MOR evidence for the therapeutic value of multiple oral re-reading

Background

Damage to the language-dominant hemisphere often results in inaccurate and slowed reading speed, both at the single-word and text levels. One approach directed toward the remediation of acquired alexia is multiple oral re-reading (MOR), a text-level intervention that was initially developed to improve reading in letter-by-letter readers (Moyer, 1979; Tuomainen & Laine, 1991; Beeson, 1998). MOR involves repeatedly reading aloud the same text for a period of time, and has resulted in increased reading rate and accuracy for both practiced and novel texts. Although initially intended to treat pure alexia, MOR has also been used successfully with other alexia syndromes, including phonological alexia (Moody, 1988; Beeson & Insalaco, 1998) and phonological text alexia (Lacey et al., 2007). In the present study, we report on a case series of six individuals who all complained of slow, effortful text reading. The current investigation was undertaken to examine the broader application of MOR with a series of individuals with acquired alexia varying in severity, and also to further characterize the ideal candidate for this type of treatment.

Method

Participants. Six individuals with acquired alexia underwent MOR treatment. They ranged in age from 57-80 years, and were an average of 35 months post onset of left hemisphere stroke. Their spoken language profiles were consistent with anomic aphasia, yet their alexia profiles ranged from pure alexia with overt letter-by-letter reading, to milder alexia characterized by slow text reading. All participants had extrasylvian lesions in the distribution of either the left posterior or middle cerebral artery. In addition, a control group of 10 adults with no history of neurological conditions or reading impairments were administered pre-treatment reading measures. Demographic information for individual patients and the control group is presented in Table 1.

Dependent Measures. Single word reading was assessed using a list of 160 words (40 each at 4, 5, 6, and 7 letters) presented in 20 point font on a laptop computer using the DirectRT program (Jarvis, 2001). Words were controlled for regularity, frequency, imageability, and grammatical class. Response times (RT) in milliseconds were recorded from stimulus onset to initiation of a verbal response as measured by voice response key. RT analyses were computed for correct responses only.

Text reading for patients was assessed using portions of the *Gray Oral Reading Test-3* (Wiederholt & Bryant, 1992). In addition, four of the six patients and all of the control participants received two reading passages developed in our lab corresponding to 2nd and 12th grade Fleisch-Kincaid reading levels. For all text reading measures, rate measured in words per minute (wpm) and accuracy measured in deviations from print (errors/100 words) were calculated. Both single word and text reading measures were administered pre- and post-treatment.

Treatment. Baseline text reading rate and accuracy was determined for each patient using passages from the *Scientific Research Associates* (SRA; 1978) series. The reading grade level at which patients read 60-70 wpm was chosen as the target level for probe texts. Practice texts were SRA passages or self-selected texts at a reading grade 0.5-1 level higher than probe texts. Treatment sessions were conducted 1-2 times per week, and consisted of the patient reading a novel probe text, followed by reading of a practice passage. The practice passage was repeatedly read aloud with the goal of increasing reading rate to 100 wpm while maintaining accuracy. Daily oral reading homework was assigned, and a new practice passage was chosen when the target goal of 100 wpm was reached. Five of the six patients also underwent treatment for lexical agraphia (Beeson et al., 2000) concurrent with MOR treatment.

Results

Patients received an average of 15 one-hour sessions (range = 8-32) of treatment. Table 2 shows pre- and post-treatment single word reading latency (RT), text reading rate and text reading accuracy for each patient. Prior to MOR treatment, all patients demonstrated a significant word length effect (Figure 1). After MOR treatment, all six patients were significantly faster at reading single words. Two patients even fell within the normal range (within 2 standard deviations of the control mean) after treatment. The slope of the regression line indicating the increase in RT for each additional letter in the word was calculated and normalized to account for individual differences in overall reading speed. Normalized slope decreased for three of the six patients, indicating a reduction in the word length effect. One patient (P140) even eliminated his word length effect altogether. This is notable given that this individual was an overt letter-by-letter reader and had the slowest single word reading speed pre-treatment.

Four of the six patients significantly increased text reading rate after treatment, as measured by average rate across all levels of GORT-R and lab-developed reading passages administered. Of the remaining two, one (P130) who was already reading at a rate within two standard deviations of the control mean pre-treatment, nonetheless significantly reduced the number of errors made during text reading. The other individual (P133) did not change in text reading rate, however number of errors made decreased, particularly for the more difficult (GORT-R Levels 7-9) passages.

Discussion

This study contributes six additional cases to the growing body of evidence demonstrating the efficacy of MOR treatment. Of particular interest was the fact that despite the range of severities and reading levels targeted for treatment, all participants demonstrated improved reading following treatment. For individuals with slower single-word reading rates and larger word length effects, MOR treatment resulted in overall faster single word and text reading. For individuals at the faster end of the continuum, MOR treatment resulted in increased text reading accuracy while maintaining reading rates.

Although it is not entirely clear what mechanism subserves improved reading, in general, MOR is thought to facilitate both top-down and bottom-up text processing, due to repeated practice identifying words in a syntactic/semantic context (Beeson et al., 2005). This mechanism may have differential effects based on the alexia profile. Indeed, Lacey and colleagues (2007) reported different patterns of improvement on untrained passages that shared 60-80% of phrases, functors, and content words as the trained passages, depending on the individual's alexia profile. Our data suggest that for individuals with slow single word reading and large word length effects (P135, P169, P170, P140), MOR seems to facilitate visual word form recognition, resulting in a shift from serial to whole-word processing. For individuals who are able to read single words relatively quickly (P130, P133) and are presumably already engaging in whole-word processing, MOR may serve to further strengthen orthographic representations and their links to semantics such that accuracy improves following treatment.

Given the predominance of written text in everyday environments, the utility of text-based reading treatments is high. However, the importance of being able to rapidly identify single words, such as reading signs when driving, also has great functional value and should not be underestimated. The results of this study support the therapeutic value of MOR for use with a range of alexia severities.

1146 words

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Table 1

Demographic Information for Individual Patients and Control Group

	Lesion	Age	Education	Time Post Onset (months)	WAB AQ (out of 100)	BNT (out of 60)
Controls*		64.2	14.2			
P130	LPCA	79	18	72	95	32
P133	LMCA	58	14	24	98.8	58
P135	LPCA	80	12	4	90.4	30
P169	LPCA	73	14	96	89.4	42
P170	LPCA	65	14	6	97	46
P140	LMCA/LPCA	76	14	10	91.4	50

*Average

WAB = *Western Aphasia Battery* (Kertesz, 1982).

BNT = *Boston Naming Test* (Kaplan, Goodglass & Weintraub, 1983)

Table 2

Pre- and Post-Treatment Reading Measures

	Pre-Treatment				Post-Treatment			
	Single Wd RT (msec)	Norm. Slope	Text Rate (words/min)	Text Acc (error/100 wds)	Single Wd RT (msec)	Norm. Slope	Text Rate (words/min)	Text Acc (errors/100 wds)
Controls	613	.008	167.0	1				
130	890	.039	123.0^{N}	4.7	769** ^{N}	.040	133 ^{N}	2.2**
133	935	.040	87.4	2.5	726** ^{N}	.031	87.6	1.7
135	1411	.140	82.7	1.1	1223**	.078	103.2**	6.8
169	1845	.074	56.5	3.3	1601**	.148	69.3*	2.5
170	1968	.176	60.3	.5	1613**	.167	71.6*	.1
140	3014	.082	52.8	3.5	1765**	.011	70.2**	3.5

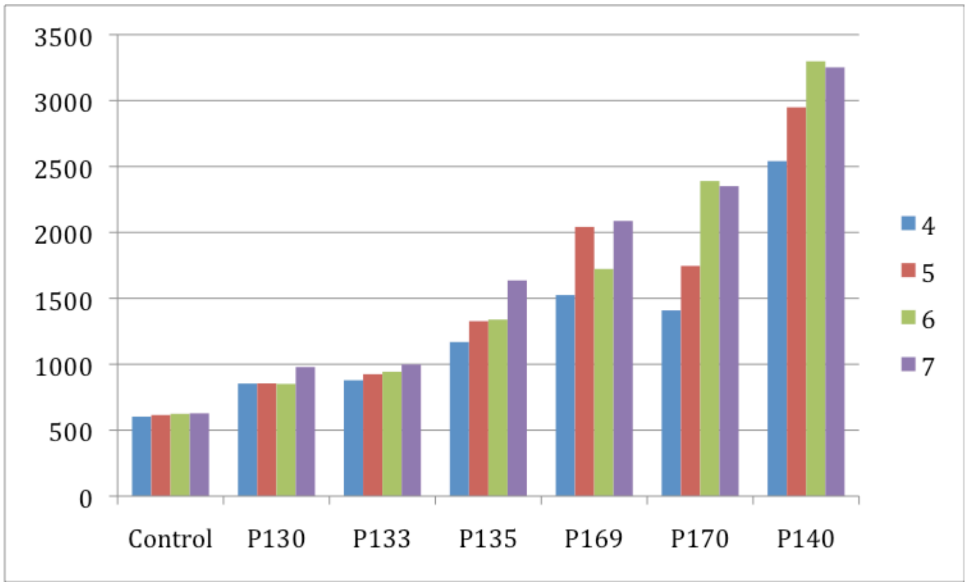
^{N} within 2 standard deviations of control average

*p < .05; **p < .001

Normalized slope = slope of regression line divided by mean RT of participant

Figure 1

a. Pre-treatment single word reading latencies for patients with control values as a reference



b. Post-treatment single word reading latencies for patients with control reading rates as a reference