)	**6.31**	**2.92**	0	2.33	**3.57**	.74	-.87	*
Control Set Naming (untrained)	1.32	**2.84**	1.41	*	0	-.27	.65	*
ENT Set Gesture (trained)	-1.43	1.32^	*	*	0	0	-3.50	-1.09
GES Set Gesture (untrained)	-1.62	1.32^	-8.49	1.62	0	0	-2.95	-.58
Control Set Gesture (untrained)	-.92	*	*	*	0	0	**2.60**	*
Gesture Training								
Phase	2	2	1	2	2	2	1	2
ENT Set Naming (untrained)	-1.41	-1.41	**4.55**	-1.77	-3.19	-8.51	.83	*
GES Set Naming (trained)	-2.83	**5.66**	**13.34**	**12.73**	.23	-1.31	**7.23**	*
Control Set Naming (untrained)	**7.78**	**2.59**	1.55	2.47	0	-2.82	-.35	*
ENT Set Gesture (untrained)	**2.54#**	1.77	*	*	**12.5**	0	1.85	*
GES Set Gesture (trained)	**8.13**	**17.68**	**48.16**	**35.64**	**24.0**	**4.0**	**2.83**	*
Control Set Gesture (untrained)	1.06	*	*	*	**9.0**	0	.53	*
Follow-Up – Baseline/Baseline SD								
ENT Set Naming	1.25	**4.12**	**5.54**	**8.36**	--	--	**4.98**	0
GES Set Naming	**5.30**	**5.38**	**10.73**	**6.02**	--	--	**8.13**	*
Control Set Naming	**2.92**	**3.22**	2.46	**7.07^**	--	--	.53	*
ENT Set Gesture	.21	1.32^	*	*	--	--	1.37	-1.09
GES Set Gesture	.32	**15.87^**	**32.79**	**29.70**	--	--	1.37	**8.08**
Control Set Gesture	-1.25	*	*	*	--	--	1.40	*

*Uncalculable because no variability and no gain
^Pooled effect by combining BL+PostTx1 probes
--Not available