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Treating attention in mild aphasia: Evaluation of attention process training-II

Laura L. Murray*, R. Jessica Keeton, Laura Karcher

Department of Speech and Hearing Sciences, Indiana University, 200 S. Jordan Ave., Bloomington, IN 47405, USA

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Abstract

This study examined whether attention processing training-II [Sohlberg, M. M., Johnson, L., Paule, L., Raskin, S. A., & Mateer, C. A. (2001). *Attention Process Training-II: A program to address attentional deficits for persons with mild cognitive dysfunction* (2nd ed.). Wake Forest, NC: Lash & Associates.; APT-II], when applied in the context of a multiple baseline ABA design, would improve the attention abilities of RW, a patient with mild conduction aphasia and concomitant attention and working memory deficits. We also explored whether APT-II training would enhance RW's auditory comprehension, other cognitive abilities such as memory, and his and his spouse's perceptions of his daily attention and communication difficulties. With treatment, RW improved on trained attention tasks and made modest gains on standardized tests and probes that evaluated cognitive skills related to treatment activities. Nominal change in auditory comprehension and untrained attention and memory functions was observed, and neither RW nor his spouse reported noticeable improvements in his daily attention or communication abilities. These and previous findings indicate that structured attention retraining may enhance specific attention skills, but that positive changes in broader attention and untrained functions are less likely.

Learning outcomes: As a result of reading this article, the participant will be able to: (1) summarize the previous literature regarding attention impairments and treatment approaches for patients with aphasia. (2) describe how Attention Processing Training-II affected the attention, auditory comprehension, and other cognitive abilities of the patient in this study.

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* Corresponding author. Tel.: +1 812 855 3585; fax: +1 812 855 5531. *E-mail address:* lmurray@indiana.edu (L.L. Murray).

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1. Introduction

Although aphasia has been traditionally defined in terms of impaired functioning in one or more language modalities (Benson, 1994; Grodzinsky, 1990), results from an increasing number of studies indicate that attention impairments commonly co-exist in chronic aphasia (e.g., Erickson, Goldfinger, & LaPointe, 1996; Kreindler & Fradis 1968; Murray, 2000; Tseng, McNeil, & Milenkovic, 1993). The construct of attention encompasses several basic and complex cognitive functions that enable selecting and manipulating external or internal stimuli for just a moment through to extended periods of time (Park & Ingles, 2001; Posner & Petersen, 1990). More basic attention functions include being alert enough to respond to stimulation and being able to sustain or maintain attention to a task or stimulus over time; complex attention functions allow us to switch rapidly our attentional focus and to respond simultaneously to multiple tasks or stimuli. In adults representing a spectrum of aphasia types and severities, both basic and complex attention functions have been found to be compromised, even when task materials are nonlinguistic in nature. For example, compared to healthy, non-brain-damaged peers, adults with aphasia perform less accurately, more slowly, or both on sustained attention (e.g., Korda & Douglas, 1997; Kreindler & Fradis, 1968), focused or selective attention (e.g., Cohen, Woll, & Ehrenstein, 1981; Van Mourik, Verschaeve, Boon, Paquier, & Van Harskamp, 1992), attention switching (e.g., Connor, Helm-Estabrooks, & Palumbo, 2001; Robin & Rizzo, 1989), and divided attention tasks (e.g., Erickson et al., 1996; King & Hux, 1996). Additionally, physiological differences (e.g., higher cortisol levels, longer latency and decreased amplitude of attention-related evoked potential waveforms) between healthy adults and those with aphasia have been identified during attention tasks (Laures & Odell, 2001; Peach, Rubin, & Newhoff, 1994).

Collectively, these findings have led to an attentional or processing model of aphasia in which some aphasic symptoms are proposed to be a product of or exacerbated by attention impairments (Connor, Albert, Helm-Estabrooks, & Obler, 2000; McNeil, 1997; McNeil, Odell, & Tseng, 1991; Murray, 1999, 2002). Several lines of research support this notion that attention deficits mediate language performance in aphasia. First, McNeil and colleagues (1991; McNeil & Doyle, 2000; McNeil & Kimelman, 1986) noted that purely linguistic accounts of aphasia insufficiently account for several prominent aphasic characteristics such as stimulability (i.e., manipulating extra-linguistic variables such as stimulus presentation rate (e.g., Brookshire, 1971) or visuospatial location (e.g., Coslett, 1999) influences the language abilities of patients with aphasia) and intra-subject variability (i.e., language performances in patients with aphasia regularly differ quantitatively and qualitatively across repeated administrations of the same task completed in the same testing context (e.g., Connor et al., 2001)). Second, significant correlations have been found between aphasic patients' performances of certain attention and language tasks (Petry, Crosson, Gonzalez-Rothi, Bauer, & Schauer, 1994). Third, as the attentional demands of language tasks are increased (i.e., in the presence of distraction; while completing a competing task), patients with aphasia demonstrate significant disruption in lexical-semantic and syntactic aspects of auditory processing (Murray, Holland, & Beeson, 1997a; 1997b; Tseng et al., 1993), and lexical-semantic, syntactic, and pragmatic aspects of verbal output (Murray, 2000; Murray, Holland, & Beeson, 1998) than

their non-brain-damaged peers. Lastly, attention appears to influence both language ability and recovery in patients with aphasia. For example, patients with concomitant cognitive deficits (including attention problems) have been found less likely to benefit from aphasia treatment than those patients without co-existing cognitive problems (Goldenberg et al., 1994; Murray, Ballard, & Karcher, 2004). Likewise, attention impairments appear to have a greater influence than degree of language deficits on the vocational outcomes of patients with aphasia (Ramsing, Blomstrand, & Sullivan, 1991).

Given the documented relation between attention and language in aphasia and the apparent detrimental effects of attention deficits on functional outcomes, several researchers have recommended directly treating attention to enhance indirectly these patients' language as well as other cognitive abilities (Goldenberg, Dettmers, Grothe, & Spatt, 1994; Murray, 1999, 2002; Van Mourik et al., 1992). Whereas many studies have evaluated attention training in patients with traumatic brain injuries (e.g., Cicerone, 2002; Sohlberg, McLaughlin, Pavese, Heidrich, & Posner, 2000), descriptions and empirical testing of attention treatments for adults with aphasia are thus far scant. An early exception is the work of Sturm and colleagues (1991; 1997). Utilizing a series of computerized tasks, these researchers found that their patients with aphasia or right hemisphere brain damage improved on the trained attention tasks; modest generalization to untrained attention domains, however, was observed only when the computer tasks were more "functional" (e.g., a photographic safari task in which patients pressed a key to take snap shots of certain objects, animals, or people) and when basic attention functions (e.g., arousal, sustained attention) were targeted. Although negligible generalization to other cognitive abilities (e.g., nonverbal problem solving) was found, the researchers did not evaluate language and so the effects of their treatment on this domain remain unclear.

In 2000, Helm-Estabrooks, Connor, and Albert used their Attention Training Program (ATP) to evaluate whether treating nonlinguistic aspects of cognition would enhance language in patients with chronic aphasia. ATP activities (e.g., symbol cancellation, auditory continuous performance) progress from relatively basic, sustained attention tasks to those with more complex, focused and alternating attention demands. Following approximately 2 months of twice-weekly therapy, two patients with mixed nonfluent aphasia displayed improvement on ATP tasks, as well as substantial gains in nonverbal reasoning and moderate, although still functional, improvement in auditory comprehension. Several months post-treatment, both patients had retained their nonverbal reasoning improvements, but their auditory comprehension gains had deteriorated. Similarly, Kohnert (2004) provided 2 months (i.e., 14 one-hour sessions) of cognitive treatment to a patient with chronic, transcortical motor aphasia. Cognitive activities such as card sorting, simple math computations, and visual search tasks were used to target sustained and alternating attention abilities. Post-treatment testing revealed substantial gains on all trained cognitive tasks, and moderate improvements in untrained language comprehension and production abilities. Definitive conclusions regarding the effects of these cognitive protocols cannot be rendered, however, until more detailed descriptions of these studies' procedures become available (e.g., treatment criteria were unspecified), and further investigations utilize more controlled, study designs (e.g., inclusion of a control test or probe to evaluate if improvements should be attributed to treatment versus other, nonspecific therapy variables).

Given the limited number of investigations concerning the potential effects of direct attention training on language recovery in aphasia, there clearly remains a need for further empirical research. Of particular interest is determining whether an attention treatment that incorporates linguistic stimuli might evoke greater and more enduring gains in language than those previously observed (e.g., Helm-Estabrooks et al., 2000; Kohnert, 2004). That is, given that previous cognitive protocols included primarily nonverbal, visual tasks, and that previous patients displayed greater gains in visual cognitive skills than language, it is possible that more remarkable language improvements might be achieved if treatment placed demands on both attention and linguistic abilities.

Currently there are two commercially available programs for remediating attention impairments via language-based tasks, Attention Process Training (APT; Sohlberg & Mateer, 1986) and APT-II (Sohlberg, Johnson, Paule, Raskin, & Mateer, 2001). These programs are based on a clinical model of attention in which attention consists of separable domains and is supported by several neural networks; thus, several aspects of attention will be most likely compromised following brain damage. Accordingly, both programs target a variety of attention functions (i.e., sustained, selective, alternating, and divided attention) via a series of graded activities, each of which is designed to isolate and stimulate a specific attention skill. The programs differ in that APT-II represents an upper extension of the original APT and therefore contains more demanding tasks to address the more complex attention impairments associated with relatively mild traumatic brain injuries (TBI).

Whereas some empirical research has evaluated these programs, these studies have exclusively involved TBI patients and additionally, have so far produced mixed findings. For example, Sohlberg, Mateer, and colleagues (Mateer, 1992; Mateer, Kerns & Eso, 1999; Sohlberg & Mateer, 1987; Sohlberg et al., 2000) conducted several investigations to explore the effects of APT on the attention and other cognitive abilities of patients with varying degrees of TBI severity. They consistently found that following APT, their patients displayed improvements on trained tasks and standardized attention tests (e.g., Paced Auditory Serial Addition Task; PASAT; Gronwall, 1977). More recently, positive effects on standardized tests and patient interviews designed to assess memory, learning, executive functioning, and levels of functional independence also were observed (Sohlberg et al., 2000). In contrast, Park, Proulx, and Towers (1999) reported that their patients with severe TBI achieved better PASAT performances following APT, but only nominal improvement on a memory test and no change on a depression measure; furthermore, their control group who was tested but not treated similarly showed gains on the PASAT but no improvement on the memory test. Park et al. concluded that APT facilitates only those specific attention skills targeted by treatment and does not foster improvement in other untrained attention and cognitive functions.

Only one APT-II study has been conducted to date. Palmese and Raskin (2000) provided three patients with mild TBI 10 h (1 h/week) of APT-II, and found that each patient demonstrated not only improved attention and processing speed on trained tasks, but also increased scores on the PASAT and two memory tests. Additionally, 6 weeks following treatment termination, the patients continued to display these improvements. Despite these encouraging findings, further evaluation of APT-II is needed to determine the reliability of Palmese and Raskin's results and to examine if positive effects generalize to patients' daily functioning and their perceptions of their impairments.

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Accordingly, the present study was conducted to evaluate the following research questions:

- (a) Would APT-II treatment positively affect the attention abilities of a patient with chronic aphasia and co-existing attention and working memory problems?
- (b) Would attention improvements related to APT-II treatment evoke concomitant improvements in auditory comprehension and other aspects of cognition?
- (c) Would the patient and his spouse perceive improvements in his daily attention and communication skills subsequent to APT-II treatment?

2. Methods

2.1. Subject

RW is a 57-year-old, right-handed male who suffered a left embolic stroke in September 1996. A CT scan indicated left hemisphere damage to cortical and deep areas of his posterior temporal lobe and most of his parietal lobe, including supramarginal and angular gyri. Following his stroke, according to the *Aphasia Diagnostic Profiles* (ADP; Helm-Estabrooks, 1992), he presented with mild to moderate Wernicke's aphasia including moderately impaired auditory comprehension and repetition abilities, and mild to moderate anomia. RW has an engineering degree and was able to return to the job he held prior to his stroke.

RW was first evaluated at our university speech and hearing clinic in June 1997 and was subsequently enrolled in individual outpatient therapy. Since then, he has continued to receive individual therapy on a variable basis depending on his schedule (e.g., depending on demands at his place of employment). Additionally, since September 1998, RW and his spouse have regularly attended weekly Aphasia Support Group meetings. Previous therapy goals primarily focused on use of compensatory strategies to assist auditory comprehension (e.g., requesting repetitions, taking notes) and word retrieval abilities (e.g., providing circumlocutions or synonyms), and direct stimulation of his auditory comprehension (e.g., listening and answering questions about increasingly longer and more complex paragraphs) and writing skills (e.g., repetitive practice of report writing to increase writing speed and accuracy). Although RW demonstrated steady progress on all treatment activities, he continued to report (as did his wife) and display difficulty comprehending spoken language in daily, complex listening conditions (e.g., noisy environments, conversations with multiple communication partners, when complex and figurative language were used).

2.2. Pre-treatment assessment

Pre-treatment linguistic and cognitive testing was completed in November 2000 (see Table 1). RW passed pure tone hearing and depression screenings (Yesavage et al., 1983) indicating that neither basic auditory problems nor depression were likely contributors to his current linguistic or cognitive difficulties. On the ADP, RW displayed mild problems comprehending and producing concrete, spoken language, but greater difficulty with repetition and singing tasks; his language profile was consistent with conduction aphasia.

Table 1

Pre- and post-treatment testing data for subject RW

Measure	Pre-treatment (November 2000)	Post-treatment (November 2001)
Aphasia Diagnostic Profiles	Standard score ^a (raw score)	
Personal information (24)	14 (24)	14 (24)
Writing (30)	15 (30)	15 (30)
Reading (30)	13 (30)	13 (30)
Information units	13 (14)	13 (15)
Phrase length	12 (12.4)	12 (12.0)
Naming (36)	13 (35)	13 (35)
Auditory comprehension (28)	12 (24)	13 (25)
Repetition (36)	9 (25)	9 (26)
Elicited gestures (21)	13 (21)	13 (21)
Singing (9)	7 (3)	7 (3)
Lexical retrieval	14	14
Aphasia severity	112 ^b	115
Aphasia type	Conduction	Conduction
Test of Language Competence	Standard score ^c (raw score)	
Ambiguous sentences (39 max)	8 (29)	9 (30)
Making inferences (36 max)	6 (28)	9 (32)
Recreating sentences (78 max)	5 (60)	5 (59)
Figurative language (36 max)	10 (32)	10 (32)
Communicative Effectiveness Index	mm (100 mm max)	
Spouse rating RW	66.8	68.1
RW's self-rating	68.0	69.2
e	D	
Working memory task	Raw score	21
Word recall errors (42 max)	25	21
True/false errors (42 max)	5	2
Wechsler Memory Scale-Revised	Percentile (raw score)	
Logical memory I	66 (27)	76 (27)
Logical memory II	53 (20)	53 (19)
Digit span		
Forwards	<4 (4)	5 (5)
Backwards	12 (4)	31 (5)
Visual Memory Span		
Forwards	73 (9)	81 (9)
Backwards	18 (5)	59 (7)
Visual reproduction I	94 (37)	98 (37)
Visual reproduction II	94 (36)	98 (37)
Test of Everyday Attention	Scaled Score ^d	
Map search (First minute)	7	8
Map search (second minute)	8	11
Elevator counting with distraction	10	12
Visual elevator (accuracy)	13	10
Visual elevator (timing)	8	10
Elevator counting with reversal	11	13
Telephone search	10	11
Telephone search while counting	7	14

Measure	Pre-treatment	Post-treatment (November 2001)	
	(November 2000)		
APT-II Attention Questionnaire	Raw Score (48 max)		
Spouse rating RW	25	23	
RW's self-rating	29	26	
Geriatric Depression Scale			
>11 Indicative of depression	8	7	

Table 1 (Continued)

^a Standard score with M = 10, S.D. = 3 based on a sample of 140 right-handed patients with left-hemisphere stroke.

^b Standard score with M = 100, S.D. = 15 based on standardization sample of 222 stroke patients.

^c Standard score with M = 10, S.D. = 3 based on standardization sample of 116 non-brain-damaged adolescents between the ages of 17–0 to 18–11.

^d Scaled score with M = 10, S.D. = 3 based on a sample of 154 non-brain-damaged adults.

The *Test of Language Competence – Expanded Version* (TLC-E; Wiig & Secord, 1989) was given to evaluate RW's high-level language abilities (e.g., understanding inferred or implied material). To interpret his performance, his standardized scores were compared to norms for the TLC-E's oldest age group (i.e., 17–18 years, 11 months). According to these norms, he scored at or within one standard deviation (S.D.) of the mean on the ambiguous sentences and figurative language subtests, but below the mean for the remaining subtests. His TLC-E raw scores also were compared to those of healthy adults of similar age and/or educational background reported in previous studies (Chenery, Copland, & Murdoch, 2002; Lethlean & Murdoch, 1997). This comparison indicated that his raw scores on the ambiguous sentences and recreating sentences subtests consistently fell greater than two S.D. below the means reported in both previous investigations. Collectively, these findings indicated that at least some high-level language comprehension and production abilities were problematic for RW.

The communicative effectiveness index (CETI; Lomas et al., 1989) was used to determine RW's as well his wife's perception of his current communicative strengths and weaknesses. Both he and his spouse gave relatively similar ratings on most CETI items, and reported that he displayed most difficulty on the following items: "Being part of a conversation when it is fast and there a number of people involved," and "Getting involved in group conversations that are about him/her."

Several tests were used to evaluate RW's verbal and nonverbal memory and attention abilities. RW demonstrated significant difficulty on the auditory verbal working memory test (Tompkins, Bloise, Timko, & Baumgaertner 1994): The number of recall errors made by RW fell greater than two S.D. above the mean performance of Tompkins et al.'s control group (M = 6.4, S.D. = 4.6) and close to one S.D. above the mean of their left hemisphere group (M = 16.8, S.D. = 10.8). Results from logical memory and digit span subtests of the *Wechsler Memory Scales – Revised* (WMS-R; Wechsler, 1987) indicated deficits of immediate and delayed verbal recall, particularly when there was little contextual support (i.e., digit span). With the exception of his poor performance on backwards visual memory span, RW performed well above average on subtests that evaluated visual memory skills and had relatively low linguistic demands.

The *Test of Everyday Attention* (TEA; Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994) was used to assess sustained, focused, alternating, and divided attention. RW displayed most difficulty on timed attention tasks regardless of whether they were linguistically loaded (i.e., visual elevator-timing, telephone search while counting) or not (i.e., map search). Although his scaled scores suggested only mild attention problems or within normal performance for his age group, they were interpreted to represent more significant deficits considering his and his spouse's subjective descriptions of his premorbid capabilities, and his educational and professional history; this interpretation of his performance was consistent with the TEA authors' recommendation to base clinical decisions regarding "abnormal" versus "normal" subtest performance on both scaled scores and premorbid abilities (see p. 12 of the TEA test manual).

Results from the APT-II (Attention Questionnaire) (Sohlberg et al., 2001) further established that RW demonstrated decreased attention skills compared to his premorbid status. Across the 12 items on the questionnaire, RW rated 1 as problematic "all the time" (i.e., "trouble paying attention to conversation, if more than one other person"), 3 as "frequently" problematic, 6 as "sometimes" problematic, and 1 as only occasionally problematic. His wife rated 3 items as frequently problematic, 8 as sometimes problematic, and only 1 as never problematic for RW. Both of them rated items pertaining to communicating under more demanding attention conditions as "frequently" problematic for RW (e.g., "Slow to respond when asked a question or when participating in conversations," "Miss details or make mistakes because level of concentration decreased").

In summary, RW presented with mild conduction aphasia with primary linguistic deficits in repetition, and high-level auditory comprehension and spoken language formulation. Additionally, he demonstrated working memory deficits, particularly for auditory verbal material, and mildly impaired attention with greater difficulty on timed tasks. Poor performance on cognitive tests did not simply reflect his linguistic limitations as he displayed difficulty on subtests that had both low (e.g., TEA map search) and high (e.g., auditory verbal working memory test) linguistic demands. Linguistic and cognitive test results were consistent with the subjective reports of RW and his spouse regarding the nature of his difficulties subsequent to his stroke.

Because previous, more traditional approaches to remediating RW's auditory comprehension deficits had been associated with only modest functional gains in his daily communication skills, because cognitive testing indicated concomitant attention and working memory problems, and because some initial aphasia research has suggested that treating co-existing cognitive deficits may enhance language skills (e.g., Helm-Estabrooks et al., 2000), we selected a cognitive approach to treat directly his attention and working memory difficulties, and hopefully, indirectly address his daily auditory comprehension problems. The APT-II program was selected because of (a) its clinical convenience, (b) its use has been associated with some positive outcomes for TBI patients (e.g., Palmese & Raskin, 2000), and (c) its tasks and organization are theoretically motivated (Sohlberg et al., 2001). That is, the clinical model of attention upon which the APT-II was developed is consistent with other attention theories as well as experimental and clinical evidence supporting the existence of distinct attention functions (Filley, 2002; Posner & Petersen, 1990). Sohlberg et al. (2001) also acknowledged the close interdependence between

working memory and attention (see also Kane, Bleckley, Conway, & Engle, 2001), and accordingly noted that certain APT-II tasks engage both working memory and attention; therefore, we hoped that APT-II would help RW strengthen both of these cognitive domains, which appeared problematic during pre-treatment testing. Lastly, we selected APT-II tasks that primarily stressed auditory attention because RW demonstrated and reported greater difficulty processing and responding to auditory stimuli, and because some attention models assert that separate attention resources support auditory and visual processing modalities (McLeod, 1977; Wickens, 1989).

3. Procedures

3.1. Study design

A single subject, multiple baseline ABA design was used (Richards, Taylor, Ramasamy, & Richards, 1999). Auditory comprehension was regularly probed to determine if attention training was associated with concomitant changes in this language ability. During the treatment phase, RW completed APT-II activities that targeted auditory sustained, selective, alternating, and divided attention. The criterion for treatment termination was mastery of all targeted APT-II tasks (i.e., 90% accuracy over three consecutive trials for each task) or three semesters of training (i.e., approximately 10 weeks/semester), whichever occurred first. A rapid naming task served as a control probe because this task assessed a linguistic behavior anticipated to remain relatively unaffected by the auditory attention treatment (Wickens, 1989), but still involved certain attention skills (i.e., sustained and selective attention, albeit in the visual modality).

3.2. Probe tasks

To monitor auditory comprehension, a paragraph listening probe was created (see Appendix A). This task required listening to four pre-recorded passages (approximately 3 min each), and then answering seven pre-recorded multiple-choice questions (four choices/question). Materials were modified from Graduate Record Examination practice items (Educational Testing Service, 1998) with passages approximating each other in length (m = 325 words, range = 319–339 words), complexity (i.e., grade level 15; Fry as cited by Vacca & Vacca, 1989), and topic familiarity. In addition to response accuracy, response times (RT) were recorded for each question so that a mean RT for each passage and across passages could be monitored.

A rapid naming task (RAN) served as the control probe, and involved naming as quickly and accurately as possible for 2 min a set of pictured objects. Materials and procedures were adapted from those of Denckla and Rudel (1974, 1976), and consisted of pictured objects arranged on four large (11 in.× 14 in.), laminated sheets. Each sheet had 10 rows with 5 line drawings of common objects (Snodgrass & Vanderwart, 1980) randomly arranged within each row. Each set of 5 line drawings depicted 4 monosyllabic and 1 disyllabic words (e.g., glasses, leaf, saw, cake, sheep), with mean word frequency (Kucera & Francis, 1982) matched across sets. Of the four stimulus sets developed for each probe task, three were randomly selected for administration throughout all experiment phases. During the treatment phase, one Paragraph and one RAN probe were administered at the beginning of each session, randomizing the order of probe tasks and stimulus sets across sessions. The remaining set of Paragraph and RAN probe stimuli was only used during pre- and post-treatment testing to assess for exposure effects. As recommended, all probe sets were administered three times during baseline (Fukkink, 1996). One week and 2 months following treatment termination, all probe sets were given to examine for maintenance of possible treatment effects.

3.3. Treatment

Treatment began with the most basic APT-II task that targeted auditory, sustained attention with the hopes of progressing through all auditory sustained, selective, alternating, and divided attention tasks (see Table 2). RW was provided 60 min weekly therapy sessions at the university clinic following procedures in the APT-II manual. Both RT and accuracy were recorded. RW also completed, depending on his schedule, 20–60 min per week of home practice. His spouse was extensively trained to collect accuracy and RT data during these at-home treatment sessions.

To move to a new APT-II task, RW was required to achieve 90% accuracy over three consecutive trials; although APT-II manual recommends one or no errors or false alarms on two consecutive trials (Sohlberg et al., 2001), a more conservative criterion was chosen to foster automaticity (Murray, 1999; Park & Ingles, 2001). In the last two months of the study, however, our original accuracy criterion was abandoned for the following reasons: (a) to target a greater diversity of attention functions as the pre-specified treatment termination date was quickly approaching when RW was still completing sustained attention tasks; (b) to placate RW's frustration with his lack of progress and the monotony of completing the same task for an extended time period; and, (c) to assure that tasks judged to have ecological validity for RW could be incorporated to foster further his motivation to complete the study.

During the latter half of the study, some modifications were introduced to simplify APT-II tasks and ensure RW's initial success when a new activity was introduced. These modifications were faded as his accuracy and/or latency improved. Specific modifications included: (a) allowing RW to write down stimuli (after they all had been presented) prior to giving his response, (b) slowing the playing speed of the pre-recorded auditory stimuli, (c) providing visual cues (e.g., on the Serial Numbers task, a cue card with the target arithmetic rule printed on it was given as a reminder), and (d) encouraging RW to repeat each stimulus aloud as it was presented and to verbalize continuously each stimulus until giving his final response. The exact number and types of strategies utilized during a given session depended on RW's initial performance of the target task that day (e.g., if he began a trial with consecutive errors, strategies were introduced until he accurately performed several consecutive trials) and the nature of APT-II task being completed (e.g., neither repeating stimuli aloud nor providing visual cues were appropriate for the time monitoring task).

For the final two treatment sessions, generalization activities were developed based on, at least in part, APT-II recommendations (Sohlberg et al., 2001). These tasks consisted of listening to and recalling directions, phone calling for driving directions, and tracking

Table 2 APT-II treatment activities and data

APT-II tasks	Activity example/description	No. of sessions to criterion ^a	Initial session perform. range	Final session perform. range
Sustained attention				
Attention tapes				
Level I	From a word list, identify items that are round	4	79–94%	88–98%
Level II	From a word list, identify words related to the previously heard word	6	76–88%	88–95%
Level III	From a word list, identify words with more than one spelling	6	74–89%	83–97%
Level IV	From a word list, identify words that when spelled backwards make a word	11	75-80%	83–97%
Paragraph Listening	Select best ending (choice of 3) for paragraphs that vary from 2–6 sentences in length	3	80–100%	90–100%
Alphabetized sentences				
Four word level	Give back words from the sentence stimuli in alphabetical order	16 ^b	39–62% 34–38 s ^c	76–88% 22–27 s
Number sequence ascending				
Four number level	Give back number sequence in ascending order	5	70–80% 10–12 s ^c	90–100% 6–10 s
Mental math	Give back series of four numbers by adding three to each number	1	90–100% 12–15 s ^c	
Alternating attention				
Serial numbers	Continually give back a number by alternating between two arithmetic rules (i.e., addition and subtraction) for a set period of time	1 ^d	60–100%	

Table 2 (Continued)				
APT-II tasks	Activity example/description	No. of sessions to criterion ^a	Initial session perform. range	Final session perform. range
Selective attention				
Mental math with noise distractor	In the presence of audiotaped or live noise, give back series of 4 numbers by adding or subtracting a given amount to each number	1 ^d	0–80% 9–34 s ^c	
Mental math with movement distractor	Same mental math activity as above but in the presence of live noise and movement (e.g., clinician shuffling papers in RW's field of view)	1 ^d	0–60% 21–39 s ^c	
Divided attention				
Time monitoring intervals on a clock	Complete a math worksheet while monitoring time	1 ^d	Math: 60–90% time intervals: 90-100%	

^a Accuracy criterion = 90% correct over three consecutive trials.

^b Accuracy criterion never reached. Instead, a new APT-II task was targeted when RW became frustrated with the sentence task due to the number of sessions spent on it and his inability to achieve further progress.

^c Average response latency per item across stimulus lists.

^d The original accuracy criterion was abandoned to: (a) maintain RW's interest and motivation, and (b) target a greater variety of APT-II and generalization tasks before terminating treatment.

football scores and other statistics while watching a video. For each task, RW answered 4–5 open-ended, content-based questions, and retold the information he had acquired. At the beginning of these sessions, RW was reminded about previously used compensatory strategies.

4. Results

4.1. APT-II treatment tasks

Overall, RW's accuracy, latency, or both on all trained APT-II tasks improved across trials and/or sessions (see Table 2). Although he quickly advanced through the initial sustained attention activities, he showed much slower progress on subsequent tasks that clearly stressed auditory-verbal, working memory as well as sustained attention. For example, RW failed to meet criterion (i.e., 90% accuracy over three consecutive trials) on the alphabetized sentence tasks despite eight weeks of practice and implementation of several strategies designed to reduce working memory demands (e.g., writing down stimuli after they were presented). In contrast, he achieved criterion on the next two sustained attention tasks fairly quickly, even though according to the APT-II's hierarchical organization (Sohlberg et al., 2001), these tasks should be more complex and thus, require more treatment to master.

During the last 2 months of treatment, only one session (but several trials) was typically devoted to each APT-II task because the end of the treatment phase was rapidly approaching and the original accuracy criterion had been abandoned. RW demonstrated greater difficulty on these more complex, alternating, selective, and divided attention tasks: His initial trial accuracies were lower, he required more cues to apply compensatory strategies, and more task modifications were needed to assist his performance on initial trials compared to previous APT-II activities (see Table 2). Within each session, however, RW improved across trials, even when task modifications and cues were faded. For example, across the six trials of mental math with distracter noise, RW's accuracy improved from 0 to 80% while his average trial RT decreased from 34 to 9 s.

Because of the design of the generalization tasks and time constraints, only two trials of each task were completed per session (see Table 3). During these tasks, RW independently utilized several previously reviewed strategies (e.g., taking notes), and during second trials,

Generalization task	No. of trials	Initial trial perform. range	Final trial perform. range
Retell directions to a local apartment complex	2	3/5 Correct unable to retell	4/5 Correct able to retell
Retell directions to get to a waterfall in a park in California	2	3/5 Correct unable to retell	5/5 Correct able to retell
Make phone call to get directions from Bloomington to Philadelphia	2	4/5 Correct able to retell	5/5 Correct able to retell
Provide score and other numerical details while watching a videotaped football game	2	1/4	2/4 Correct

 Table 3

 Generalization treatment activities and data

his performance consistently improved. He also reported that he perceived these activities to be more helpful than APT-II tasks because they helped him determine when and how attention and memory strategies could be utilized in his daily activities and environments.

4.2. Probe tasks

During treatment, RW displayed a trend towards improved listening accuracy and RT on the paragraph probe (see Fig. 1). These accuracy improvements, however, appeared related, at least in part, to exposure effects because his accuracy performance varied little on the paragraph probe set presented only prior to and following treatment. In contrast, RW achieved faster RTs on this probe set following treatment versus during baseline. This finding suggested that improved speed on the other paragraph probes was unlikely due to exposure effects alone.

To help objectify our visual inspection of these data, Shewart-chart trend lines (Robey, Schultz, Crawford, & Sinner, 1999) were calculated (see Fig. 2). The upper Shewart line

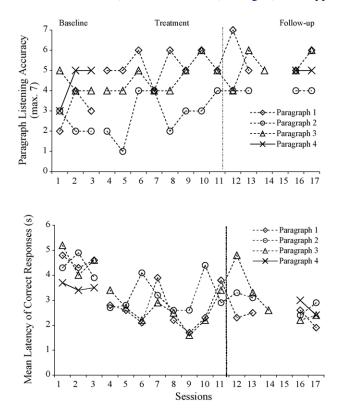


Fig. 1. RW's performance on the paragraph listening probe task across baseline, treatment, and follow-up phases. The upper graph represents accuracy data and the lower graph represents response latency data. In both graphs, paragraph 4 was the stimulus set that was completed only during baseline and follow-up phases to examine for exposure effects. The dashed vertical line in both graphs indicates the point at which the original accuracy criterion for APT-II treatment tasks was abandoned.

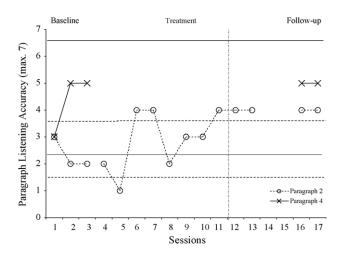


Fig. 2. Examples of Shewart-chart trend lines (Robey et al., 1999) that were used to examine for treatment effects in probe task data. The solid horizontal lines represent the upper and lower Shewart lines for paragraph 4 data, and the dashed horizontal lines represent the upper and lower Shewart lines for paragraph 2 data. According to the guidelines of Robey et al. (1999), a treatment effect is present for paragraph 2 data, whereas there is no substantive change in RW's performance in response to paragraph 4. The dashed vertical line indicates the point at which the original accuracy criterion for APT-II treatment tasks was abandoned.

represents two S.D. above the mean of the baseline data for a given stimulus set, and the lower line represents two S.D. below that baseline mean. According to Robey et al. (1999), substantive change has occurred if at least two successive data points within the treatment phase fall outside of these horizontal lines. Analysis of the paragraph accuracy data indicated that RW's performance of only probe paragraphs 1 and 2 improved. Review of Shewart-chart lines for paragraph RT data indicated that compared to his baseline performance, RW responded considerably more quickly over time during the treatment phase, and continued to do so during follow-up sessions.

On the control, RAN probe, RW showed an abrupt increase in naming rate at treatment onset, despite a relatively stable baseline (see Fig. 3). Despite some fluctuation on subsequent treatment phase probes, his naming rates during follow-up approximated those obtained during the first treatment phase probe. Shewart-chart lines indicated that RW named correctly considerably more pictures during treatment and follow-up versus baseline. Because substantive positive change also was observed in the RAN probe set given only prior to and following treatment, RAN improvements are unlikely due to only exposure or practice effects.

4.3. Post-treatment tests

Table 1 displays RW's performance of the test battery administered one to two weeks following treatment termination. Minimal change was observed in his basic language (i.e., no ADP post-treatment scores fell outside the confidence range for their respective pretreatment scores) or high-level language abilities (i.e., nominal changes on the TLC-E). Furthermore, there was little change in how RW and his spouse rated the adequacy of his

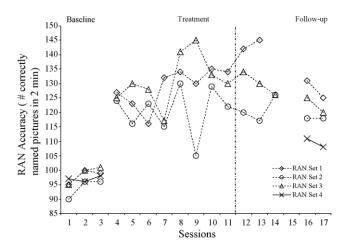


Fig. 3. RW's performance on the rapid naming (RAN) probe task across baseline, treatment, and follow-up phases of the experiment. RAN set 4 was the stimulus set that was completed only during baseline and follow-up phases to examine for exposure effects. The dashed vertical line indicates the point at which the original accuracy criterion for APT-II treatment tasks was abandoned.

communication abilities following treatment (i.e., their pre- and post-treatment CETI ratings differed by less than the standard error of 5.87 reported by Lomas et al., 1989).

Moderate improvements on some attention and memory measures were noted (see Table 1). For example, RW made fewer word recall and true/false errors on the Working Memory Task; these changes were considered substantive because they far exceeded the standard error of measurement (SEM) reported by Lehman and Tompkins (1998) for healthy adults (SEM = 0.6) or adults with right hemisphere brain damage (SEM = 0.9) (SEM data for adults with aphasia have not yet been reported). Despite this improvement, his working memory scores still fell outside the range for healthy adults (Tompkins et al., 1994). Although RW achieved some higher WMS-R raw scores, particularly on subtests most similar to APT-II tasks used in treatment (e.g., forwards and backwards digit span), these gains did not appear significant when reliable change indices (RCI; Jacobson & Truax, 1991; Sawrie, Chelune, Naugle & Luders, 1996) were calculated.

RW achieved higher scaled scores on seven TEA subtests. Post-treatment gains on only map search (second minute) (i.e., a sustained and selective attention task) and telephone search while counting (i.e., a divided attention task), however, exceeded RCI values (Jacobson & Truax, 1991; Sawrie et al., 1996) and thus were considered substantial. Minimal changes were noted when comparing the pre- and post-treatment ratings of RW and his spouse on the APT attention questionnaire.

5. Discussion

In the current study, APT-II (Sohlberg et al., 2001), a structured treatment protocol designed to remediate attention deficits associated with mild TBI, was given to RW, a

patient with chronic, conduction aphasia and concomitant attention and working memory impairments. Purposes of the study were to explore not only whether RW would display improvement on trained attention tasks and related tests of attention, but also whether these improvements would facilitate positive change in his auditory comprehension and other cognitive abilities, and in his and his spouse's perceptions of his daily attention and communication abilities.

Within APT-II treatment sessions, RW demonstrated gradual improvements in response accuracy, latency, or both. These findings indicated that RW's language impairments did not preclude his completion of APT-II tasks. Furthermore, he was able to acquire the specific attention skills that APT-II targets with similar success as that reported for TBI patients (Palmese & Raskin, 2000) and as that observed when different structured attention training programs have been given to stroke patients (Sturm et al., 1991, 1997).

It should be noted, however, that APT-II's hierarchical organization did not completely correspond with the degree of difficulty RW displayed across activity levels and stimuli lists. For example, even following 16 sessions, RW never met our a priori accuracy criterion on the "simplest" sustained attention task, alphabetized sentences. In contrast, on mental math, which according to the APT-II manual should be the most difficult sustained attention activity, he achieved criterion within one session. An important clinical implication of this finding is that when using APT-II with patients who have concomitant language symptoms, particular attention to the linguistic demands of tasks must be considered when planning the progression of task difficulty levels. For instance, alphabetized sentences will typically be the most difficult sustained attention activity for many aphasic patients because it requires phoneme-to-grapheme conversion (Rapp & Gotsch, 2001) whereas other APT-II sustained attention tasks do not. Clearly, further research is needed to establish the reliability and validity of the APT-II task hierarchy for not only patients with co-existing language impairments, but also those whose symptom profiles are more consistent with the patient population for whom APT-II was developed.

Test battery data also suggested that some of RW's specific attention skills had improved. That is, following treatment, RW tended to show greatest improvement, albeit modest, on tests similar to either trained APT-II activities or the probe tasks to which he was repeatedly exposed. More specifically, RW achieved substantially improved posttreatment scores on TEA map search – second minute, TEA telephone search while counting, and the working memory task. Like RW's treatment protocol, these tests require sustained, selective, and divided attention and/or working memory, and emphasize information processing speed. Relatedly, recurring exposure to the RAN probe task (which required visual sustained attention/scanning and fast information processing) may account for, at least in part, RW's improvement on visual attention TEA subtests, even though auditory attention was the primary focus of his APT-II treatment.

A focus of this study was to determine whether APT-II treatment effected positive changes in RW's auditory comprehension as well as other cognitive abilities. Probe findings indicated some improvement in his listening abilities: Compared to baseline, he achieved substantially faster latencies on the paragraph listening probe task as treatment progressed, and maintained this improvement during follow-up probe sessions. Other auditory comprehension measures (i.e., ADP and TLC-E subtests, paragraph listening probe response accuracy), however, were associated with no apparent treatment-related changes. These findings are not as encouraging as those of Helm-Estabrooks et al. (2000). These researchers' two aphasic patients displayed small (i.e., 6-7 percentile point increases on the auditory comprehension subtests of the Boston Diagnostic Aphasia Examination) but "functionally meaningful gains in auditory comprehension" (p. 472) following structured attention training. As previously mentioned, however, Helm-Estabrooks and colleagues' results should be interpreted cautiously because of design limitations. Likewise, these researchers did not specify whether their patients' auditory comprehension score improvements exceeded expected practice effects or how their "functionally meaningful gains" were objectively quantified. Additionally, disparity between our results and those of Helm-Estabrooks et al., 2000 may be related to subject (i.e., RW's auditory comprehension appeared less impaired than that of Helm-Estabrooks et al.'s patients) or procedural differences (e.g., auditory-verbal versus visual-nonverbal treatment activities, treatment intensity). Accordingly, further research is needed to establish whether auditory comprehension or other linguistic deficits associated with aphasia might benefit from attention training, and what patient or treatment variables might influence the magnitude of treatment effects.

One somewhat unexpected finding was that RW displayed improvements on the RAN probe task that could not be attributed to exposure effects alone. In view of multiple resource models of attention (e.g., McLeod, 1977; Wickens, 1989), we originally hypothesized that RW's RAN performance would demonstrate little change because this task primarily stresses visual attention whereas APT-II stresses auditory attention. In hindsight, however, RAN completion does involve some of the same skills targeted in treatment. For example, many APT-II tasks required RW to give quick and continual verbal responses, albeit in response to auditory stimuli (e.g., alphabetized sentences, mental math). Therefore, RAN improvements might be a product of practicing rapid verbal responses during treatment activities. Another possibility is that attention treatment improved RW's information processing speed (regardless of input modality), which in turn enhanced his performance of RAN and other speeded tasks (e.g., response latency on the paragraph listening probe, TEA map search, TEA telephone search while counting).

RW displayed nominal change on attention and memory tests that were less related to treatment or probe tasks (e.g., WMS-R visual reproduction). These findings are consistent with those of past investigations regarding the effects of structured attention training programs, including APT and APT-II, on the cognitive abilities of patients with TBI (Gray, Robertson, Pentland, & Anderson, 1992; Niemann, Ruff, & Baser, 1990; Palmese & Raskin, 2000; Park et al., 1999; Sohlberg et al., 2000), aphasia (Helm-Estabrooks et al., 2000; Sturm et al., 1991, 1997), or right hemisphere brain damage (Sturm et al., 1991, 1997). This pattern of treatment effects has led several researchers to propose that structured attention retraining is most likely to evoke change in specific skills rather than enhance cognitive functions per se (Cicerone et al., 2000; Park & Ingles, 2001; Park et al., 1999). Review of RW's performance of the test battery and probe tasks indicates that his outcomes are consistent with this proposal as well.

Despite improvements on trained APT-II activities and modest increases on certain probe tasks and formal tests, little change was observed on questionnaires designed to quantify and qualify changes in the perceptions of RW and his wife. Our review of the attention retraining literature indicated that hardly any studies incorporated measures to examine patients' and caregivers' views of treatment outcomes, and thus there were limited results with which to compare our findings. In the few investigations that did utilize patient or caregiver questionnaires, findings were similar to ours: Structured attention treatments were not associated with significant positive change in the patients' or caregivers' perceptions of the patients' cognitive impairments or daily functioning (Novack, Caldwell, Duke, Bergquist, & Gage, 1996; Ponsford & Kinsella, 1988; Thomson, 1995).

Sohlberg et al. (2000) also found no significant effects of APT treatment on the questionnaire responses of their TBI patients. During a structured interview, however, their patients who showed most improvement on a standardized test of attention reported the greatest number of positive changes in attention and memory following APT. Sohlberg et al. (2000) conjectured that the concrete thinking of TBI patients may lead them to report changes only when they are asked about tasks, events, and abilities that are specific to their personal lives (versus the generic and broad tasks, events, and abilities about which questionnaires typically ask). Whereas this proposition may explain, at least in part, the lack of positive questionnaire findings for TBI patients, it does not account for why caregivers' questionnaire responses in the current and previous studies (e.g., Ponsford & Kinsella, 1988) suggest unimpressive treatment outcomes. An alternate but associated explanation may relate to the psychometric properties of the questionnaires being utilized. That is, in many cases, the reliability and validity of the questionnaires have not yet been reported. For example, with respect to the current study, although the psychometric properties of the CETI have been published (Lomas et al., 1989), those of the APT-II Attention Questionnaire have not. Therefore, psychometric limitations may be confounding patient and caregiver questionnaire responses. Finally, it remains possible that retraining attention via structured tasks is not the most efficient means to evoke changes in daily attention functioning that are meaningful or observable to patients and their caregivers. This explanation is supported by the more encouraging functional outcomes reported following goal-based and strategy-training interventions (which incorporate tasks similar to our generalization activities) (Cicerone, 2002; Manly, Ward & Robertson, 2002; Park & Ingles, 2001; Wilson, 1996; Wilson & Robertson, 1992). Accordingly, these treatments may represent more effective or efficient approaches to attention rehabilitation.

Collectively, the present and previous findings (e.g., Park et al., 1999; Sturm et al., 1991, 1997) regarding the effects of APT, APT-II, and other structured attention training programs suggest that for patient populations with aphasia or TBI improvements may be limited to specific attention skills; positive changes in broader cognitive functions, untrained cognitive skills, and patients' and caregivers' perceptions of their impairments are less likely. Following over 50 h of attention training, RW achieved only modest gains on standardized tests and probe tasks that were closed related to APT-II activities, and neither RW nor his spouse reported noticeable positive changes in his daily communication or attention abilities. Whereas our initial findings raise doubt that structured attention programs such as APT-II represent a viable or efficient approach to treating concomitant

attention problems in patients with aphasia, clearly further research is needed not only to determine the reliability and validity of our results, but also to inform discrimination of attention treatment approaches (e.g., retraining versus skills-training versus strategy teaching versus combined approach) for patients with aphasia.

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Appendix A. Example of the paragraph listening probe task

Although stage plays have been set to music since the era of the ancient Greeks when the dramas of Sophocles and Aeschylus were accompanied by lyres and flutes, the usually accepted date for the beginning of opera, as we know it is 1600. As part of the celebration of the marriage of King Henry IV of France to the Italian aristocrat Maria de Medici, the Florentine composer Jacopo Peri produced his famous Euridice, generally considered to be the first opera. Following his example, a group of Italian musicians, poets, and noblemen called the Camerata began to revive the style of musical story that had been used in Greek tragedy. The Camerata took most of the plots for their operas from Greek and Roman history and mythology, writing librettos or dramas for music. They called their composition opera in musica or musical works. It is from this phrase that the word "opera" is borrowed.

For several years, the center of operas was Florence, but gradually, during the baroque period, it spread throughout Italy. By the late 1600s, operas were being written and performed in Europe, especially in England, France, and Germany. But, for many years, the Italian opera was considered the ideal, and many non-Italian composers continued to use Italian librettos. The European form de-emphasized the dramatic aspect. New orchestral effects and even ballet were introduced under the guise of opera. Composers gave in to the demands of singers, writing many operas that were nothing more than a succession of brilliant tricks for the voice. Complicated arias, recitatives and duets evolved. The aria, which is a long solo, may be compared to a song in which the characters express their thoughts and feelings. The recitative, which is also a solo, is a recitation set to music whose purpose is to continue the story line. The duet is a musical piece written for two voices, which may serve the function of either an aria or a recitative.

- 1. This passage is a summary of:
 - (a) opera in Italy
 - (b) the Camerata
 - (c) the development of opera
 - (d) Euridice
- 2. According to this passage, when did modern opera begin?
 - (a) In the time of ancient Greeks
 - (b) In the fifteenth century

- (c) At the beginning of the sixteenth century
- (d) At the beginning of the seventeenth century
- 3. According to the author, what did Jacopo Peri write?
 - (a) Greek tragedy
 - (b) The first opera
 - (c) The opera Maria de Medici
 - (d) The opera The Camerata
- 4. The author suggests that Euridice was produced:
 - (a) in France
 - (b) originally by Sophocles and Aeschylus
 - (c) without much success
 - (d) for the wedding of King Henry IV
- 5. What was the Camerata?
 - (a) A group of Greek musicians
 - (b) Musicians who developed a new musical drama based up Greek drama
 - (c) A style of music not known in Italy
 - (d) The name given to the court of King Henry IV
- 6. From what did the term "opera" derive?
 - (a) Greek and Roman history and mythology
 - (b) Non-Italian composers
 - (c) The Italian phrase that means "musical works"
 - (d) The ideas of composer Jacopi Peri
- 7. Which of the following is an example of a solo?
 - (a) A recitative
 - (b) A duet
 - (c) An opera
 - (d) A lyre

Note: Correct answers are in bold font. The passage was adapted from materials published by Educational Testing Service (1998).

Appendix B. Continuing education self study questions

- 1. Previous research regarding attention abilities in adults with aphasia has indicated that:
 - (a) adults with aphasia only demonstrate attention deficits when tasks have heavy linguistic demands
 - (b) adults with aphasia only demonstrate attention deficits when tasks involve auditory stimuli
 - (c) adults with aphasia only demonstrate attention deficits in the acute stages of recovery
 - (d) adults with aphasia demonstrate deficits of primarily sustained attention
 - (e) adults with aphasia may demonstrate deficits in one, a combination, or all aspects of attention

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- 2. An attentional or processing model of aphasia proposes that:
- (a) the linguistic impairments of adults with aphasia compromise their attention abilities
- (b) aphasic symptoms are a product of decreased processing speed
- (c) aphasic symptoms are a product of or exacerbated by attention impairments
- (d) aphasic symptoms and attention impairments are a product of decreased working memory capacity
- (e) only aphasic comprehension impairments are a product of or exacerbated by attention impairments
- 3. The attention treatment used in the current study consisted of:
- (a) Helm-Estabrooks and colleagues' (2000) Attention Training Program
- (b) Sohlberg and Mateer's (1986) Attention Process Training
- (c) Sohlberg and colleagues' (2001) Attention Process Training-II
- (d) Attention Training Program and generalization activities
- (e) Attention Process Training-II and generalization activities
- 4. In the current study, treatment effects were documented by:
- (a) comparing pre- and post-treatment test battery outcomes and examining performance on probe tasks
- (b) comparing pre- and post-treatment test battery outcomes
- (c) examining performance on probe tasks
- (d) evaluating performance on the final attention treatment activity
- (e) eliciting patient and caregiver feedback regarding their opinions of treatment activities
- 5. The findings of the current study indicated that:
- (a) structured attention training produced significant improvements in not only our aphasic patient's attention abilities, but also his auditory comprehension and other cognitive skills
- (b) structured attention training produced greatest improvements in those cognitive skills most closely related to treatment and probe tasks
- (c) our patient and his caregiver reported noticeable improvements in his daily attention and communication abilities following treatment
- (d) attention deficits in adults with aphasia cannot be remediated
- (e) structured attention training for adults with aphasia should utilize tasks with linguistic versus nonlinguistic content

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