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Aphasia

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(We gratefully acknowledge the contribution of JB Orange PhD)

Last Updated: September 2013

Abstract

The AHCPR Post-Stroke Rehabilitation Clinical Practice Guidelines defines aphasia as "the loss of ability to communicate orally, through signs, or in writing, or the inability to understand such communications; the loss of language usage ability." It has been reported that aphasia is one of the most common consequences of stroke in both the acute and chronic phases. Acutely, it is estimated that from 21 - 38% of stroke patients are aphasic. The presence of aphasia has been associated with decreased response to rehabilitation intervention and increased risk for mortality. In the present review, definitions, natural history and impact of aphasia are discussed. Therapy-based interventions are reviewed including group programs, training conversation partners, computer-based instruction, filmed language instruction constraint-induced therapy, repetitive transcranial magnetic stimulation, and direct current stimulation as well as deficit specific rehabilitation. Pharmacotherapy for aphasia is also addressed.

Key Points

Therapies for Aphasia

- Language therapy is most effective in treating aphasia when provided intensely; less intensive therapy given over a longer period of time does not provide a statistically significant benefit, although some clinical benefit may be achieved.

- Trained volunteers can provide an effective adjunct to speech-language pathologists' treatment.

- Participation in group therapy may result in communicative and linguistic improvements.

- Community-based language therapy programs provide a setting for improved language functions taking into account limitations and constraints of the "real-world".

- Supported Conversation for Adults with Aphasia improves conversational skill. In addition, training communication partners may result in improved access to conversation and increased social participation.

- Group-based caregiver education may be associated with improvement in caregiver stress.

- Educational seminars for aphasic individuals and their families/caregivers may improve not only knowledge, but may also be beneficial in terms of social participation and family adjustment.

- Further research needs to be done to determine the impact of aphasia programs on the psychological well-being of patients and their families.

- Computer-based aphasia therapy results in improved language skills and may improve functional communication.

- Remote assessment of language following stroke provides reliable results comparable to face-to-face assessment.

- There is insufficient evidence regarding the application of remotely administered and monitored language therapy.

- Supplementary-filmed programmed language instruction does not provide a benefit in aphasic patients.

- Music intonation therapy may have benefits in the treatment of nonfluent aphasia. Constraint-induced aphasia therapy may result in improved language function and everyday communication in individuals with chronic aphasia.

- Treatment with repetitive transcranial magnetic stimulation may have positive and durable effects on naming performance in individuals with chronic post-stroke aphasia.

- Site and polarity specific transcranial direct stimulation may improve naming ability in chronic aphasia.

Rehabilitation of Specific Aphasia Deficits

- Task-specific semantic therapy and task-specific phonological therapy improves semantic and phonological language activities respectively in aphasia.

- Cognitive linguistic therapy with both semantic and phonological elements may improve semantic fluency.

- Phonological and semantic cueing may improve naming accuracy in aphasics with word-finding deficits.

- Intensive language therapy may be associated with improved language function for individuals with global aphasia.

- There is insufficient evidence regarding the effectiveness of alexia-specific therapy. Further research is required.

Drug Therapies for Aphasia

- Piracetam when combined with language therapy results in improved aphasia recovery.

- Bromocriptine does not improve aphasia recovery post-stroke.

- The effectiveness of levodopa as an adjunct to speech and language therapy may be limited.

- Dextroamphetamine appears to improve aphasia recovery when combined with language therapy.

- Cholinergic treatment has not been studied sufficiently in aphasia recovery.

- Dextran 40 treatment results in worse outcomes when compared to no treatment in aphasia recovery.

- Treatment with Moclobemide, a MAO-inhibitor, does not enhance aphasia recovery.

- Treatment with donepezil HCl may have a positive effect on global language function.

- Significant language and communication gains have been demonstrated following the use of memantine in conjunction with constraint-induced language therapy.

- Treatment with galantamine may result in improved linguistic function.

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14. Aphasia

14.1 Defining Aphasia

The AHCPR Post-Stroke Rehabilitation Clinical Practice Guidelines defines aphasia as "the loss of ability to communicate orally, through signs, or in writing, or the inability to understand such communications; the loss of language usage ability"(Klein 1995). Darley (1982) noted that aphasia is generally described as an impairment of language as a result of focal brain damage to the language dominant cerebral hemisphere. This serves to distinguish aphasia from the language and cognitive-communication problems associated with non-language dominant hemisphere damage, dementia and traumatic brain injury (Orange & Kertesz 1998). Ninety-three percent of the population is right-handed, with the left hemisphere being dominant for language in 99% of right-handed individuals (Delaney & Potter 1993). In left-handed individuals, 70% have language control in the left hemisphere, 15% in the right hemisphere, and 15% in both hemispheres (O'Brien & Pallett 1978). Language function is almost exclusively the domain of the left hemisphere; for 96.9% of the population language control is localized primarily in the left hemisphere.

Table 14.1 Boston Classification System - Characteristic Features of Aphasia

Type	Fluency	Comprehension	Repetition
Broca's	Nonfluent	Good	Poor
Transcortical motor	Nonfluent	Good	Good
Global	Nonfluent	Poor	Poor
Wernicke's	Fluent	Poor	Poor
Transcortical sensory	Fluent	Poor	Good
Anomic	Fluent	Good	Good
Conduction	Fluent	Good	Poor

The concept of aphasia as simply a disorder of language fails to do the entity justice. Kertesz (1979)clinically described aphasia as a *"...neurologically central disturbance of language characterized by paraphasias, word finding difficulty, and variably impaired comprehension, associated with disturbance or reading and writing, at times with dysarthria, non-verbal constructional and problem-solving difficulty and impairment of gesture"*. The Boston classification system is used frequently by researchers and clinicians to classify type of aphasias (Table 14.1). Type of aphasia is determined, primarily, by lesion location (Godefroy et al. 2002).

14.2 Natural History and Impact of Aphasia

It has been reported that aphasia is one of the most common consequences of stroke in both the acute and chronic phases. Acutely, it is estimated that from 21 – 38% of stroke patients are aphasic (Berthier 2005). A recent report based on data from the Ontario Stroke Audit (Ontario, Canada) estimated that 35% of individuals with stroke have symptoms of aphasia at the time of discharge from inpatient care (Dickey et al. 2010).

Global aphasia is the most common type in the acute period affecting as many as 25-32% of aphasic patients, while other classic aphasias described within the Boston system of classification are seen less frequently (Godefroy et al. 2002; Laska et al. 2001; Pedersen et al. 2004). The frequency of unclassified or mixed aphasias that cannot be assigned to a classic category is more difficult to determine. Godefroy

et al. (2002) reported approximately 25% of patients as having nonclassified aphasias, comprised mostly of disorders similar to anomic aphasia in addition to some other impairments. In that study, the presence of nonclassified aphasia was significantly associated with a history of previous stroke. Initial stroke severity and lesion volume have been associated with initial severity of aphasia (Ferro et al. 1999; Laska et al. 2001; Pedersen et al. 2004).

Significant risk factors associated with development of aphasia include older age and greater severity of stroke and of disability (Bersano et al. 2009; Croquelois & Bogousslavsky 2011; Dickey et al. 2010; Engelter et al. 2006; Gialanella & Prometti 2009; Kyrozis et al. 2009). In a population-based study of aphasia following first-ever ischemic stroke, Engelter et al.(2006) reported that risk for aphasia increased significantly with age, such that each advancing year was associated with 1-7% greater risk. While 15% of individuals under the age of 65 experienced aphasia, in the group of patients 85 years of age and older, 43% were aphasic. In a study of 1,541 consecutive stroke cases, Croquelois et. al. (2011) also found cardioembolic origin and superficial middle cerebral artery stoke to be significant risk factors for the development of aphasia.

For many, aphasia improves during the first year following the stroke event. A review by Ferro et al. (1999) reported that approximately 40% of acutely aphasic patients experience complete or almost complete recovery by one year post stroke. Similarly, Maas et al. (2012) found that 86% of patients presenting with aphasia symptoms in an emergency setting experienced partial improvement within six months, 74% of whom had completely resolved.

Within the literature, most longitudinal studies have reported that the greatest amount of spontaneous recovery occurs in the first 3 months following stroke. After this, the rate of recovery slows and little additional spontaneous recovery can be expected after the first 12 months (Ferro et al. 1999). Pedersen et al. (2004) reported that during these first 12 months, aphasia of all types (even global aphasia) tended to evolve to a less severe form. Non-fluent aphasias evolved to a fluent aphasia, although the reverse was not observed. While 61% of aphasic patients in the Copenhagen Aphasia Study still experienced aphasia at one year post stroke, it was usually of a milder form.

Similarly, Bakheit et al. (2007b) demonstrated that patients with all types of aphasia experienced significant improvement in the first 6 months post-stroke when treated with conventional speech and language therapy as part of a comprehensive rehabilitation program. Improvements were greatest in the first 4 weeks, and then slowed to a lesser though still significant rate. Further, individuals diagnosed with Broca's aphasia demonstrated the greatest gains despite greater initial impairment. In general, patients with Broca's aphasia made greater gains in terms of scores on the Western Aphasia Battery than patients with global aphasia, who in turn demonstrated greater improvement than those with Wernicke's, anomic or conduction aphasia.

The degree and rate of recovery may be different for various facets of language. In their 1999 review, Ferro et al. reported that comprehension, especially for everyday functional communication, recovers most rapidly . Repetition is also quick to recover, while naming and fluency are slower to recover and are least likely to recover entirely. Furthermore, in a study of 147 patients, El Hachioui et. al. (2013) observed that linguistic component scores in phonology were found to be predictive of functional verbal outcome at 1 year following a stroke. However, Pedersen et al. (2004) reported no significant differences in recovery on the various parts of the Western Aphasia Battery and found that gains ranged from 54% for comprehension to 78% for naming. An additional study by Hachioui et al. (2011) suggested that it may be beneficial to test performance levels for the various facets of language separately, rather than rely on overall assessments in order to examine recovery patterns.

The most powerful predictor of recovery may be the initial severity of aphasia such that greater severity is associated with poorer recovery (Berthier 2005; Laska et al. 2001; Lazar et al. 2010; Pedersen et al. 2004) (Ferro et al. 1999). Lazar et al. (2010) reported that more than 80% of recovery could be predicted based on initial severity of aphasia. In addition, the authors suggested that the relationship between recovery and initial impairment is proportional. Based on 21 stroke patients with mild to moderate aphasia and composite scores from 3 subtests of the Western Aphasia Battery (comprehension, repetition and naming), the authors demonstrated that patients improved by 73% of maximum potential recovery (defined as maximum potential language score minus their initial WAB score) during the first 90 days post stroke. The authors suggested that this may be attributable to mechanisms of spontaneous recovery common to all domains of function.

The influence of other factors on the degree of recovery is less clear. While some studies report recovery to be significantly better for younger patients (Ferro et al. 1999; Laska et al. 2001) others report that age does not predict recovery (Payabvash et al. 2010; Pedersen et al. 2004). Similarly, while there are reported gender differences in type and severity of aphasia, sex does not predict recovery (Laska et al. 2001; Payabvash et al. 2010; Pedersen et al. 2004). Studies examining handedness and education also provide conflicting results (Berthier 2005; Ferro et al. 1999).

In examining the prediction of language recovery, Payabvash et al. (2010) derived a model based on analysis of admission CT perfusion scans to predict early language improvement in individuals with acute stroke. Using multiple logistic regression, the authors identified 4 factors that could predict improvement on the NIHSS aphasia item with 90% sensitivity (91% specificity): aphasia score on admission NIHSS, presence/absence of proximal cerebral artery occlusion on admission CT, relative cerebral blood flow of the sublobar insular ribbon (lower third) and relative cerebral blood flow of angular gyrus (BA39). The authors present an 8-point scoring system to predict language improvement based on these 4 factors (Payabvash et al. 2010).

Mortality. The presence of post-stroke aphasia has been associated with higher rates of mortality over both the short and long-term. Laska et al. (2001) demonstrated that mortality among aphasic patients was 11% in the acute period compared to 3% among non-aphasic patients. While this early comparison did not reach statistical significance, it was significant at 18 months (p=0.02). However, more recently, Guyomard et al. (2009) examined in-hospital mortality for individuals with dysphasia and reported significant increases in risk associated with speech disorders, even when controlling for age, sex, premorbid Rankin score, previous disabling stroke and stroke type (OR = 2.2, 95% CI 1.8-2.7).

Similarly, Bersano et al. (2009) reported significantly greater rates (11% vs. 4%; p<0.0001) of in-hospital mortality for individuals with aphasia vs. those without. At 2-year follow-up, 34% of individuals with aphasia had died vs. 19% of non-aphasic individuals. Individuals with aphasia did have more severe strokes, greater motor impairments and were more likely to have experienced a haemorrhagic stroke. However, presence of aphasia was associated with significantly greater odds for mortality overall (OR=2.09; 95% CI 1.90-2.32) when controlling for age, sex, atrial fibrillation, cerebral haemorrhage and severity of motor impairment (Bersano et al. 2009).

In the Copenhagen Aphasia Study, Pedersen et al. (2004) reported mortality in aphasic patients to be 27% one year following stroke. In that study, there was a tendency for mortality at one year to be associated with the severity of aphasia at the time of the acute admission.

Rehabilitation Gains. In a study of 240 stroke patients, Paolucci et al. (2005) reported that, while all patients experienced significant gains over the course of rehabilitation, patients with aphasia and comprehension deficits had poorer outcomes in terms of activities of daily living, mobility and urinary continence at discharge than patients with no aphasia or patients with aphasia but no comprehension deficits. The most powerful predictor of effectiveness of rehabilitation as assessed on the Barthel Index and Rivermead Mobility Index was performance on a semantic-associated word comprehension task. For patients with aphasia and comprehension deficits, the risk of poor response to rehabilitation was approximately 5 times greater than for patients with aphasia and no comprehension deficits or patients with no aphasia (Paolucci et al. 2005). Additionally, in a study of 156 patients, Gialanella (2011) demonstrated that comprehension deficits were predictive of total Functional Independence Measure (FIM) score at discharge from inpatient rehabilitation.

Presence of aphasia may result in extended lengths of stay in rehabilitation, with less demonstrated gain over time. Gialanella & Prometti (2009) demonstrated that in a group of 252 stroke patients admitted for inpatient rehabilitation, those with aphasia (n=126) tended to have longer lengths of stay (p=0.056), smaller gains in function (assessed on the motor Functional Independence Measure score; p=0.017) and poorer rehabilitation gains per day (p<0.0001) than individuals with no aphasia (n=126).

Although the presence of aphasia has also been reported to have an adverse effect on mood, functional and social outcomes as well as overall quality of life (Davidson et al. 2008; Ferro et al. 1999; Wade et al. 1986). Williamson et al. (2011) demonstrated no significant association between aphasia severity and overall quality of life in a group of 24 subjects with chronic stroke.

Discharge Destination. Individuals with post stroke aphasia may be less likely to return home following stroke. Dickey et al. (2010) reported that (in Ontario, Canada) twice as many patients with aphasia are discharged directly to long-term care from acute care than individuals without aphasia (14% vs. 7%). However, relatively more individuals with aphasia are discharged to inpatient rehabilitation facilities (34% vs. 24%). In addition to having greater dysfunction at admission to and discharge from inpatient rehabilitation as well poorer rates of recovery compared to nonaphasic patients, Gialanella and Prometti (2009) reported that significantly more individuals with aphasia were discharged to nursing homes (p=0.002). Similarly, Bersano et al. (2009) demonstrated that, at 2 years post stroke, relatively fewer individuals with aphasia still lived at home compared to patients with no aphasia (87% vs. 91%). Auditory comprehension, reading comprehension, and tactile naming deficits were more common in individuals discharged somewhere other than home when compared with those discharged home (63.6% vs. 42.9; 70.7% vs. 54.0%; 62.9% vs. 43.6% respectively) (Gonzolez-Fernandez 2013).

14.3 Therapies for Aphasia

Reviewing and critiquing therapies for aphasia was challenging because of the extensive number of heterogeneous studies, many of which relied on small samples and were poorly designed or of overall low quality.

14.3.1 Language Therapy Reviews

Robey (1994) performed a meta-analysis of 21 studies of aphasia treatments that revealed several important findings. The significant findings of this meta-analysis were summarised by Orange and Kertesz (1998) into four points: "(1) the performance of individuals who receive language therapy in the acute stage of recovery is nearly twice as large as the effect of spontaneous recovery alone; (2) language therapy initiated after spontaneous recovery has a positive, albeit small, effect on language performance; (3) a medium to large effect is present in comparisons of treated versus untreated

individuals when therapy is begun in the acute phase and (4) a small to medium effect is present in treated versus untreated groups when therapy is begun in the chronic stage of recovery (i.e. 6 – 12 months post onset),".

Robey (1998) conducted a second meta-analysis of 55 articles to investigate the general effectiveness of aphasia treatments across stages of recovery and to assess the different experimental and clinical dimensions of aphasia treatment. Again, Robey found that the average effect for treated recovery was nearly twice that for untreated recovery when treatment was begun in the acute phase. When treatment was initiated in the acute phase, the average effect size, although smaller, was 1.68 times greater than that of spontaneous recovery alone. When treatment was delayed until the chronic phase, the average effect size for treated patients was smaller, but still exceeded that of non-treated patients. In addition, the meta-analysis revealed that the more intensive the therapy, the greater the improvement. Robey suggested that two hours of treatment per week should be the minimum length of time for patients who can tolerate receiving intensive therapy. Finally, it was noted that large gains were made by individuals with severe aphasia treated by speech-language pathologists (Robey 1998).

Both the Robey meta-analyses (1994, 1998) examined aphasia therapy as it pertained to all aphasic patients and not just stroke-based patients with aphasia. Furthermore, both meta-analyses excluded drug treatment therapies. Finally, neither Robey meta-analyses assessed the quality of methodology of the trials reviewed.

A Cochrane Systematic Review by Greener et al. (1999) identified 12 trials investigating speech and language therapy for aphasia following stroke that were rated as suitable for review. However, they noted that most trials were old, and often had poor quality or used methodology that could not be evaluated unambiguously. Overall, the trials lacked sufficient detail for Greener et al. (1999, 2001) to carry out complete descriptions and analyses. Consequently, they were unable to determine whether formal language therapy was more effective than informal support. Kelly et al. (2010) provided an updated Cochrane review including results from a total of 30 trials comparing i) speech and language therapy (SLT) with no SLT, ii) SLT with social support and communication stimulation and iii) two different approaches to SLT (see Table 14.2). Few significant differences were noted in SLT vs. no SLT comparisons; however, the authors note that there is a consistent direction of results in favour of speech and language therapy, overall. There was some evidence that the provision of social support and stimulation was associated with improved receptive and expressive language skills, although this result was based primarily upon findings of a single study. In examining specific approaches, the authors found that intensive SLT was associated with improved written and receptive language and in overall measures of severity when compared to conventional SLT. Volunteer-facilitated therapy appeared to produce outcomes similar to conventional SLT and, in one study, produced superior results on measures of spoken repetition. Apart from these two notable exceptions (intensity and volunteer-facilitated therapy), the authors state that there was insufficient evidence to support the effectiveness of one approach over the other.

In considering the results of their review, the authors point out several important limitations. Included studies were all small and of the 30 studies only 2 performed a power calculation to determine appropriate sample size. Outcome assessment was heterogeneous and data reporting inadequate and/or incomplete, thereby limiting the number of studies that could be included in the meta-analyses. The authors report a substantial use of unpublished data.

14.3.2 Individual Studies of Language Therapy for Aphasia after Stroke

There is a large literature on studies on speech and language therapy in aphasic patients. Robey et al. (1994; 1998) included no fewer than 55 studies in his meta-analyses and the recently updated Cochrane review included 30 studies (Kelly et al. 2010). While the conclusions offered by both of these reviews are generally in favour of speech and language therapy interventions, the quality of the studies produced is questionable. Kelly et al. (2010) noted that while the use of blinded assessors has improved, many studies do not adequately describe randomization, report adequate statistical summary data, perform a priori sample size calculations or use standardized assessments.

Table 14.2 Cochrane Review of Effectiveness of Speech and Language Therapy for Post-Stroke Aphasia (Kelly et al. 2010)

Study	Types of Intervention
Bakheit et al. 2007	Intensive vs. conventional SLT
David et al. 1982	Conventional SLT vs. social support & stimulation
Denes et al. 1996	Intensive vs. conventional SLT
DiCarlo et al. 1980	SLT+filmed instruction vs. conventional SLT
Doesborgh et al. 2004a	Semantic treatment vs. phonological treatment
Doesborgh et al. 2004b	Computer-based SLT vs. no SLT
Drummond et al. 1981	Gesture cuing vs conventional SLT
Elman et al. 1999	Conventional SLT vs. social support & stimulation
Hinckley et al. 2001	Functional SLT vs. conventional SLT
Jufeng et al. 2005 (Chinese)	Group SLT vs. conventional SLT vs. no SLT
Katz et al. 1997	Computer-mediated SLT vs. computer-based placebo vs. no SLT or computer-based stimulation
Leal et al. 1993 (abstract)	Conventional vs. volunteer-facilitated SLT
Lincoln et al. 1982	Crossover trial of conventional SLT, operant training SLT and social support and stimulation.
Lincoln et al. 1984a	Conventional SLT vs. no SLT
Lincoln et al. 1984b	Operant training + conventional SLT vs. attention placebo + conventional SLT
Lyon et al. 1997	Functional SLT vs. no SLT
MacKay et al. 1988	Volunteer-facilitated SLT vs. no SLT
Meikle et al. 1979	Volunteer-facilitated SLT vs. conventional SLT
Meinzer et al. 2007	Constraint-induced SLT vs. volunteer-facilitated constraint-induced SLT
ORLA 2006 (poster)	Intensive vs. conventional SLT
Prins et al. 1989	STACDAP SLT vs. conventional SLT
Pulvermuller et al. 2001	Constraint-induced SLT vs. conventional SLT
Rochon et al. 2005	Sentence mapping SLT vs. social support and stimulation
Shewan et al. 1984	Language-oriented SLT vs. conventional SLT vs. social stimulation and support
Smania et al. 2006	Conventional SLT vs. no SLT (limb apraxia therapy only)
Smith et al. 1981	Intensive SLT vs. no SLT vs. conventional SLT
Van Steenbrugge et al. 1981 (Dutch)	Task-specific SLT vs. conventional SLT
Wertz et al. 1981	Group SLT vs. conventional SLT
Wertz et al. 1986	Conventional SLT vs. no SLT vs. volunteer-facilitated SLT
Wu et al. 2004 (Chinese)	Conventional SLT vs. no SLT

In addition to studies not published in English, the present review excludes abstracts, posters and conference proceedings several of which were used in the Cochrane review (Leal et al. 1993). The study by Smith et al. (1981) contains no data regarding speech and language therapy outcomes and was,

therefore, also excluded as was the study by MacKay et al. (1988) which reported no results. We have also chosen to separate evaluation of specific therapies such as group therapy, gestural cuing, constraint-induced language therapy, or computer-based language therapy from the assessment of the more general "language therapy". Individual studies examining the effectiveness of speech and language therapy in general, are summarised in Table 14.3.

Table 14.3 Effects of Language Therapy on Aphasia Post-Stroke

Author, Year Country PEDro Score	Methods	Outcomes
David et al. (1982) UK 5 (RCT)	155 aphasic stroke patients at 3 weeks post-stroke were randomised to receive either therapy from a speech-language pathologist for 30 hours over 15 to 20 weeks or from an untrained volunteer providing support and encouragement for a similar time.	Patients in both groups showed improvement; however, no significant differences in Functional Communication Profile (FCP) scores were noted between the groups.
Lincoln et al. (1982) UK 4 (RCT)	24 stroke patients receiving inpatient stroke rehabilitation were randomly assigned to one of 4 groups; i) speech therapy + non-specific treatment (control condition) ii) non-specific treatment + speech therapy, iii) speech therapy + operant training and iv) operant training + speech therapy. Each group received 2, 4-week interventions (e.g. group 1 received speech therapy for 4 weeks followed by non-specific therapy for 4 weeks). All treatments were provided in 12 30-minute sessions. Speech therapy was conventional speech therapy, operant training followed a specific verbal conditioning procedure and non-specific treatment provided a conversation session about a series of predetermined topics with a therapist. Assessments were conducted at baseline and after each intervention condition.	For all groups, there was a significant improvement demonstrated over time on the majority of assessments including the overall PICA (p<0.001). However, there were no significant differences between treatments on any assessments with the exception of Raven's Progressive Matrices, on which speech therapy produced greater improvement than non-specific treatment (p<0.01). In addition, non-specific treatment was associated with significantly greater improvement in communication as rated on the Speech Questionnaire (p<0.01); however, the authors note that test re-test and inter-rater reliability for this assessment was poor. When "treated patients" (n=24) were compared to "untreated" (n=9 patients who received only 1 session of SLT per week) there were no significant differences noted on any assessment.
Lincoln et al. (1984) UK 6 (RCT)	327 aphasic stroke patients who were able to cope with language testing assessment were randomised at 10 weeks post-stroke to receive 2, 1-hour therapy sessions per week at either a hospital or at home for 34 weeks or to receive no treatment.	Patients in both groups demonstrated improvement; however, no significant differences in language recovery were noted between the groups on the PICA, FCP, and the Boston Diagnostic Aphasia Examination (BDAE).
Shewan & Kertesz (1984) Canada 5 (RCT)	100 aphasic stroke patients who were unable to recover their language skills within the first 2 to 4 weeks post-stroke were randomised to one of 3 treatments: (1) language oriented therapy (LOT) provided by a speech-language pathologist (SLP), (2) stimulation facilitation therapy (ST) provided by a SLP and (3) unstructured settings therapy (UNST) provided by nurses. Patients who did not want/were unable to participate formed a control group. Patients in each of the 3 treatment groups received 3, 1-hour sessions a week for 1 year.	No difference in Western Aphasia Battery (WAB) scores, its subsets Aphasia Quotient (AQ) and Cortical Quotient (CQ) scores and Auditory Comprehension Sub-Test for Sentences scores between the groups. The AQ scores of patients in the treatment groups were significantly higher compared to the control groups. Individually, LOT and ST patients significantly improved compared to the control patients, but no significant differences were observed between the UNST and the control group. The CQ scores of the treatment groups were significantly higher compared to patients in the

		control group. Individually, ST patients had higher CQ scores than the controls but the LOT and UNST groups were not significantly different from the controls.
Wertz et al. (1986) USA 6 (RCT)	121 male veterans under the age of 75 year and between 2 to 4 weeks after onset of single thromboembolic stroke with lesion confined to the left hemisphere and demonstrated language severity from 10th-80th percentile on PICA on entry into the study. Patients were randomized into one of three groups: (1) 8 to 10 hours a week of clinic treatment with speech therapy for 12 weeks followed by 12 weeks of no treatment; (2) 8 to 10 hours a week of home treatment by a trained volunteer for 12 weeks followed by no treatment; or (3) Treatment deferred for 12 weeks followed by 12 weeks of clinic treatment with a speech-language pathologist.	After 1st 12 weeks of treatment clinic treated patients performed significantly better than those deferred on the PICA. No significant difference noted between home treated and clinic or between home treated and deferred treated patients. After 24 weeks of treatment there was no significant difference between any groups.
Hartman (1987) USA 6 (RCT)	60 right-handed patients with acute aphasia due to left hemispheral stroke were randomly assigned to 1 of two 2 of therapies for six months, beginning one month post-stroke. Conventional language therapy provided by professional speech pathologists twice weekly was compared with emotionally supportive counselling therapy, also provided by professional speech-language pathologists at the same intervals. Language function was measured by the PICA. 50 patients were also retested at 10 months post stroke.	Hartman noted no significant difference in the amount of improvement between the two groups.
Marshall et al. (1989) USA 5 (RCT)	This study involved 121 males who were 2 to 12 weeks post onset from a single left hemisphere thrombosis infarct resulting in aphasia. Patients were randomized to receive home therapy treatment given by a wife, friend or relative, treatment by speech-language pathologist or treatment by speech-language pathologist deferred for 12 weeks. Therapy was provided for 8 to 10 hours a week for 12 weeks.	At 12 weeks, the SLP group showed significantly more improvement than deferred group. Improvements noted in home treatment group did not differ from SLP group. At 24 weeks deferred treated group caught up to other 2 groups and no significant differences between groups was noted.
Prins et al. (1989) Netherlands 5 (RCT)	32 patients with aphasia for at least 3 months following a left hemispheric stroke were randomized to receive either systematic therapy (STAC) or conventional therapy (STIM). The STAC comprised of a series of 28 different tasks on four levels: nonverbal, phonology, lexical-semantics and morphosyntax. The STAC group received treatment twice a week for 5 months. The STIM group received therapy during the same period of time with the same frequency as the STAC group. Eleven patients received no treatment during the 6-month period of the study trial. Patients were tested on a test battery with two parts: subtests for auditory comprehension (items used as practice material in the STAC group) and 8 tests for auditory comprehension, reading comprehension and oral expression (items not used as practice material in either treatment group).	No significant differences were noted between the groups (including the control group) on any of the test batteries. Interventions provided to the STAC and STIM (conventional therapy) groups did not result in significant gains when compared to untreated controls.
Laska et al. (2011)	99 individuals who experienced a stroke completed this study. Patients who could begin the intervention within	No difference was seen between the control and treatment group on ANELT scores and in terms

Sweden 7 (RCT)	2 days of stroke onset were randomized to receive either speech language therapy or no therapy. The treatment period was for 21 days and consisted of Language Enrichment Therapy (LET) for 45 minute sessions every weekday. Baseline conditions were determined by the short adjusted version of NGA and the Amsterdam-Nijmegen everyday language test (ANELT). The primary study outcome was the ANELT score. The secondary outcome was the aphasia coefficient (Coeff) which comes from an adjusted version of the Norsk grunntest for afasi (NGA).	of the Coeff directly following the intervention and 6 months later (p=NS).
Bowen et. al. (2012) UK (7) RCT	170 individuals were enrolled in this multicentre, parallel group randomized control trial which examined the efficacy of enhanced communication therapy within the first four months after stroke, compared to attention control (AC) (natural recovery). The SL therapy was consensus-based, best practice guided, and was provided over a 13 week period. The primary study outcome was functional communicative ability as rated on the activity subscale of the Therapy Outcome Measure (TOM). Assessments were completed at baseline and 6 months follow up.	The 81 individuals in the treatment group received an average of 22 visits (18 hours) over the 13 week study period. An overall improvement of 0.8 on the activity level of the TOM was observed, indicating a clinically meaningful improvement from a baseline mean of 2.4 ('limited communication, relies on cues and context to make basic needs understood') to 3.6 ('consistently able to make needs known, communicates beyond here and now') at six month follow up, with similar gains seen in both study arms. No significant differences were found between group means at six month follow up on mean TOM scores (mean difference = 0.25 95% CI -0.19, 0.69; p=0.27). This observation was maintained even after adjusting through various sensitivity analyses.

Discussion

Studies summarised in the present review include an examination of the effectiveness of general or "conventional" speech language therapy in the treatment of post-stroke aphasia compared to either no therapy or support and stimulation conditions. Based on published results from 9 RCTs (4 of good quality, 5 of fair), there is no clear evidence for the effectiveness of speech and language therapy, although results tend to favour intervention, as noted by Kelly et al. (2010). A brief summary of results is provided in Table 14.4. When interpreting these results, it is important to note that there are many possibly sources of biases that are often uncontrolled in aphasia treatment studies. These include lack of *a priori* sample size calculations, the mixing of aetiologies, inappropriate use of non-standardized measures, inappropriate measures, weak design, lack of clarity regarding aphasia types or levels of severity, undocumented type of language therapy and frequency of therapy, among other deficiencies.

Table 14.4 Effectiveness of Speech and Language Therapy Post Stroke

Study	PEDro Score	N	SLT Therapy Provided	Result
Lincoln et al. 1984	6	327	2, 1-hour sessions per week for 34 weeks.	-
Wertz et al. 1986	6	121	8 to 10 hours a week for 12 weeks	+
Hartman 1987	6	60	2 times a week for 6 months	-
Lincoln et al. 1982	2	24	12 30-min sessions over 4 weeks	-
David et al. 1982	5	155	30 hours over 15 to 20 weeks.	-

Shewan et al. 1984	5	100	3, 1-hour session a week for 1 year.	+
Marshall et al. 1989	5	121	8 to 10 hours a week for 12 weeks	+
Prins et al. 1989	5	32	2 sessions a week for 5 months	-
Laska et al. 2011	7	99	45 minute sessions every weekday for 21 days	-
Bowen et. al. 2012	7	170	Up to 3 contacts per week for 13 weeks	-

14.3.2.1 Intensity of Speech and Language Therapy

The most effective means of treating aphasia post stroke has yet to be determined, and studies investigating the efficacy of speech and language therapy for patients suffering aphasia post stroke have yielded conflicting results. One possible explanation for the observed heterogeneity of findings across studies is a difference in intensity of therapy. The recent Cochrane update (Kelly et al. 2010) reported that intensive therapy was associated with improved outcome when compared to conventional treatment; however, more participants withdrew from intensive therapy conditions than conventional. Studies examining the role of intensity in effectiveness are summarised in Table 14.5.

Table 14.5 Effects of Intensity of Therapy

Author, Year Country PEDro Score	Methods	Outcomes
Brindley et al. (1989) UK 4 (ABA)	This study involved Broca's aphasic patients defined by the BDAE without predominate apraxia and who were 1-year post stroke. Two groups of 5 patients each received five hours of language therapy for 5 days a week for 12 weeks. Comparison was made language during the intensive period of therapy with a 12-1week non-intensive period pre-course and a similar 12-week non-intensive period post-stroke.	Significant improvement on FCP - details in movement, speech, reading, and overall score were noted during the intensive period. There was a significant ratio of improvement on FCP between intensive period and 2nd non-intensive period in movement, speech and overall score. Language Assessment Remediation and Screening Procedure showed significant improvement in intensive period on sentence length increase, reduction in element omission, and increase in percentage of full utterances.
Poeck et al. (1989) Germany No Score	The study involved 160 aphasic stroke patients with CT revealing involvement of left hemisphere only and beyond the acute stage of neurological illness. Patients received intensive language treatment for 9 hr/week, for 6 to 8 weeks. Results were compared to a previous multicentre study of 92 German aphasic patients who did not receive language treatment. Patients were sub-grouped as early or late treated patients.	In the early phase mean gains for each measure were significant for both treatment and control group on the Token Test and for repetition. About 2/3 of treatment patients showed a significant improvement in Aachen Aphasia Test.
Denes et al. (1996) Italy 6 (RCT)	17 patients with global aphasia following left hemisphere stroke were randomly assigned to receive either standard treatment (n=9) or intensive treatment (n=8). Patients receiving standard treatment received an average of 60 therapy sessions over 6 months (approximately 3 per week). Intensive treatment consisted of 130 sessions over the same time period. Therapy was conducted using an "ecological" approach, that is, focusing on the restoration of language in a conversational setting. Language impairment was assessed using the Aachen Aphasia Test (AAT).	Participants in both groups demonstrated changes over time on all subtests (token test, repetition, written language, naming and comprehension) as well as the overall profile. The largest amount of improvement over time was demonstrated by the intensive therapy group; although, on between-group comparisons this differed from the standard treatment group for written language only. Analysis of individual scores revealed that individuals receiving intensive therapy demonstrated a greater number of

		improvements for every AAT subtest.
Hinckley & Craig (1998) USA No Score	In three small studies (n=15, 15, 10; total n=40), patients received a 6 week course of intensive speech/language therapy (15 hrs. individual, 5 hours group, 3 hours computer lab) followed by a 6-8 week period of no therapy (study 1), <3 hours therapy (study 2) or 3-5 hours therapy (study 3) and a second 6-week period of intensive therapy. Pre and post-phase assessments included the Boston Naming Test (BNT), and analysis of content units (CU) from the analysis of utterance procedure.	In all studies, the greatest improvements in naming ability as assessed on the BNT were associated with intensive treatment. No or non-intensive treatment was associated with no significant improvement over time. Return to intensive therapy resulted in more significant improvement. Total therapy received in each intensive period = 120 hours while non-intensive therapy provided 12 – 30 hours over 6 weeks.
Hinckley & Carr (2005) USA No Score	13 individuals with moderately severe aphasia were assigned to receive either 20 hours of individual context-based therapy + 5 hours of group treatment per week (intensive therapy) or 4 hours of individual, context-based therapy per week (non-intensive therapy). Context-based therapy included role-plays, self-generated strategies and context-specific cues. Assessment included performance on a criterion task (ordering items from a catalogue), the communicative abilities in daily living (CADL-2) and subtests (e.g. oral and written picture naming) from the psycholinguistic assessment of language processing in aphasia (PALPA). Assessment was conducted before and after intervention.	Eight patients received intensive training, 5 non-intensive. There were no significant between group differences reported at baseline. Both groups demonstrated significant improvement on the criterion task. There was no significant between group differences reported for the criterion task. On the CADL-2, the non-intensive treatment group improved more than the intensive group (p<0.05). There was no significant between group difference on the PALPA oral picture naming subtest, but the intensive group did demonstrate significantly more improvement than the non-intensive group in the written naming subtest (p<0.05).
Bakheit et al. (2007a) UK 8 (RCT)	97 patients with aphasia post first-ever stroke were randomly assigned to receive either 5 1-hour long sessions of speech therapy per week (intensive therapy, n=46) vs. two 1-hour long sessions (standard therapy, n=51). An additional 19 patients received therapy via National Health Service (NHS) therapists, but were not randomized to a treatment condition. Language function was assessed at 4, 8, 12 and 24 weeks using the Western Aphasia Battery.	Overall, there were no significant differences noted in performance on the WAB between standard and intensive therapies. However, none of the patients assigned to the intensive therapy group received the full course of therapy – only 13/51 received 80% or more. Patients assigned to the intensive therapy group were often too ill or refused therapy during the first 4 weeks of the study. When the subgroup of patients that received the most therapy was compared to the standard therapy group, no significant difference in WAB scores was noted at any assessment point. The NHS group received the least amount of therapy (mean = 6.9 hours over 8.6 sessions vs. 19.3 hours over 19.3 sessions). WAB scores were significantly higher in patients receiving standard therapy vs. NHS level therapy.
Godecke et. al. (2012) Australia 7 (RCT)	59 aphasic stroke patients were randomized to receive either daily aphasia therapy or usual care (≤1 session/ week). Individualized, daily aphasia therapy treatment was provided 5 days/ week to a maximum of 20 sessions (30-80 minute sessions). The primary outcome of this study was AQ scores on the Western Aphasia Battery (WAB) and the Functional Communication Profile at discharge from hospital or at 4 weeks post randomization	Daily therapy participants received an average of 7.5 treatment sessions over the study period (mean 331 minutes of training). Controlling for baseline stroke severity, daily therapy treatment participants improved to a significantly greater degree on AQ and FCP scores compared with controls (p=0.01 and p=0.004 respectively). These improvements were maintained at 6 month follow up, however, between group differences were no longer significant.

Discussion

Overall, the present review has included 13 RCTs examining either the effectiveness of SLT compared with a non-SLT control condition or intensity of therapy, specifically. We have noted that the failure to identify a consistent benefit associated with speech and language therapy might have been due to the low intensity of speech-language therapy applied in the negative studies while higher intensities of therapy appeared to be present in positive studies.

An examination of intensity of treatment and mean change scores undertaken by Bhogal et al. (2003) showed significant positive treatment effects for a mean of 8.8 hours of therapy per week for 11.2 weeks versus negative studies that provided approximately 2 hours per week for 22.9 weeks. On average, positive studies provided a total of 98.4 hours of therapy while negative studies provided a total of 43.6 hours of therapy. Hours of therapy provided in a week and total number of hours of therapy were significantly correlated with greater improvement on both the PICA and the Token Test while total length of therapy (i.e. time) was inversely correlated with mean change in PICA scores. Bhogal et al. (2003) concluded that intense therapy over a short amount of time could improve outcomes of speech and language therapy for stroke patients with aphasia.

In contrast, Bakheit et al. (2007b) were unable to demonstrate an association between intensity and improvement on the Western Aphasia Battery; however, the authors suggest that the amount of therapy received by patients in the intensive therapy condition (approximately 4 hours/week over 12 weeks) may not have reached the threshold necessary to enhance recovery.

The most recent and largest RCT examined by Bakheit et al. (2007a) failed to uncover a benefit of intensive aphasia therapy as assessed using the Western Aphasia Battery. The average length of stroke onset was one-month. The authors reported that the majority of patients receiving intensive treatment weren't able to tolerate it. Patients were either too ill or refused therapy and actually had lower WAB scores compared with patients who received less intensive, standard therapy (68.6 vs. 71.4).

Table 14.6 Intensity of Therapy Provided in Randomized Controlled Trials

Study	PEDro Score	N	Intensity of Therapy	Result
Lincoln et al. 1982	4	24	12, 30-minute sessions over 4 wks	-
Lincoln et al. 1984	6	327	2, 1-hour sessions per week for 34 weeks.	-
Wertz et al. 1986	6	121	8 to 10 hours a week for 12 weeks	+
Hartman 1987	6	60	2 times a week for 6 months	-
David et al. 1982	5	155	30 hours over 15 to 20 weeks.	-
Shewan et al. 1984	5	100	3, 1-hour session a week for 1 year.	+
Marshall et al. 1989	5	121	8 to 10 hours a week for 12 weeks	+
Prins et al. 1989	5	32	2 sessions a week for 5 months	-
Meikle et al. 1979	4	31	Minimum 3 and maximum 5 sessions/week for 45 minutes.	-
Brindley et al. 1989	4	10	5 hours over 5 days a week for 12 weeks.	+
Denes et al. 1996	6	17	60 sessions vs. 130 seesions over 6 months	+
Bakheit et al. 2007	8	97	4 hrs/week vs. 2 hrs/week (over 12 weeks)	-

14.3.2.2 Volunteer-facilitated Speech and Language Therapy

Kelley et al. (2010) reported that speech therapy delivered by volunteers produced outcomes similar to those produced by therapy delivered by trained speech-language professionals. Individual studies examining the use of volunteer-facilitated therapy are summarised in Table 14.7.

**Table 14.7 Volunteer-facilitated Speech and Language Therapy**

Author, Year Country PEDro Score	Methods	Outcomes
Meikle et al. (1979) UK 4 (RCT)	31 patients who had suffered a stroke 3 weeks prior and passed through the acute phase being left with disabling dysphasia were randomly assigned to 1 of 2 groups. One group received conventional speech therapy from a quality speech therapist while the other group received therapy from a non-professional volunteer.	No significant differences were observed between the two groups on Porch Index of Communicative Ability (PICA) scores.
Wertz et al. (1986) USA 6 (RCT)	121 male veterans under the age of 75 year and between 2 to 4 weeks after onset of single thromboembolic stroke with lesion confined to the left hemisphere and demonstrated language severity from 10th-80th percentile on PICA on entry into the study. Patients were randomized into one of three groups: (1) 8 to 10 hours a week of clinic treatment with speech therapy for 12 weeks followed by 12 weeks of no treatment; (2) 8 to 10 hours a week of home treatment by a trained volunteer for 12 weeks followed by no treatment; or (3) Treatment deferred for 12 weeks followed by 12 weeks of clinic treatment with a speech-language pathologist.	After 1st 12 weeks of treatment clinic treated patients performed significantly better than those deferred on the PICA. No significant difference noted between home treated and clinic or between home treated and deferred treated patients. After 24 weeks of treatment there was no significant difference between any groups.
Marshall et al. (1989) USA 5 (RCT)	This study involved 121 males who were 2 to 12 weeks post onset from a single left hemisphere thrombosis infarct resulting in aphasia. Patients were randomized to receive home therapy treatment given by a wife, friend or relative, treatment by speech-language pathologist or treatment by speech-language pathologist deferred for 12 weeks. Therapy was provided for 8 to 10 hours a week for 12 weeks.	At 12 weeks, the SLP group showed significantly more improvement than deferred group. Improvements noted in home treatment group did not differ from SLP group. At 24 weeks deferred treated group caught up to other 2 groups and no significant differences between groups was noted.

Discussion

All studies summarised here demonstrated no significant differences in outcomes between individuals receiving treatment provided by a trained volunteer and those who received conventional therapy provided by a professional speech-language pathologist. Use of volunteers could be an effective supplement to available speech language resources; one which could help to increase intensity of therapy where appropriate.

Home Treatment for Aphasic Patients by Trained Nonprofessionals. (Marshall et al. 1989)
This study involved 121 males who were 2 to 12 weeks post onset from a single left hemisphere thrombosis infarct resulting in aphasia. Patients were randomized to receive home therapy treatment given by a wife, friend or relative, treatment by speech-language pathologist or treatment by speech-language pathologist deferred for 12 weeks. Therapy was provided for 8 to 10 hours a week for 12 weeks. At 12 weeks, the SLP group showed significantly more improvement than deferred group. Improvements noted in home treatment group not differ from SLP group. At 24 weeks deferred treated group caught up to other 2 groups and no significant differences between groups was noted.
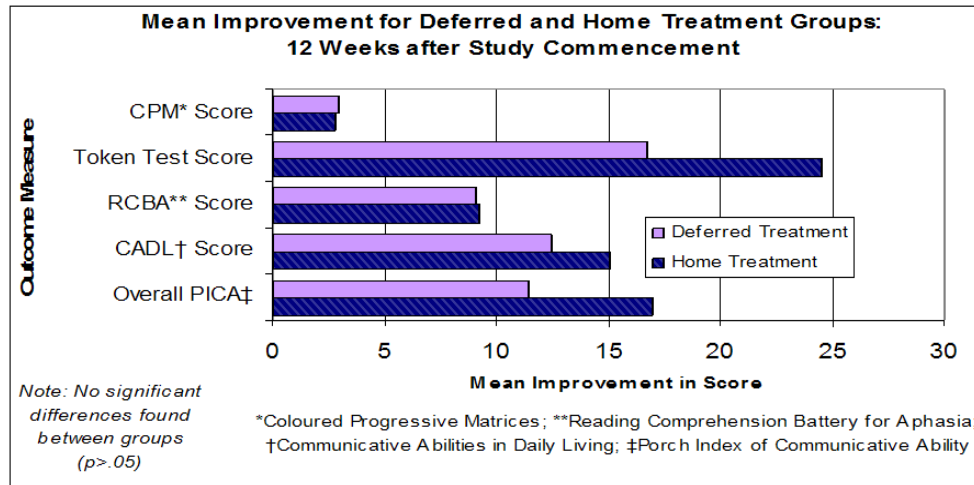
Conclusions Regarding Effectiveness of Aphasia Therapy

There is conflicting (Level 4) evidence whether speech and language therapy (SLT) is efficacious in treating aphasia following stroke. The most recent meta-analysis reported a consistent, though non-significant, benefit associated with the provision of SLT.

Based on the results of 2 meta-analyses, there is strong (Level 1a) evidence that intensive SLT produces more significant benefit than conventional SLT. In general, greater benefits are associated with very intense therapy over a relatively short period of time rather than less intense therapy over a longer period.

There is strong (Level 1a) evidence that trained volunteers can provide speech and language therapy and achieve similar outcomes to speech- language pathologists.

> *Language therapy is most effective in treating aphasia when provided intensely; less intensive therapy given over a longer period of time does not provide a statistically significant benefit, although clinical benefits can be achieved.*

> *Trained volunteers can provide an effective adjunct to speech-language pathologists' treatment.*

14.3.3 Group Therapy for Aphasia Post-Stroke
Group therapy for aphasic patients is a potential means to maximize limited language therapy resources and encourage social interactions. Individual studies examining the effectiveness of group language therapy are summarised in Table 14.8.

Table 14.8 Efficacy of Group Language Therapy for Aphasics

Author, Year Country PEDro Score	Methods	Outcomes
Wertz et al. (1981) USA 6 (RCT)	67 male aphasic stroke patients with a stroke (left hemisphere and no worse than 20/100 vision in better eye, 4 weeks post onset and entry scores from the 15th to the 75th percentile on the PICA) were randomly assigned to either group A or group B. Patients in group A received 4 hours a week of individual treatment with a therapist in traditional stimulus response type treatment. Patients in group B received group treatment designed to facilitate language use in a social setting.	Group A patients performed significantly better on the graphics sub-test of the PICA.
Aten et al. (1982) USA No Score	7 male patients received functional communication intervention consisting of group therapy in one-hour sessions 2X/week for 12 weeks. Topics included shopping, giving & following directions, social greetings and exchanges, supplying personal information, reading signs and directories and gestural responding.	Scores on the PICA did not differ significantly pre to post intervention. However, scores on the Communication Abilities of Daily Living (CADL) scale were significantly improved (p<0.01).
Marshall et al. (1993) USA No Score	25 patients with mild aphasia post stroke met in groups of 6 to 10 with a clinician undertaking problem-solving group therapy approach.	14 patients showed an overall improvement on the PICA; only 4 patients showed little or no change. Those who improved attended weekly meetings, participated avidly and displayed concern and interest for other members.
Bollinger et al. (1993) USA No Score	14 patients at least 18 months since stroke onset and presenting with aphasia were received Contemporary Group Treatment (CGT) involving a group interactive process with encouragement of multimodal stimulation and communication and Structured Television Viewing Group Treatment (STVGT). Patients were divided into two groups based on the Communicative Abilities in Daily Living results (high vs. low) to ensure adequate communication proficiency within groups. Group therapy consisted of 1-hour sessions, 3 times a week for 10 weeks, followed by 10 weeks of STVGT followed by a 10-week withdrawal period. After the withdrawal period, 10 weeks of STVGT was re-initiated followed by 10 weeks of CGT and concluded with another 10-week withdrawal period.	10 patients completed the study protocol. There were statistically significantly increases on the Porch Index of Communicative Abilities (PICA) and CADL after the first block of treatments with retention of skills during withdrawal. A significant increase in PICA scores was noted during the 2nd block of treatments and withdrawal. Significant gains were demonstrated on the CADL during the intial therapy block were maintained through the successive treatment/withdrawal interval. There was no change in the Auditory Comprehension for Sentences.
Brumfitt & Sheeran (1997) UK No Score	6 aphasic patients participated in 10 sessions of approximately 90 minutes duration of group therapy. The group therapy programme consisted of communication activities within the group that encouraged sharing of personal experiences, videotaping of role-play activities for self- and group-evaluation and practice tasks completed outside the group.	Significant improvement noted in patients on communicative competence and attitudes in communication over the course of the intervention.

Elman & Berstein-Ellis (1999) USA 4 (RCT)	Chronic aphasic patients were randomly assigned to two treatment and two deferred treatment groups. 24 patients completed the 4-month treatment trial. The treatment patients participated in 5 hours of group communication treatment weekly provided by a speech-language pathologist. Focus of treatment included increasing initiation of conversation and exchanging information using whatever communicative means possible. The deferred group, while awaiting treatment, engaged in activities such as support, performance or movement groups to control for effects of social contacts.	Patients in the treatment group demonstrated significantly higher scores on the WAB AQ (p<0.05) and CADL (p<0.05). There was no significant difference between groups reported on the SPICA. Significant increases in performance were evident at 2 and 4 months. No significant decline in performance occurred at time of follow-up (4-6 weeks post-intervention).

Discussion

Of the 6 studies summarised in Table 14.8, only two were randomized controlled trials. The remainder were small, single-group prospective studies offering no possible comparisons to the treatment condition. However, results of these uncontrolled studies appeared generally positive, reporting significant improvements in communication activities over time.

Conclusions Regarding Group Therapy for Aphasia Therapy Post-Stroke

There is moderate (Level 1b) evidence based on one RCT of fair quality that group intervention results in improvements on communicative and linguistic measures among patients with chronic aphasia.

There is moderate (Level 1b) evidence, based on one "good" RCT (PEDro = 6), that group therapy results in less improvement in graphic (writing) elements of aphasia when compared to individualized therapy.

> *Participation in group therapy may result in communicative and linguistic improvements.*

14.3.4 Community-Based Treatment Programs

As noted by Aftonomos et al. (1999), most conclusions regarding the efficacy of aphasia therapy are derived mainly in academic research; however, it is in the community that patients with aphasia are identified, reached and treated (Aftonomos et al. 1999). Thus, aphasia therapy depends on "its ability to promote and improve functional outcomes in real-world settings of constraints and limitations". Individual studies examining community-based treatment are summarised in Table 14.9.

Table 14.9 Community-Based Aphasia Programs

Author, Year Country PEDro Score	Methods	Outcomes
Hoen et al. (1997) Canada No Score	Evaluation of the York-Durham Aphasia Centre's community-based programme. Psychological well-being was evaluated using the Ryff's Psychological Well-being Scale to 35 patients and 12 family members.	Patients were observed to show positive significant change on five of six measures of well-being: self-acceptance, purpose of life, personal growth, autonomy and environmental mastery. Family members showed positive significant changes in five of 6 measures as well: personal growth, positive relations with others, purpose of life, self-acceptance.

Aftonomos et al. (1999) USA No Score	60 patients with aphasia enrolled in 2 community-based, comparably managed and equipped therapy programs. The program incorporated specially designed computer-based tolls before and after treatment at the impairment (speech-language test performance) and disability levels (functional communication). The Western Aphasia Battery (WAB) and the Communicative Effectiveness Index (CETI) were admininstered.	Patients' mean performance scores improved significantly in response to treatment on the WAB and the CETI. No significant difference between improvements in patients in acute versus chronic stages aphasia, between different impairment severity levels, different locations, at the level of function or of different diagnostic types.
Worrall & Yiu (2000) USA 5 (RCT)	14 aphasic patients were randomly assigned to participate in either recreational activities or the Speaking Out program. The Speaking Out intervention consisted of 10 scripted modules addressing issues in everyday functional communication. Subjects participated in both conditions in a crossover design. Each 10-week intervention phase was separated from the next by a 10-week withdrawal phase. Group A participated in Speaking out first (1-2 hours per week for 10 weeks), then withdrawal followed by recreational activities (crafts, cards & games). Group B participated in recreational activities first, then withdrawal and then the Speaking Out program. Both recreational activities and the Speaking Out Program were conducted in the home by trained volunteers.	There was a significant difference for both groups before and after the Speaking Out intervention on the WAB (group A p=0.046; group B p=0.036). For group A, there was a significant difference in general health perception assessed on the SF36 before and after participation in Speaking Out (p=0.028). For Group B, there was a significant difference in scores on the ASHA Functional assessment of Communication Skills before and after Speaking Out (p=0.018). When scores were analyzed to compare the Speaking Out intervention with just recreational activities, no significant between group differences were noted.
Van der Gaag et al. (2005) UK No Score	38 patients with long-term stroke and aphasia together with 22 of their caregivers were recruited upon referral to a community-based aphasia therapy centre. Over a period of 20 weeks, patients received an average of 34 hours of group aphasia therapy while relatives/carers received an average of 22 hours of therapy specific to carers. An average of 8 hours of counselling was provided to each participant. Group activities included conversation, communication skills, use of art forms, discussion & self-advocacy, training and monitoring communication skills of partners. Assessments before and after participation in the programme included the EQ5D, Stroke and Aphasia Quality of Life Scale (SAQoL-39), the Communication Effectiveness Index (CETI) and the Carer's Assessment of Difficulties Index (CADI). In addition, patients and carers participated in semi-structured interviews both before and after participation in therapy.	Quality of life improved significantly by the end of 6 months as assessed on the EQ5D (p=0.02). The condition-specific scale (SAQoL-39) reflected significant improvement only on the communication subscale (p<0.001). Based on interviews, the majority of patients and carers reported positive changes in quality of life including increased self-confidence, better communication with strangers, family & friends and an increase in desire to participate (eg. in social activities). Scores on the CETI improved significantly from baseline to 6 months as reported by both the patient (p=0.007) and carer (p=0.005). Patients reported feeling more confidence in communicating and in using alternative forms of communication (e.g. gestures and writing). Differences from baseline to 6 months were not significant on the CADI; however, they reported feeling more supported and less isolated. Group therapy was seen as a good resource of advice and tips for coping and a means to hear from others in similar situations. Few carers found group sessions unhelpful or uncomfortable.

Training volunteers as conversation partners using "Supported Conversation for Adults with aphasia" (SCA). (Kagan et al. 2001)

40 volunteers were randomly assigned to either receive a workshop training session designed to teach them how to acknowledge and reveal the competence of adults with aphasia through supported conversation (SCA) or were assigned to be exposed to aphasia by watching a video that told stories of patients with aphasia and their families. There were also given opportunity to interact with aphasia patients. 40 stroke patients with moderate to severe aphasia were randomly assigned to volunteers.

SCA trained volunteers scored higher than controls on rating of acknowledging competence and revealing competence of their aphasic partners. Patients assigned to trained volunteers scored higher on social and message exchange skills than did patients assigned to control volunteers.

Pre- and Post-test Volunteer Scores: Training vs. No Training

(M)SCA = Measure of Supported Conversation for Adults with Aphasia
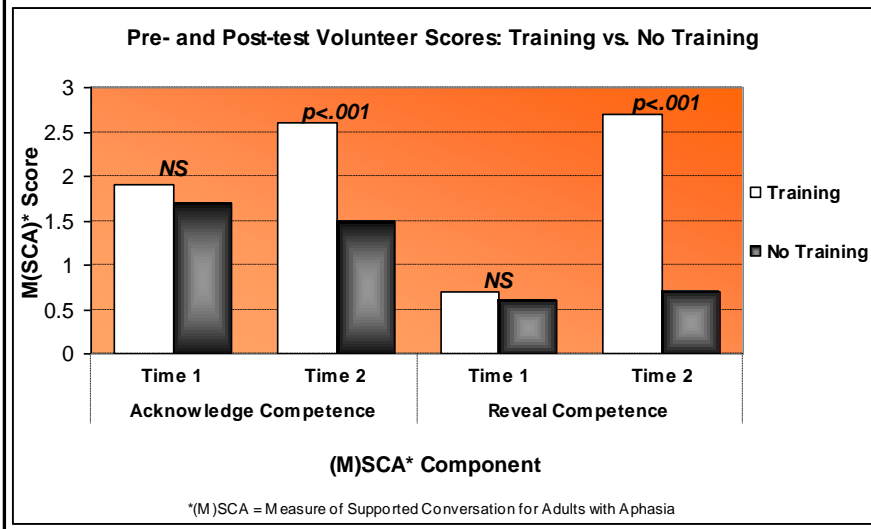
Discussion

While there seems to be a generally positive effect associated with community-based aphasia intervention, there is little to recommend any one treatment over the other. Treatment at a community-based aphasia centre was associated with improved communication readiness, well-being and self-confidence. In the sole randomized controlled trial of a community-based program provided in the home, intragroup analysis revealed a significant difference between pre- and post-treatment scores on both body function (impairment) and activity (functional) level assessments. However, there were no significant differences reported between patients receiving recreational activity interventions and those receiving the experimental intervention (Worrall & Yiu 2000). In fact, in-home social or recreational visits may have had as much effect as the targeted program intervention.

Conclusions Regarding Community-Based Aphasia Programs

Based on a single RCT of fair quality, there is moderate evidence (Level 1b) that an in-home program administered by trained volunteers improves language outcomes at the impairment and functional levels. However, there is no evidence that a targeted aphasia program is superior to in-home visits for the purpose of simple recreational activity.

> *Community-based language therapy programs provide a setting for improved language functions taking into account limitations and constraints of the "real-world".*

14.3.4.1 Training Conversation/Communication Partners

Conversation is important in social participation and plays a key role in many social functions such as establishing and maintaining relationships, sharing ideas and opinions or making plans. According to Kagan et al. (2001), it is also the means by which individuals reveal their inner competencies. Individuals living with aphasia have lost, to varying degrees, the tools of conversation. This loss impacts the ability of the individual to participate in social roles and obscures the individual's inner competencies (Kagan et al. 2001; Rayner & Marshall 2003).

Interventions focused on the restoration of conversation are not restricted to alleviating impairment of language but also attempt to remove barriers to social participation in the settings within which the individual with aphasia lives and interacts with others (Lyon et al. 1997). Training conversation or communication partners within the aphasic individual's social setting is one way to promote opportunities for restored access to conversation (Marshall 1998; Rayner & Marshall 2003). Individual studies examining the training of communication partners are summarised in Table 14.10.

Table 14.10 Training Conversation/Communication Partners

Author, Year Country PEDro Score	Methods	Outcomes
Lyon et al. (1997) USA No Score	10 treatment triads (patient, caregiver and communication partner) enrolled over a 3 year period. 2/3 of triads were assigned to begin treatment immediately; 1/3 had treatment deferred for 2 months. Treatment consisted of 2 phases lasting for 5.5 months. Phase 1 consisted of 1- 1.5 hour sessions twice weekly for 6 weeks during which the volunteer learned specific strategies to promote communication together with the aphasic patient in his/her triad. Phase 2 consisted of twice weekly sessions. Session one was a review of the previous week's activity and planning for the next session. Session two consisted of activities/tasks of interest chosen by the aphasic individual and planned out by the patient, communication partner and clinician. Assessments included the Boston Diagnostic Aphasia Examination (BDAE), the Communication Activities in Daily Living (CADL) scale, the Affect Balance Scale (well-being) and 2 measures constructed for the study – the Communication Readiness and Use Index (CRUI) and the Psychosocial Well-being Index (PWI). Independent, subjective ratings of outcome were made by speech-	No pre-post differences reached significance for scores on the BDAE, CADL or ABS measures. Patients in the deferred treatment groups also demonstrated no differences on these measures while awaiting treatment. On the non-standardized measures (CRUI & PWI), significant differences were found (p<0.05) whether they were rated by patient, caregiver or communication partner) when comparing baseline to post-treatment scores. Subjective judgements from independent clinicians did not correlate strongly with the gains on the CSUI or PWI. While almost all patients demonstrated gains on the CRUI and PWI, only 2/3 were rated as meeting or exceeding expectations by the 2 independent clinicians.

	language clinicians familiar with the patients.	
Wilkinson et al. (1998) UK No Score	In this study, an aphasic woman and her husband were asked to videotape themselves during peak conversation times at home for a week. The camera was then returned to the speech language therapist (SLT) who transcribed and analyzed their conversations verbally and nonverbally to determine which aspects of conversation the couple may wish to change. Therapy (termed 'interaction therapy') consisted of 3 stages: observation, where the couple and the SLT watch the video together; discussion, where they discuss how they feel about certain patterns of conversation; and suggestions for change, where the SLT highlights the problem areas and suggests ways to improve the flow of conversation. After 4 two-hour therapy sessions, the couple was asked to videotape themselves once again and the conversations were transcribed and analyzed to assess improvement.	In the post-therapy assessment of conversation, the couple did not display the same 'other-repair' pattern that was causing disturbance in the prior assessment. Further research into this therapeutic approach is suggested. It is emphasized that language therapy must not neglect functional and psychosocial issues if it is to bring about meaningful change for aphasics and their conversational partners.
Booth & Swabey (1999) UK No Score	4 individuals with aphasia at least 6 months post stroke and an adult relative living with them participated in a communication skills program based on Conversation Analysis. A conversational analysis profile for people with aphasia (CAPPA) was created via a structured interview with carers to determine the carer's perception of the patient's language abilities and conversation as well as analysis of a 10-minute conversation between carers and patients with aphasia. The interview and conversation analysis were compared to derive a summary profile. After this initial assessment, carers participated in a weekly communication skills group for a total of 6 weeks. The group program consisted of lectures, discussions, workshops as well as personalized information & management strategies based on the conversation analysis. The CAPPA was repeated following the intervention.	Carers' perception of communication more closely matched results of conversation analysis following the communication skills intervention. Increased awareness, however, was not necessarily indicative of how well carers were able to manage communication problems arising during conversation. While there was a decrease in the rating of severity of problems following intervention, it was not significant. Carers expressed increasing distress with the burden of topic initiation and management during conversation. However, carers also reported that they found reinforcement and personalized conversational examples useful in understanding principles of CAPPA. Carers enjoyed the interactive nature of the workshops as well as the opportunity to interact with other people who shared their concerns.
Kagan et al. (2001) Canada & USA 6 (RCT)	Study included 40 stroke patients with moderate-to-severe aphasia and volunteers at an aphasia centre. Volunteers were randomly assigned to either receive a workshop training session designed to teach them how to acknowledge and reveal the competence of adults with aphasia through supported conversation (SCA) or were assigned to be exposed to aphasia by watching a video that told stories of patients with aphasia and their families. There were also given opportunity to interact with aphasia patients. Patients were randomly assigned to volunteers.	SCA trained volunteers scored higher than controls on rating of acknowledging competence and revealing competence of their aphasic partners. Patients assigned to trained volunteers scored higher on social and message exchange skills than did patients assigned to control volunteers.
Hopper et al. (2002) USA No Score	2 patients with chronic aphasia post stroke participated together with their spouses. Each couple participated in a baseline and instruction session in which the aphasic partner's ability to convey a story to the non aphasic partner was assessed and used to generate personalized communication strategies. Specific strategies offered by	A trend toward improvement was identified in the number of main story concepts conveyed when baseline scores were compared to post-treatment scores. One aphasic individual demonstrated improvement on CADL-2 scores while the other did not. Naïve observers

	therapists were chosen by the couples. Each couple then participated in 10 treatment sessions in which the aphasic individual watched a videotaped story and then attempted to convey it to the nonaphasic partner. A clinician was present and intervened in the process to provide information about how to use effective strategies in the event of communication breakdown or miscommunication (conversational coaching). Pre and post treatment probes were conducted. The primary outcome was number of main story concepts communicated successfully. Aphasic individuals were also assessed using the CADL-2.	reported greater understanding of the conversation between both couples after treatment than at baseline.
Cunningham & Ward (2003) UK No Score	Four individuals with aphasia post stroke and their spouses participated in a training program intended to improve conversation. Couples & researchers determined topics of conversation to be used in the study. Baseline evaluation consisted of 3 sessions (one week apart) in which conversations between patients and spouses were videotaped and analysed via conversational analysis. The frequency and type of nonverbal communication was also recorded. Intervention consisted of 5 sessions (1.5 hours for 5 weeks). Sessions 1&2 were educational/informative, session 3 included instruction/feedback based on the videorecordings taken during baseline, sessions 4 & 5 included active roleplaying and practise of supported conversations. Baseline assessments were repeated following intervention. At both assessment periods, couples completed the Visual Assessment of Self-Esteem Scale (VASES) and the Hospital Anxiety and Depression Scale (HADS).	Conversational analysis revealed that post-intervention 3 of 4 couples demonstrated an increase in successful conversational repairs. In addition, the number of trouble sources initiated by the aphasic partners decreased following intervention for 3 of 4 couples. No significant changes in the use of nonverbal communication were noted. However, there was a nonsignificant trend identified suggesting an increase in the use of gestures overall. There were no significant differences identified from baseline to post intervention on either the VASES or HADS scales.
Rayner & Marshall (2003) UK No Score	A training course, based on SCA (Kagan et al. 2001), was delivered to 6 volunteers at a social club for individuals with aphasia. Participants with aphasia were recruited from the same group. All aphasic participants had stable language functioning and were at least 1 year post-stroke. Training consisted of 3 3-hour morning sessions. Session one consisted of education/information regarding theories of conversation and aphasia, session two focused on the Aphasia Centre Instructional Video and discussion of alternate means of communicating and session three consisted of clarification, review and the opportunity to practise new strategies. The course was evaluated by assessing videotaped conversations between aphasic individuals and trained volunteers. Tapes were evaluated using Kagan's rating scales (Kagan et al. 2001). Two questionnaires were administered to volunteers before and after training to assess knowledge of aphasia and knowledge of communication strategies.	After training, there was a significant improvement in ratings of volunteer performance and of the aphasic person's performance/level of involvement in videotaped conversations (p<0.001). In addition, a significant (p<0.001) correlation was identified between volunteer skills/performance and level of participation by the aphasic individual. There was a significant improvement in volunteers knowledge about aphasia (p<0.005) and about strategies to use in conversation (p<0.0.05). When the questionnaire regarding strategies was administered twice to a group of untrained volunteers, no improvement was seen on the second administration.
Sorin-Peters (2004) Canada	Five individuals with aphasia and their spouses participated in a communication training programme based on principles of conversation partner training and	After training and follow-up, couples demonstrated improvements in interaction and transaction. Couples appeared more at ease and

No Score	learner-centred adult education. The program was developed based on the experience, needs, learning styles and rhythms of the participants. Pre and post intervention as well as 2-month follow-up assessments included videotaped conversations between the couples, the Couple Questionnaire (spouses' attitudes toward partners and couple's ability to communicate) and a semi-structured interview. Verbal and nonverbal communication behaviours were transcribed from the videos and analysed qualitatively using the categories of interaction and transaction.	conversations more closely resembled natural adult conversation. Prior to training, spouses appeared to interview or test their partners with aphasia; after training, conversation included more discussion and reminiscence. Spouses used more verbal and non-verbal strategies resulting in more transfer of information between spouses and aphasic partners. Prior to training, spouses dominated conversational turn control. Post training, turn control was more balanced. Spouses used more effective communication strategies after training allowing partners to convey more information. Themes identified during interviews, conversations and from the Couples Questionnaire included expression of anger, sadness and grief, acceptance (after the training) as well as the presence of marital issues.

Discussion

Most studies identified in the present review were very small single group studies with very few participants (n<10). Most interventions were based, to varying extents, on individualized instruction according to the needs and communication styles of each communication dyad. A single non-randomized study of communication triads, which did offer between-group comparisons, demonstrated improvements in communication readiness and well-being from the point of view of the patient and caregiver, despite no significant improvements on standardized measures of language impairment or communication activities of daily living (Lyon et al. 1997).

The SCA technique (Kagan et al. 2001) represents a more generic tool used to teach communication partners skills they can use to promote conversation. Results demonstrated significant improvements (vs. controls) in social and message exchange skills.

Conclusions regarding Training Conversation/ Communication Partners

There is moderate (Level 1b) evidence that the technique of training conversation partners, Supported Conversation for Adults with Aphasia (SCA) is associated with enhanced conversational skill for both the trained partner and the individual with aphasia.

There is limited (Level 2) evidence that training communication partners is associated with improvements in well-being and social participation. However, the majority of studies appear to be very small and of single group design. Further research is required.

> *Supported Conversation for Adults with Aphasia improves conversational skill. In addition, training communication partners may result in improved access to conversation and increased social participation.*

14.3.4.2 Patient and Caregiver Education

Community-based therapy, partner training and group therapy have both been examined as possible intervention approaches in long-term or chronic aphasia. The role of education for both the patient and family has also been examined as a means to improve communication in the home and social

participation.

Table 14.11 Caregiver/Patient Education Programs

Author, Year Country PEDro Score	Methods	Outcomes
Hinckley et al. (1995) USA No Score	Adults with aphasia and their families/caregivers participated in a brief education program presented in a 2-day conference format. Goals of the conference were to increase productivity, to learn about aphasia, to increase knowledge about therapy options and home practice and to learn coping skills and deal with psychological issues.	6-month outcomes demonstrated that attendance was associated with improvements in aphasia knowledge, independence in the home and increased communication with family members. The majority of participants had located useful community resources within 6 months of attendance. Participants completed a Community Integration Questionnaire at the time of the seminar and then again at 6 month follow-up. There was significant improvement in community integration scores noted at 6 month follow-up
Hinckley & Packard (2001) USA No Score	Subjects in the participant group (n=21) were recruited from among aphasic individuals and their caregivers who attended a 2-day educational seminar about living with aphasia. A comparison group (n=15) was recruited from the seminar mailing list and was comprised of interested aphasic individuals & their caregivers who did not attend the seminar. This study is based on the same seminar format as the above study but also includes a comparison group and assessment of additional outcomes (FAI, McMaster Family Assessment Device)	At 6-month follow-up, participating caregivers and aphasic individuals rated their level of knowledge higher than those individuals who did not participate (p<0.05). There was no difference between pre and post seminar assessments on any of the measures for the non-participant group. The participant group's scores on the Community Integration Questionnaire did not change from pre to post seminar assessments, however, significant changes were noted on the family assessment device and Frenchay activities index (both p<0.05).
Draper et al. (2007) Australia 4 (RCT)	39 caregivers of stroke patients with aphasia were randomly allocated to either participate in a group-based intervention (n=19) or be put on a 3-month waiting list (control group, n=20). The group training program included education, support, and functional communication/skills training, 2-hours per session once per week for 4 weeks. Primary study outcomes included caregiver stress (assessed using the General Health Questionnaire – GHQ), caregiver burden (Relatives' Stress Scale – RSS) and both use and effectiveness of 8 functional communication strategies. Assessments were conducted at baseline and completion of the intervention. Questionnaires were mailed at 3 month follow-up.	The treatment group demonstrated significant improvement in GHQ scores over the period of the intervention (p=0.006) whereas the waiting list group demonstrated no improvement. There were no other significant within group changes reported at either the end of intervention or at the end of the 3 month follow-up period. Improvements demonstrated on the GHQ for patients in the treatment group were not sustained at 3 months. Between-group comparisons were not reported.

Discussion
Of the three studies summarised here, only one was a randomized controlled trial. Draper et al. (2007) reported that participation in a group-based education and support program was associated with significant, though temporary benefits in terms of caregiver distress. No benefit was reported on any other outcome including use and perceived effectiveness of functional communication strategies.

However, the study suffered from several notable limitations including problems in recruitment, insufficient power and no reported between-group comparisons.

Conclusions Regarding Brief Family and Patient Education Interventions

There is moderate (Level 1b) evidence based on a study of 'fair' quality that group-based caregiver education is associated with temporary improvement in caregiver stress, but not with improved use or effectiveness of functional communication strategies.

There is limited (Level 2) evidence that participation in educational seminars results in improved knowledge, participation in social activities and family adjustment. Further examination of the role of education is warranted.

> ***Group-based caregiver education may be associated with improvement in caregiver stress.***

> ***Educational seminars for aphasic individuals and their families/caregivers may improve not only knowledge, but may also be beneficial in terms of social participation and family adjustment.***

14.3.5 Computer-Based Treatment in Aphasia

Computer-based aphasia therapy is appealing in that it provides a means for massed practice, thereby increasing intensity of therapy (Wallesch & Johannsen€Horbach, 2004), while minimizing use of therapist time and resources (Katz & Wertz 1997). However, the effectiveness of computer-based therapies has not been thoroughly investigated. A review of reports of computerised treatments for aphasia (Wertz & Katz, 2004) identified eight phase 1 studies, three series of phase 2 studies and a single phase 3 study using the model for clinical outcome research developed by Robey and Schultz (1998) (Table 14.12) .

Table 14.12 Studies included in Wertz and Katz 2004

Study	Phase
Seron et al. 1980	1
Mills 1982	1
Katz & Nagy 1982	1
Katz & Nagy 1983	1
Scott & Byng 1989	1
Deloche et al. 1993	1
Crerar & Ellis 1995	1
Crerar et al. 1996	1
Katz et al. (1984, 1985, 1989)	2
Loverso et al. (1988, 1992, 1985)	2
Steele, Weinrich et al. (1987, 1989); Weinrich et al. (1993, 1989); Aftonomos et al. 1997.	2
Katz & Wertz 1997	3

Phase 1 and 2 studies are concerned with the development and refinement of hypotheses and are appropriate for small, single group or single subject/case series designs while phase 3 studies examine the efficacy of treatment under controlled conditions (Wertz & Katz, 2004). Results of phase 1 and 2 studies were mixed. Computer-based therapy appeared to have a positive effect in some of the studies;

however all of the studies reported in the review provide evidence based on single small group or case study designs. There was a single study identified as a phase 3 study, which evaluated the effects of computer-based therapy in a randomised controlled trial. The results of this single RCT favoured the efficacy of computerised treatment. Studies identified for inclusion in the present review are summarised in Table 14.13.

Table 14.13 Computer-Based Treatments in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Bruce & Howard (1987) UK No Score	This study involved 5 previous participants of a previous study that exhibited word-finding difficulties but could repeat single words, had Broca's aphasia and were more than 6 months post stroke. Patients were trained to use computer generated phonemic cues to assist with word retrieval. Two sets of pictures were presented. On each occasion the subject could use the aid with one of the two sets.	Significant differences between the aid and control conditions in word retrieval was noted in 4 out of the 5 patients
Aftonomos et al. (1997) USA No Score	This study involved 23 chronic aphasia patients who had previously been treated with traditional methods 6 months to 15 years post onset. Assessed aphasic patients' response to resumption of therapy using computer-based treatment. All subjects had 1 hr clinical sessions by speech therapist using designated computer based system, Lingraphica. The Lingraphica system allows patients to build messages via a string of selected pictures, which may be read or reproduced digitally as speech. Mean length of therapy = 16.2 weeks.	Patients improved approximately 10 percentile points on the PICA after 40 hours of therapy (3 patients) (p=0.005). The remaining 20 patients improved significantly from pre to post-treatment on the Boston Naming Test (p=0.005). Changes in the BNT were reported for most patients regardless of length of time between onset of aphasia and commencement of therapy. Similar improvements were reported for performance on subtests of the Western Aphasia Battery and the Boston Diagnostic Aphasia Examination.
Petheram (1996) UK No Score	10 patients at least 5 months since single left stroke with Functional Communication Profile (FCP) score of 42 - 89 received a computer for their home. A speech language pathologist provided initial instruction and demonstration of computer-based task. Patients worked on their own on each computer tasks: 10 exercises or 20 questions with 3 levels based on a psycholinguistic approach. If patients answered correctly 5 consecutive questions, the material was advanced to a higher level. If 3 of the 5 answers were incorrect, level of difficulty was lowered. Duration of treatment was 3 weeks.	Willingness of patients to make unsupervised use of microcomputers was confirmed: 9 of 10 patients made some use and 6 or 10 used it for an average of 2 hours of more per week. Response time significantly decreased at the end of treatment compared to the beginning of treatment. Post-FCP scores significantly improved.
Katz & Wertz (1997) USA 5 (RCT)	55 patients with aphasia due to single left hemisphere thromboembolic infarct at least 1-year post onset and scored between 5-90th percentiles on PICA. Patients were randomised to 3 groups: (1) computer reading treatment, (2) computer stimulation (non-verbal, cognitive rehab programs) or (3) no treatment. Subjects in computer groups used computers 3 h/week for 26 weeks.	Computer reading group better on PICA "overall" and "verbal" sections and on WAB Aphasia Quotient and repetition subtests than other 2 groups. The computer stimulation group improved only on the overall PICA score. Computerized reading therapy demonstrated generalization to non-computer, non-written language.
Aftonomos et al. (1999) USA	60 aphasic patients with an assignment of 1 to 8 diagnostic categories through administration of WAB and had completed at least 1 month in the community-	Significant improvements were demonstrated on all subtests of the WAB (p≤0.0006). Functional communication as represented by CETI scores also

No Score	based program were involved. Patients were enrolled in 2 community-based programs, which use a computer-based tool, (the Lingraphica System – see Aftonomos et al. 1997) as part of an extensive, detailed formal patient care system. Treatment consisted of 1-hour sessions. Patients were also expected to complete prescribed activities at home. Mean number of sessions per patient was 41.7. The mean duration of treatment was 20.5 weeks. Outcomes were assessed via the Western Aphasia Battery (WAB) and Communicative Effectiveness Index (CETI).	improved significantly over the duration of treatment (p<0.0001). Ratings on the CETI were obtained from individuals close to the subject (spouse, adjust child, sibling, etc).
Doesborgh et al. (2004a) Netherlands 6 (RCT)	18 people with aphasia post stroke and who had received intensive impairment-based interventions for aphasia were randomly assigned to receive either 10 – 11 hours therapy with Multicue (n=8) or no treatment. Multicue is a computer program for the improvement of word finding based on cueing therapy. Sessions lasted 30 – 45 minutes and were conducted 2-3 times per week for approximately 2 months. While patients were treated via the Multicue program, apart from assigned language therapy and group psychosocial therapy, no other interventions were given. Participation in the "no treatment" condition continued for 6 – 8 weeks.	Mean improvement on the Boston Naming Test (BNT) and the Amsterdam-Nijmegan Everyday Language Test (ANELT-A) did not differ between groups. However, subjects who received treatment with Multicue improved their scores on the BNT significantly (p=0.02). Scores on the BNT did not improve for participants allocated to the control condition. Improvement on the BNT did not generalise to improvement in everyday verbal communication as assessed by the ANELT-A.
Cherney (2008) USA No Score	AphasiaScripts is software package developed to function as a "virtual therapist". Scripts are recorded as per patient needs – the patient listens to these scripts and then may participate in word, sentence and conversation practice. 3 individuals with chronic aphasia participated in a computer script training program (AphasiaScripts) for 15 weeks. Individualized scripts were developed for each participant over the course of the first 5 weeks (1hr sessions, once per week). For weeks 6 – 15, scripts were practiced independently in the home (≥30 minutes/day). Weekly meetings were held to assess progress and monitor compliance. Standardized testing (WAB, communication activities of daily living- CADL-2, Quality of Communication Life Scale) were conducted before and after 9 weeks of training.	Positive changes in content, grammatical productivity and rate of production were reported associated with training. 2/3 participants demonstrated more than 5 points improvement on the WAB, but no changes in functional communication were noted. Only 1 participant demonstrated improvement on the quality of life scale. Qualitative analysis of exit interviews identified the following themes: increased verbal communication, improved communication skills evident in other modalities and situations, changes in communication noticed by others, increased confidence and satisfaction with the computer program.
Manheim et al. (2009) USA No Score	20 individuals with chronic aphasia participated in the AphasiaScripts training program. Participants developed 3 scripts with an SLP over 5 sessions, then practiced each script for 3 weeks, in a consecutive fashion at home on a laptop computer (total of 9 weeks intervention). Participants maintained a log of practice times. Practice was also recorded by the computer via log-on/log-off times. Compliance was checked via meetings with the SLP once per week. Outcomes assessed included the communication difficulties (CD) subscale, the Communication-Associated Psychological Distress (CAPD) subscale and the Mobility subscale from the Burden of Stroke Scale (BOSS). Assessments were	CD scores reflected no change from entry to pretreatment assessment. From pre- to post-treatment there was a significant decrease in scores (improvement) (p=0.38, ES = 0.43). From the end of the intervention to follow-up, there was a further, non-significant improvement in scores. Overall improvement from pre-treatment to follow-up was significant (p=0.003, ES = 0.67). Changes in the CAPD scores reflected improvement from pretreatment through follow-up, but these did not reach statistical significance. Mobility scores did not demonstrate change over time.

		conducted at study entry, 6 weeks later (pretreatment), end of intervention (post-treatment) and 6-week follow-up.	
Fridriksson et al. (2009) USA No Score	10 individuals with chronic, nonfluent aphasia (Broca's) participated in self-administered, computer-based training. Each participant was provided with a laptop with an installed program, headphones and a set of a large green and red response buttons. The programs consisted of 2 treatment phases 1) audio-visual (AV) and 2) audio-only (AO). Each included 18 colour pictures of high-frequency nouns each presented in a 3-level hierarchy. Pictures were presented on the screen for 2 seconds, then the patient was presented with a spoken word through the headphones (AO). The patient's task was to signal whether the word matched the picture (green button) or not (red button). In the AV condition, presentation of the spoken word was supplemented with a video of a man's mouth pronouncing the word. Half of the participants started with the AO treatment and then changed to AV, the other half began with AV. There was one session per day for a minimum of 5 sessions. When the patient achieved 90% accuracy, they advanced to the next level – a minimum of 15 sessions per treatment phase. Outcomes were 1) naming task consisting of the 36 trained nouns 2) performance on the Philadelphia Naming Test (175 nouns).	Following AV treatment, participants could name significantly more of the trained nouns than at baseline (p<0.0001). Although AO training was associated with improvement, it was not significant. AV training was associated with more improvement in naming trained nouns compared to AO (p=0.0006). On the Philadelphia Naming Task (untrained nouns), AV treatment was associated with improved performance compared to baseline (p<0.0001). Similarly, AO training was associated with non-significant improvement vs. baseline. Although AV appeared to be associated with a greater treatment effect than AO, it was not statistically significant.
Cherney et. al. (2010) USA (6) RCT	25 individuals with chronic, non-fluent aphasia were randomized to receive either Oral Reading for Language in Aphasia (ORLA) therapy delivered by a computer, or the same therapy delivered by a speech language pathologist following a no-treatment period of 7-12 weeks. Each participant received 24, one hour sessions of ORLA. Participants were assessed using the Western Aphasia Battery (WAB) at baseline, after a no treatment period of 7-12 weeks, prior to the start of intervention, and post intervention.	All 25 participants received all 24 sessions of therapy over an average of 12.62 weeks. Computer delivered ORLA therapy resulted in improvements on the WAB-AQ from pre- to post treatment (mean change in test score = 3.29. SD=6.16). This was compared with the change in WAB score between baseline and pre-treatment assessments (-0.4, SD=3.44) which was equivalent to an effect size of d=0.74 (CI -0.15-1.57) for change in WAB-AQ scores associated with treatment. Change from pre-treatment to post-treatment between the computer delivered ORLA and speech language pathologist delivered ORLA groups showed no significant difference for any of the assessed outcomes.
Palmer et. al. (2012) UK (8)RCT	34 participants with aphasia were randomized to receive either computer-based therapy (20 minutes, 3x per week) or usual care over a 5 month intervention period. The intervention consisted of speech and language therapy delivered through independent use of a computer therapy program (Step-by-Step) configured by an SLP and supported by a volunteer. Clinical effectiveness was evaluated using the Object and Action Naming Battery administered at baseline, 5 month follow up, and 8 month follow up.	10 of the 15 participants (66.7%) randomized to the computer therapy arm were able to complete the therapy with the recommended frequency. The change in naming ability between groups from baseline to 5 month follow up was 19.8% (95% CI, 4.4 - 35.2; P=0.014), with the treatment group demonstrating a greater improvement in naming ability. The effect was greater in favour of the computer therapy treatment group by 23.2% (95% CI, 7.9%-41.3%; p=0.006). There was no significant between group difference in

		percentage change in naming ability at 8-month follow-up.

Discussion

Overall, the results of studies examining computer-based intervention are positive. In 3 studies, improvements are reported on assessments undertaken not only at the impairment level, but also at the level of functional communication (Aftonomos et al. 1999; Manheim et al. 2009; Petheram 1996). Four of the studies in the above table were randomized controlled studies examining the effectiveness of a specific computer-based intervention. All four of these also reported positive results, although only the reading intervention (Katz & Wertz 1997) was able to demonstrate any generalization of effect. Cueing treatment provided by use of the Multicue program did not appear to have an effect on every day, verbal communication (Doesborgh et al., 2004).

Palmer et al. (2012) investigated the feasibility of self-managed computer treatment for individuals with chronic aphasia following stroke. Over 75% of individuals were offered the therapy using a trained volunteer as a support (as per protocol). Volunteer support was unavailable for the remaining treatment group participants. Of those who received volunteer support, 66.7% completed the study intervention with the recommended frequency, while 25% of individuals who had no available support were able to complete the program as recommended. Furthermore, a mean of 75% of computer therapy time completed was independent practice indicating the ability of participants to use the program autonomously. This demonstrates that the use of a self-managed computer treatment program with volunteer support is a feasible way of providing intervention for people with aphasia after stroke.

While all of the studies reported a generally positive effect, none established which element of the therapeutic intervention might be responsible for the demonstrated improvements (Wallesch & Johannsenâ€•Horbach, 2004). Whether improvements are attributable to the use of the computer, the opportunity to augment therapy intensity through additional practice opportunities or other concurrent activities is not known. This is particularly true of studies such as Aftonomos et al. (1999) in which patients took part in a comprehensive community-based program that used the Lingraphica computer system. Further study, especially at the level of randomized controlled trial, is indicated.

Conclusions Regarding Computer-Based Treatment of Aphasia

There were 4 RCTs identified; one of fair and three of good quality. Based on the results of these studies, there is strong evidence (Level 1a) that computer-based interventions can improve language skills assessed at the impairment level. There is limited (Level 2) evidence that improvements made via computer-based intervention generalize to functional communication.

> *Computer-based aphasia therapy results in improved language skills and may improve functional communication.*

14.3.5.1 Telerehabilitation and Speech and Language Therapy

Although increased intensity of speech language therapy (SLT) has been associated with improved outcome, delivery of such services may be complicated by issues of increased demand, available resources and equitable access to services. While "in-person" services are the gold standard of care, other options for service delivery should be considered. One such option is telerehabilitation or telecare, in which services are provided at a distance. Online platforms such as video-conferencing or interactive

computer-based programs may be used to assess, deliver interventions and monitor function in a timely fashion (Theodoros et al. 2008).

Two previous reviews have identified a number of studies examining the use of telerehabilitation for the provision of communication services in a variety of populations including stroke (Hill & Theodoros 2002; Reynolds et al. 2009). The majority of studies included in both of these reviews present positive findings with regard to the use of telehealth. However, in both reviews, the authors note that the research suffers from a number of significant shortcomings that need to be addressed. Studies tend to be very small of single group or case series design. Twenty-two of the 28 studies identified for inclusion by Reynolds et al. (2009) were classified as preliminary studies only (i.e. pilot studies, case studies, conference presentations). Studies tend to lack important information necessary for replication (e.g. information about characteristics of participants and about the technology and procedures employed). Outcome assessment was varied and measures used were not necessarily accompanied by appropriate reliability and validity information.

14.3.5.2 Remote Assessment

The majority of studies identified in previous reviews have examined the use of telehealth technologies for evaluation and consultation. Individual studies examining the use of telecare technology for the purposes of language assessment and/or diagnosis are summarized in Table 14.14.

Table 14.14. Telehealth and Language Assessment Post Stroke

Author, Year Country PEDro Score	Methods	Outcomes
Duffy et al. (1997) USA No Score	This study compared the results of remote vs. face-to-face assessments. Remote assessments were performed via i) satellite (n=8, 2 stroke patients), ii) videotaped samples (n=24); iii) teleconferencing at the Mayo Clinic (n=150). For satellite assessments, a clinician was available onsite to perform simultaneous observation. Videotaped samples were sent to the "on-satellite" clinician for diagnosis. Previous reports of teleconferenced assessment were reviewed. In addition to history and recording of symptoms, the range of assessments performed included oral mechanism and motor speech examination in addition to language assessments (simple & complex commands, picture identification & naming, sentence repetition, word definition, proverb explanation, storytelling, oral spelling, reading aloud and verbal comprehension). Time for examination, counselling and discussion with patient/caregiver was 20 – 45 minutes	For the n=8 satellite group, there were no disagreements between observer and remote pathologist. For previously videotaped samples, agreement between the face-to-face and satellite observer was 96%. Review of the Mayo teleconferencing sessions revealed a broad range of speech pathology diagnoses made using these techniques. Only 13% of the sample yielded an uncertain diagnosis and a face-to-face assessment was required in only 4% of the cases reviewed.
Lemaire et al. (2001) Canada No Score	47 remote rehabilitation consultations (for communication disorders, foot care, gait problems, orthotics, prosthetics, arm weakness and wheelchair prescriptions) were conducted over a 21-month period. Videoconferencing systems (computer, video-capture card, desktop conferencing software, video-capture and editing software, speaker phone, camcorder & tripod) were provided by each community site by the rehabilitation centre. Satisfaction questionnaires were	Mean reported consultation time was 42 minutes. The majority of offline time was spent in video recording and capture. System failures occurred in 9 cases. Remote clinicians tended to report greater satisfaction than specialists, perhaps because these consultations provided access to specialised services not otherwise available to them. Overall, more 80% of responses related to ease of use, understanding

	completed by clients, remote clinician and rehabilitation specialists.	and overall satisfaction supported the use of teleconferencing. A majority of clients reported being comfortable with the use of teleconferencing and were confident in the result.
Georgeadis et al. (2004) USA No Score	40 patients with recent traumatic brain injury (TBI) or stroke (n=28) were tested in both face-to-face and teleconference settings. The order of assessment was randomised for each patient. The Story Retell Procedures was used for assessment employing two randomly selected story sets (3 stories each). In SRP, the participant listens to a digitised, pre-recorded story that is accompanied by black and white line-drawings as illustration. The participant is then shown all drawings simultaneously and must retell the story in his/her own words. The Percent Information unit metric was used to evaluate performance and compare results across testing conditions.	A random sample of 12 stories was used to examine inter-rater reliability. Inter-rater agreement for these 12 stories was 92.8%. Overall, performance in the teleconference setting was somewhat better than in the face-face setting, although there were no significant differences in performance across settings (p=0.495). Correlation between performances across settings was high (r=0.92). Individuals with TBI tended toward worse performance in the teleconference setting (p=0.2) while individuals with right CVA did better (p=0.06). A participant exit survey revealed high levels of acceptance for teleconferencing for individuals with stroke but not TBI (p<0.001).
Brennan et al. (2004) USA No Score	As for Georgeadis et al. (2004), n=44. Authors also examined the effect of age, education, technology experience and gender on variations in performance between settings.	There was no significant difference in storytelling performance between settings (p=0.49). None of the descriptive variables were significantly associated with differences in performance between settings, although there was a non-significant trend identified such that youngest age group (18-35) tended to perform best in face to face assessment while the oldest patients (53-70) performed best in the telerehabilitation setting. This may have been, in part, explained by the fact that younger patients were primarily TBI patients who may not perform as well in teleconference settings vs. individuals with stroke (Georgeadis et al. 2004).
Palsbo (2007) USA No Score	24 individuals with previous stroke (time since event = 2-15 years) were assessed at two 2 sites by 2 pairs of speech language pathologists. At each site, patients were randomly assigned to i) assessment by the face-to-face SLP or ii) assessment by the remote SLP (note that while the patient sat in front of the videoconferencing equipment he/she was scored by both a remote and face-to-face SLP). Assessment included administration of a subset of the Boston Diagnostic Aphasia Examination (BDAE) selected according to the National Outcomes Measurement system (functional communication measures).	For face-to-face administration of the BDAE, % of exact agreement ranged from 50% (speech expression and comprehension) – 67% (motor speech). In the remote administration setting, agreement ranged from 8% (speech comprehension) – 25% (speech expression and motor speech). The authors examined % agreement within one point which yielded 92% agreement in face-to-face examinations and 92 – 100% agreement for remote examinations.
Theodoros et al. (2008) Australia No Score	32 individuals with aphasia following stroke or TBI were assessed simultaneously in either a remote-led or face-to-face led environment (i.e. individuals in a remote-led assessment were scored simultaneously by an SLP making silent in-person observations and individuals in a face-to-face led condition were scored simultaneously	There were no significant differences in ratings obtained in remote vs. face-to-face assessment. Agreement between face-to-face and remote raters was reported to be moderate to very good – 75% of subtests and rating scales achieved very good agreement (k=0.81-1.0).

	by a remote observer). Patients were randomly assigned to either remote-led or face-to-face led assessments. Assessors were blind to the type and severity of aphasia previously diagnosed for each participant. Remote assessments or observations were conducted using an internet-based videoconferencing system (bandwidth 128 kbits/sec). Assessments consisted of a short form of the BDAE-3 and Boston Naming Test (BNT). In addition 15 patients assigned to remote assessment completed a satisfaction questionnaire.	90.5% exact agreement was recorded for diagnosis. Six types of aphasia were identified in the participant sample. Of the individuals assigned to remote assessment who completed a satisfaction questionnaire, 100% reported that they were at least satisfied with the service. 80% rated the audio and visual quality as good or excellent. 93% reported feeling comfortable and confident with the assessment process.
Hill et al. (2009) Australia No Score	As for Theodoros et al. 2007. In addition, patients were grouped according to severity level as rated by the SLPs in order to determine the effect of severity on telerehabilitation assessment. Three levels of aphasia severity were identified (mild, moderate and severe). Mild and moderate groups each contained 10 participants and the severe group contained 12 participants. All analyses were conducted using these levels of severity.	Percentage levels of agreement were highest in individuals with mild deficits. When a Kruska-Wallis test was applied to BDAE-3 subtest clusters, there was no significant difference between levels of severity for the majority of subtests. However, significant differences were identified for naming and paraphasia suggesting that severity of aphasia may affect assessment of these two areas in the telerehabilitation environment. However, good strength of agreement was still obtained between remote and face-to-face assessment in these two areas. Level of severity had no significant effect on level of satisfaction with remote assessment.

Discussion

Overall, results from the studies summarized here are positive reporting good agreement between remote and face-to-face assessment. All report good agreement between the results of remote and face-to-face assessment. Studies providing information specific to individuals with stroke suggest that remote assessment is both reliable and feasible (Brennan et al. 2004; Georgeadis et al. 2004; Palsbo 2007; Theodoros et al. 2008). When compared to individuals with traumatic brain injury, those with stroke appear to perform better in teleconference settings (Georgeadis et al. 2004).

While some authors have suggested that remote evaluation may not be suited for individuals with more severe communication deficits, Hill et al. (2009) reported that, while assessment may be more difficult or "laborious" given more severe deficits, the reliability of the assessment is not significantly affected by the severity of impairment.

14.3.5.3 Remote Intervention

Most studies of telerehabilitation interventions for speech and language therapy following stroke are case studies or very small, preliminary reports. Individual studies identified for inclusion in the present review are summarized in Table 14.15.

Table 14.15. Telerehabilitation for Speech and Language Intervention

Author, Year Country PEDro Score	Methods	Outcomes
Mortley et al. (2003) UK No Score	Case series to examine the feasibility of delivering and monitoring computer-based therapy with no face-to-face intervention. Seven patients with aphasia, at least 12 months post stroke, received computer-based	Total number of hours spent doing computer-based language exercises ranged from 20 – 67. Median number of hours spent per month per person = 7. A median of 39 exercises were

	language therapy over a period of 6 months. All therapy was conducted using a computer (PC) in the patients' own home. On a monthly basis, the therapist conducted a remote session (transferring completed computer exercises from the patient to the therapists' computer, evaluation and telephone conference to discuss progress, difficulties and modification to the program of exercises). A second appointment was set to download new exercises from the therapies to the patients. INTACT software was used as the source for therapy exercises; PC anywhere was used as the communications platform. Number of exercises, attempts, total time spent, number of successful and failed remote sessions and reasons for failure were all used as evaluative measures.	assigned per person and number of attempts per exercise ranged from 5 – 40. 6 remote updates per person were planned. One individual received all updates successfully – in all other cases there was at least one technological failure.
Mortley et al. (2004b)a Mortley et al. (2004a)b UK No Score	Case series of 7 patients (ABA design, where A represents no-treatment) with previous stroke (at least 2 years post onset). Initial assessments were conducted face-to-face in order to evaluate deficits and plan therapy. A home visit was conducted to install software (or computer if needed) with the first set of exercises for independent practice. Patients were instructed to use the system as much as they would like. The system allowed patients to access results and monitor their own progress. When ready, they could forward results to the therapist via the Internet who would review the results and provide feedback via telephone. The therapist would analyse results and select new exercises which were then transferred onto the secure website by an agreed upon time when they would be available for the patient to download. The treatment cycle continued for 3 months, followed by a single face-to-face assessment, then continued for another 3 months. Assessments were conducted at weeks 1 (baseline 1), 7 (baseline 2), 36 and 42. Assessments included naming performance on the Object and Action Naming Battery and the Sentence Comprehension Assessment (used as a control task). Assessments of word picture naming (PALPA 47, 48), oral reading, and patterns of response in word retrieval were used to create a profile for each participant.	Group mean for total number of hours' practice was 74 hours, 20 minutes (12 hours, 23 minutes per month and 2 hours 45 minutes per week). Number of exercises ranged from 16-70 and attempts per exercise from 6 – 44 reflecting the individualised nature of the program. Remote sessions with the therapist lasted approximately 2 hours (downloading patient results, telephoning the patient to discuss progress, analysing results and picking and configuring new exercises and putting these on the secure server). Number of remote therapy sessions ranged from 3 – 6 over the 27 weeks of therapy. All patients were able to participate (carry out exercises, forward results and download exercises) independently. Language performance was stable between baseline 1 & 2. All patients demonstrated significant improvement in object naming between baseline 2 and end of therapy. Mid-term assessments demonstrated generalisation to untreated items for 3 of 7 participants. 6 patients participated in interviews. All perceived participation as a positive experience. All reported perceived improvement in functional communication.

Discussion

Given that initial efforts were frustrated by cumbersome technological issues, particularly around the length and complexity of data transfer (Mortley et al. 2003), new software incorporating improved interfaces and automated data transfer procedures using a secured internet site was developed and tested (Mortley et al. 2004b). In this study, therapy was tailored to each patient by selecting a range of exercises from the software library suited to individual levels of impairment and stated language goals. In addition, exercises could be further configured to match patient ability and stage of therapy and personally relevant vocabulary such as names of family or important places could be embedded in the selected tasks.

Use of the remotely administered and monitored program of computer-based therapy for naming deficits as described by Mortley et al. (2004b) was associated with significant gains in naming performance over time. In addition, all patients were able to use the system effectively, even those with moderate to severe impairments. In an associated qualitative study (Mortley et al. 2003), participants reported positive responses to this type of therapy. They derived a greater sense of control and felt that they practised more intensely than in therapies experienced previously. Patients attributed improvements in naming to the intensity of practice. In addition, they felt more confident and had greater self-esteem which they felt contributed to perceived improvement in functional communication (Mortley et al. 2003). Further study regarding the use of telerehabilitation for the provision of speech and language therapy is required.

Conclusions Regarding Telerehabilitation

There is limited (Level 2) evidence that the use of teleconferencing for remote assessment is comparable to face-to-face assessment in individuals with aphasia following stroke.

There is an absence of evidence regarding the use of telerehabilitation for speech and language therapy. Preliminary case series have reported positive results for a program of naming therapy.

> *Remote assessment of language following stroke provides reliable results comparable to face-to-face assessment.*

> *There is insufficient evidence regarding the application of remotely administered and monitored language therapy.*

14.3.6 Filmed Language Instruction
The use of a prepared program of filmed language instruction has been assessed in a single RCT (Table 14.16).

Table 14.16. The Impact of Filmed Language Instruction

Author, Year Country PEDro Score	Methods	Outcomes
Di Carlo (1980) USA 4 (RCT)	14 aphasic patients were randomized to receive traditional speech therapy (ST) or to the experimental group receiving ST with a systematic filmed program instruction. The control group engaged in viewing slides and other nonprogrammed activity. Patients were tested on reading recognition, reading comprehension, figure background, visual learning, visual closure and vocabulary.	No significant differences were observed between groups.

Conclusion Regarding Filmed Language Instruction

There is moderate (Level 1b; 1 RCT, n=14) evidence that supplementary-filmed programmed language instructions did not provide a benefit in aphasic patients.

> *Supplementary-filmed programmed language instruction does not provide a benefit in aphasic patients.*

14.3.7 Music Based Therapies

Music and music based therapies in the rehabilitation of speech disorders, such as aphasia, have been used for over a century. This form of therapy has not been extensively studied in randomized controlled trials, however, it shows promise as a potentially effective treatment for this condition. Music and speech are thought to have shared neural pathways (Tomanino 2012). Singing also reduces the rate at which words are articulated and, as such, dependence on the left hemisphere is reduced (Marchina 2010). Similarly, lengthening of syllables provides the ability to distinguish phonemes as well as allows the stringing of words to enhance fluency (Marchina 2010). Furthermore, rhythmic tapping that is often associated with music based therapy may engage the right hemisphere sensorimotor network, providing an impulse for verbal production and encourage auditory-motor coupling (Marchina 2010).

There are a number of music based therapies that may be used when treating aphasia. The most prominent is Melodic Intonation Therapy (MIT). This therapy encompasses the two main components of music based therapy: melodic intonation (singing) and rhythmic tapping while words, and eventually phrases, are repeated (Marchina 2010). Other approaches to this type of therapy involve other musical elements such as melody, rhythm, dynamics, tempo, and meter (Hurkmans 2012). These components of music may be provided as therapies encompassing the singing of familiar songs, musically assisted speech, dynamically cued singing, rhythmic speech cueing, or oral motor exercises (Tomanino 2012).

Table 14.17 Music Based Therapy for Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Conklyn et. al. (2012) USA 5(RCT)	In a pre-post-test design, 30 participants (n=16 treatment, n=14 controls) were randomized to receive either Modified Melodic Intonation Therapy (MMIT) or a control situation. Both consisted of a 10-15 minute session with a music therapist, however, the treatment group involved the therapist teaching the participant a melodic phrase, and the control group consisted of the therapist discussing the participants impairment, treatment approaches and outcomes. Participants in both groups underwent two treatment sessions. Outcomes were assessed using a study specific measure modeled from the Western Aphasia Battery.	After the first visit, a significant difference between groups was observed for the adjusted total score (difference = 6.4, p=0.02) in favour of the treatment group. The treatment group also demonstrated a significant difference in scores in responsiveness between visits 1 and 2 (p=0.01), whereas this improvement was not observed in the control group.
Lim et. al. (2013) Korea No score	A total of 21 participants from two different hospitals participated in the study. Therapy received was determined by hospital setting. 12 participants from hospital one received neurogenic music therapy intervention (NMT) (therapeutic singing and rhythmic left hand slapping), and 9 participants from hospital two received language oriented treatment. Participants were divided into 'subacute' (stroke <180 days) and 'chronic' (stroke >180 days) subgroups for analysis purposes. The Western Aphasia Battery was used to assess changes in aphasia symptoms	No significant differences were observed between groups before and or during the treatment period. Within group comparisons demonstrated significant improvements before and after treatment in the Neurogenic Music Therapy chronic subgroup on the WAB-AQ, spontaneous speaking, repetition, and naming (all p<0.05). NMT subacute group demonstrated significant improvements on the WAB-AQ, spontaneous speaking, understanding, and naming. In the language oriented speech therapy group, the chronic subgroup demonstrated improvements in repetition; however, no significant improvements

		were seen in the subacute group.

Discussion

Music therapy for the treatment of aphasia has shown some promise in one RCT. Although there are a number of studies looking at the effect of this treatment, many have small sample sizes or are case based, and are of low methodological quality. Furthermore, the mechanism by which music and melodic intonation therapy effects improvements in aphasia symptoms is not well understood.

Conclusion Regarding Music Based Therapies

There is moderate (Level 1b; 1 RCT) evidence that Modified Music Intonation Therapy may have some ability to improve the recovery of nonfluent aphasia

> *Music Intonation Therapy may have possible benefits in the treatment of nonfluent aphasia*

14.3.8 Constraint Induced Therapy (CI) for Aphasia

Forced use paradigms are popular for subsets of stroke patients in an effort to encourage increasing use of non-functional limbs, especially the upper extremity. The use of this paradigm has now been extended to the treatment of aphasia with a form of CI therapy that was developed for treatment of linguistic functioning. Chronic aphasic patients use communication channels that are most accessible to them and which require the least amount of effort such as drawing and gesturing, or use only those communicative utterances they know they can produce with ease. Constraint induced aphasia therapy is based on three principles: (1) use of intensive practice for short time intervals is preferred over long-term, less-frequent training (intensive practice); (2) constraints are used that force the patient to perform action that (s)he normally avoids (constraint induction); (3) that the therapy focuses on actions relevant in everyday life (behavioural relevance).

Individual studies of constraint-induced language therapy for aphasia following stroke are summarised in Table 14.17.

Table 14.18 Constraint Induced Therapy for Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Pulvermuller et al. (2001) UK, Germany 6 (RCT)	17 patients with language impairment due to a single stroke affecting the left middle cerebral artery with no severe perceptual or cognitive deficits were randomized to either treatment or control groups. Patients in the treatment group received CI therapy for 3 hours/day for two weeks. The control group received conventional therapy for 3 hours/day for 4 weeks.	Patients in the CI group demonstrated significant improvement on 3 of the 4 components of Aachen Aphasia Test scores while patients in the control group did not demonstrated significant improvement. Patients in the CI group had significantly higher Communicative Activity Log scores of communication of everyday life compared to patients in the control group.
Meinzer et al. (2004) Germany No score	28 patients with chronic aphasia (>12 months post onset following stroke) participated in intensive speech and language therapy – 3 hours/day for 2 weeks. Training techniques included intense use of language together with restraint of non-verbal methods of communication.	Performance increased on the Aachen Aphasia Test (AAT)(p<0.0001) and TokenTest (p<0.0001). Decreased delta activity was demonstrated 16 patients & increased left hemisphere activity was demonstrated in 12 after training – this

		increase covaried with time since stroke. Magnitude of change was greater in patients demonstrating significant improvements on the AAT.
Meinzer et al. (2005) Germany No Score	27 patients with chronic aphasia were assigned to receive either constraint induced therapy (CIAT, n=12) or constraint induced therapy "plus" (CIATplus, n=15). CIAT consisted of 30 hours of training over 2 weeks. This included communicative language games/tasks of increasing difficulty. Tasks took place in a group learning format with screens placed between players to limit nonverbal communication. CIATplus participants CIAT plus a written language component (task sessions) and individualized instructions for communication exercises in the home involving family and friends. Assessments included the Aachen Aphasia Test, the Communicative Effectiveness Index and the Communicative Activity Log.	Participants in both training groups demonstrated significant improvements on the AAT and all subtests (p<0.0001 & p<0.001 respectively) when baseline scores were compared with post-training scores. Groups did not differ on any test score either before or after training. Scores at 6 months continued to demonstrate significant improvement over baseline in both groups (p<0.001). Communication effectiveness, assessed by patient relatives, was significantly improved for both groups. Relatives of patients in the CIATplus group reported further improvements at the 6-month follow-up. Patients and relatives in both groups reported an increase in the amount of communication following training though relatives of patients in the CIATplus group noticed a more pronounced increased in communication (p<0.01). Relatives of both groups reported significant increases in comprehension. Increases in communication and comprehension tended to be greater and more persistent in patients receiving CIATplus training.
Maher et al. (2006) USA No Score	11 patients were assigned to receive either constraint-induced language therapy (CILT) or PACE (promoting aphasic communicative effectiveness) therapy. Both groups received 3-hour sessions, four days/week for 2 weeks. Therapy was conducted in with patients in groups of 2 or 3 with 2 SLPs per group. Therapy tasks and intensity was consistent over groups. PACE participants were encouraged to communicate using any or all modalities available to them (gesturing, writing etc.) whereas CILT participants were restricting to verbal production only. Assessments, conducted at baseline, post-intervention and at one month, included the Western Aphasia Battery (AQ), Boston Naming Test (BNT), Action naming Test (ANT), Apraxia Battery for adults-2 (ABA), and linguistic analysis of a narrative discourse sample (cinderella story re-telling).	There were no significant between group differences for age, AQ, BNT or ANT at baseline. There was a higher incidence of severe apraxia of speech impairment in the PACE group. Both groups demonstrated significant change on the WAB AQ over the course of therapy (p=0.004). There were no significant group or groupXtime interactions. Similarly, there was significant change over time demonstrated by both groups on the BNT and ANT tests, but there were no significant between group differences on these measures. Linguistic analyses revealed increases in number of words, utterances and sentences produced following treatment in both groups. However, subjective analysis revealed qualitative differences in favour of the CILT group in that the majority of raters preferred narrative samples produced by participants who had received CILT.
Meinzer et al. (2007b) Germany 5 (RCT)	Twenty individuals with chronic aphasia were placed in groups according to severity of aphasia. Groups also included relatives of patients who agreed to participate. Groups were randomly assigned to receive either CIAT delivered by a psychologist or by a trained layperson (participating relative). Relatives were trained as	All patients completed the program of CIAT and received the same number of treatment sessions. There was significant improvement in the AAT profile scores in both treatment groups over time. In addition, patients in both groups improved significantly on all subtests of the AAT.

	layperson trainers by attending a 2-hour introductory session that included materials, procedures, approaches and information regarding adjustment of task difficulty. In addition, training sessions were offered for the layperson trainers at the end of each daily session. All participant groups received CIAT training for 3 hours per day for 10 consecutive working days. Language functions were assessed before and after treatment using the Aachen Aphasia Test (AAT) which includes 5 subtests (token test, repetition, written language, naming and comprehension).	Group X time analysis did not demonstrate significant between group differences for either the profile scores or the AAT subtests.
Szaflarski et al. (2008) USA No Score	3 male patients with moderate to severe aphasia post stroke received a modified (hierarchical task arrangement) 1-week program of group CIAT. Four sessions (45 minutes) were provided per day for 5 days with 10 – 15 minute breaks in between to provide an additional 30 – 45 minutes of socialization. 2 – 3 clinicians were involved in the treatment group during all sessions. Clinicians set language goals for each patient based on pre-treatment evaluation and informed the patient of his language target specific to his individual program. Formal assessment included BDAE-3 subtests for comprehension and verbal expression and the mini-communicative activity log (CAL).	All participants demonstrated improvement on at least one assessment. Two out of 3 patients demonstrated notable improvements on comprehension and verbal skills. No subjective improvements were noted on the CAL.

Discussion

Overall, studies of CIAT appear to yield positive results. A single, small RCT has reported that the use of constraint-induced aphasia therapy is associated with improved language outcomes at the levels of both impairment and function when compared to conventional therapy. In a second small RCT, Meinzer et al. (2007a) demonstrated that CIAT may be provided in a group setting led by trained laypersons with similar results to professional-led CIAT. In addition, gains made via constraint-induced therapy may be similar to those seen with other therapies such as PACE and may be sustained for some time past the end of treatment (Maher et al. 2006; Meinzer et al. 2005).

A recent review identified 5 primary studies examining the effectiveness of constraint-induced therapy applied to the rehabilitation of aphasia (Balardin & Miotto 2009). The authors noted that while the studies reported improvements associated with constraint-induced therapy, available evidence is insufficient. Only 2 randomised controlled trials have been conducted and only one examined the effectiveness of CIAT vs. standard therapy. Recommendations in favour of CIAT should be treated as guidelines for future research (Balardin & Miotto 2009).

Conclusions Regarding Constraint-Induced Aphasia Therapy

There is moderate (Level 1b) evidence, based on one "good" RCT (PEDro = 6), that forced-use aphasia therapy results in greater language performance in chronic aphasics over a short period of time.

Based on a single small RCT of fair quality, there is moderate (Level 1b) that CIAT administered by trained laypersons is as effective as CIAT administered by professionals.

There is limited (Level 2) evidence that improvements in language function are similar following CIAT, CIATplus and PACE therapies.

> *Constraint-induced aphasia therapy may result in improved language function and everyday communication in individuals with chronic aphasia.*

14.3.9 Repetitive Transcranial Magnetic Stimulation (rTMS)

Transcranial magnetic stimulation is a non-invasive procedure that uses a rapidly fluctuating magnetic field to "create electrical currents in discrete areas of the brain" (Martin et al. 2004). Multiple stimuli can be used to increase or decrease the excitability of the affected cortex, temporarily.

In stroke patients with nonfluent aphasia, functional MRI studies have revealed unusually high levels of right-sided cortical activation during language tasks (Martin et al. 2004; Naeser et al. 2004; Naeser et al. 2005a; Rosen et al. 2000). While the potential importance of activation of the right frontal cortex in language recovery cannot be dismissed (Rosen et al. 2000), it has also been suggested that this unusually high level of activation is not necessarily associated with improved language performance, but rather may be a maladaptive strategy that hinders aphasia recovery in non-fluent patients (Martin et al. 2004; Naeser et al. 2004; Naeser et al. 2005b; Rosen et al. 2000). Recent studies have examined the effectiveness of the application of slow rTMS to reduce excitability in right-sided Broca's homologue in improving naming function in patients with nonfluent aphasia.

Table 14.19 Repetitive Transcranial Magnetic Stimulation for Treatment of Nonfluent Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Martin et al. (2004) International No Score	Phase 1: Slow, 1Hz rTMS was applied for 10 minutes to 4 R perisylvian language homologues in separate treatment sessions with 6 chronic stroke patients (1 – 30 years post left hemisphere stroke). Immediately following each session, naming ability was tested using a list of 20 Snodgrass and Vanderwart pictures. 5 test lists were generated each with the same level of difficulty. Phase 1 was intended to identify which region was associated with the best response following stimulation. Phase 2: 4 chronic aphasia patients received slow, 1 Hz rTMS for 20 minutes 5 days per week for 2 weeks to the area identified as having the best response in phase one of the trial. Language testing included the first 20 items of the Boston Naming Test and naming subtests of the Boston Diagnostic Aphasia Exam. Testing was conducted prior to treatment, at the end of treatment and at 2 months.	In Phase 1, application of rTMS to the posterior gyral portion of the pars triangularis portion of R Broca's homologue (R BA 45) was associated with the best response. Five of six patients demonstrated significant improvement in naming when post-treatment scores were compared to baseline. Naming scores associated with stimulation of this area were significantly greater than those associated with stimulation of any of the other areas tested. Phase 2: Stimulation of R BA 45 was associated with significant improvement on the Boston Naming Test (p=0.003) and on naming subtests of the Boston Diagnostic Aphasia Exam (12 tools/implements p=0.035 & 12 animals, p=0.015) at 2 months following treatment. No negative side effects or complications were observed during or after treatment sessions.
Naeser et al. (2005b)(a) International No Score	4 stroke patients with chronic, nonfluent aphasia were treated with 1 Hz rTMS for 20 minutes each day, 5 days a week for 2 weeks (10 treatments in total) applied to the anterior part of R Broca's homologue (pars triangularis). 1 – 2 weeks prior to treatment patients were assessed using the first 20 items of the Boston Naming Test, subtests of the Boston Diagnostic Aphasia Exam (BDAE) and naming lists generated from the standardized set of Snodgrass and Vanderwart. Naming reaction time was also assessed using the Snodgrass	Immediately following treatment, there was significant improvement on number of pictures named (p=0.028) and reaction time (p=0.04) on the Snodgrass and Vanderwart lists. At 2 weeks following treatment, patients showed significant improvement on the BDAE animal naming subtest (p=0.02). At 2 months, there was significant improvement on the Boston naming test (p=0.003), the Animal Naming subtest of the BDAE (p=0.02) and the Tools/Implements

	and Vanderwart lists. Patients were assessed again at 2 weeks, 2 months and 8 months post treatment.	naming subtest of the BDAE (p=0.04). At 8 months, scores continued to improve relative to baseline, but only the Tools/Implements subtests were significant (p-0.003). Improvements were also noted in number of words per phrase used in the cookie theft picture subtest of the BDAE at 2 months, though these were not sustained. No patients experienced negative side effects.
Barwood et al. (2011a)(a) Australia 8 (RCT)	12 stroke patients with chronic aphasia were randomized receive either treatment with 1 Hz rTMS for 20 minutes a day for 2 weeks or a placebo treatment (rTMS using a sham coil). Behavioural language function was measured using the Boston Naming Test (BNT) and subtests of the Boston Diagnostic Aphasia Examination (BDAE). Lexical-semantic function was measured using a picture naming technique. Assessments were performed at baseline and 1-week post treatment. Results of repeat assessments undertaken at 2 months post-stimulation are reported in Barwood et al. (2010).	The treatment group performed significantly better than the control group on the following subtests: BDAE naming actions, BDAE naming tools and instruments, BDAE repetition of sentences, Cookie Theft picture description complexity index, Cookie Theft picture description longest words per phrase, Commands, and the overall BDAE score from the subtests used in the study (p<0.05 for all but the Cookie Theft picture description longest words per phrase which had a p<0.01). Patients from the treatment group also performed significantly better on the BNT (p<0.05) and in the latency (p<0.01) and accuracy (p<0.05) portions of the Picture Naming assessment.
Barwood et al. (2011b) (b) Australia (f/u study)	Results of repeat assessments (n=12) at 2-months post-stimulation (see Barwood et al. 2011, above).	The treatment group scored significantly higher on the following tests: BDAE naming actions (p<0.01), BDAE naming tools and instruments (p<0.05), BDAE repetition of sentences (p<0.05), Cookie Theft picture description complexity index (p<0.05), Cookie Theft picture description longest words per phrase (p<0.01), Commands (p<0.05), and the overall BDAE score from the subtests used in the study p<0.01), the BNT (p<0.05) and in the latency (p<0.05) and accuracy (p<0.05) portions of the Picture Naming assessment.
Szaflarski et al. (2011) USA No Score	8 patients that experienced a left middle cerebral artery stroke with moderate to severe aphasia underwent treatment of rTMS using fMRI. The rTMS was localized to the left-hemisphere Broca's area and was applied for 200 seconds during 10 daily treatments using a procedure called intermittent theta burst stimulation (iTBS). A battery of tests were used to determine change (Boston Naming Test (BNT), the Controlled Oral Word Association Test (COWAT), the Semantic Fluency Test (SFT), the Complex Ideation Subtest from the Boston Diagnostic Aphasia Examination (BDAE), the Peabody Vocabulary Test IV (PPVT IV), and a mini-Communicative Abilities Log (CAL)). Assessments were performed within a week of initiating treatment and within a week of completing treatment.	Significant improvements were observed in semantic fluency (p=0.028) and a trend towards significant improvement was seen on the CAL (p=0.075). All other tests showed no significant difference from pre-treatment measures.
Weiduschat et al. (2011) Germany	A total of 10 stroke patients were randomly assigned to a treatment (n=6) or a control (n=4) group. The treatment group received 1 Hz rTMS over the right-	It was found that, in the treatment group, the LI shifted significantly more to the left than the LI of the control group (p=0.008) suggesting

8 (RCT)	hemispheric Broca homologue while control patients received 1 Hz rTMS over the vertex. All rTMS stimulations occurred 5 days a week for 2 weeks and were followed by 45 minutes of speech and language therapy. All patients received model-oriented aphasia therapy. Outcome measures were assessed at baseline and directly following the 2 week treatment. Measures were the change in laterality indices (LI) (determined by activation positron emission tomography) and the Aachen Aphasia Test (AAT).	suppression of an inferior adaptive strategy used for aphasia patients. Over time, individuals in the treatment group demonstrated significant improvement in total AAT scores (p=0.002), while the control group did not (p=ns). Significant changes in naming function were seen only in the group receiving rTMS.
Waldowski et. al. (2012) Poland 8 (RCT)	26 participants with a confirmed stroke and resulting aphasia were randomized to receive either real inhibiting rTMS or sham rTMS 5 days a week for 3 weeks. Both groups also received 45 minutes of speech/ language therapy immediately following rTMS treatment/sham. Naming assessments were completed at baseline, immediately following treatment, and at 15 week follow up using the Computerized Picture Naming Test (CPNT)	Both treatment and control groups improved significantly on naming ability during the treatment period, however, there were no significant differences observed between group at any time point. The experimental groups demonstrated slightly better reaction times immediately following rTMS (Bonferroni corrected p=0.048), however, this difference was not maintained at 15 week follow up
Kindler et. al. (2012) Switzerland 5 (RCT)	18 participants with aphasia following first ever stoke were included. Patients were randomized to receive either a Theta Burst Stimulation (TBS) application of rTMS (30Hz pulses x 267 bursts) which took approximately 44 seconds or a sham condition. Participants underwent 2 sessions separated by a 1 week period. A Timed Picture Naming Task and an alertness test (from the Test of Attentional Performance) were administered both before and immediately following treatment.	Significant differences were observed between groups on naming scores in favour of the treatment group ($F_{1,16}$= 7.72, p=0.013, r=0.57), as well as on naming latency ($F_{1,16}$= 7.56, p=0.014, r=0.56). No between group differences were found on measures of alertness
Medina et. al. (2012) USA 5(RCT)	10 participants with left hemisphere ischemic stroke (>6m post) participated. Following baseline assessment, participants were randomized to receive either real rTMS (rTMS) or sham rTMS (sTMS). In the rTMS participants, the optimal site for rTMS application was identified for each individual. Participants underwent 10 sessions over 12 days. A follow up assessment was competed 2 months following treatment and included the Cookie Theft Picture Description. The sTMS group crossed over to the rTMS group following the 2 month follow up and also received 10 sessions of treatment over 12 days.	In all participants, the rTMS treatment produced significant improvements between baseline and follow-up in discourse productivity (number of narrative words) (t_9=-2.07, p=0.035), whereas no improvement was observed in the sham condition. Due to small sample size, authors were not able to draw conclusions regarding comparisons between sham and treatment groups
Abo et. al. (2012) Japan No Score	24 participants with aphasia symptoms persisting for >1 year as a result of a stroke were included. Participants underwent 10 sessions of rTMS (1Hz, 2,400 pulses) followed by 60 minutes of intensive speech therapy. Participants were assessed using the SLTA (spontaneous speech, auditory comprehension, reading comprehension, and writing), and the Japanese version of the Western Aphasia Battery 1 week prior to admission to the study. The WAB and SLTA were also administered	All patients experienced significant long term improvements in SLTA total score and spontaneous speech sub scores (both p<0.01), as well as auditory comprehension scores (p<0.05). Significant short term improvements were observed in correct answer rates of both the SLTA (p<0.05) and WAB (p<0.01). In individuals with fluent aphasia, significant long term improvements in SLTA total score

| | 1 hour following the last intervention session, and the SLTA was re-administered 4 weeks following discharge. | (p<0.01, as well as the spontaneous speech sub score and reading comprehension sub score (both p<0.05), were found. Significant short term improvements were observed in correct answer rates on the WAB (p<0.05).

Individuals with nonfluent aphasia produced significant improvements on SLTA total score and spontaneous speech sub score only (both p<0.05). |

Discussion

Early studies demonstrated positive results with regard to naming, generalisation and duration of treatment effect (Martin et al. 2004; Naeser et al. 2005a).

In a randomised controlled trial, Barwood et al. (2011b) demonstrated significant improvement on several domains of the BDAE following rTMS treatment, including naming actions, naming tools and instruments, repetition of sentences and the Cookie Theft picture description complexity test as well as on the Boston Naming Test. A 2-month follow-up revealed similar results suggesting some durability of treatment effect (Barwood et al., 2011).

A single case study of an individual with chronic non-fluent aphasia has also examined whether the effects of rTMS may generalise to other language abilities (Hamilton et al. 2010). In that study, significant improvement in naming was reported, in addition to improvements in picture description (number of narrative words and nouns, sentence length and use of closed class words) at 2, 6 and 10 months following treatment. In addition, that individual demonstrated significant improvement in spontaneous speech as assessed on the Western Aphasia Battery. Similarly, both of the recently published RCTs, reported significant improvement in performance on comprehensive language assessment associated with treatment (Barwood et al. 2011b; Weiduschat et al. 2011)

Weiduschat et al. (2011) however, examined the effectiveness of rTMS when used in conjunction with speech language therapy (45 minutes/session following each rTMS treatment). All participants received model-oriented language therapy and all of them experienced improvement over time. Individuals assigned to receive rTMS improved to a greater extent. This may be attributed, to some extent, to a significant improvement in the naming subtest scores only for individuals who had received rTMS (p=0.03).

Conclusions Regarding Repetitive Transcranial Magnetic Stimulation

Based on the results of 3 RCTs of good quality, there is strong (Level 1a) evidence that treatment with rTMS may result in improvements in performance on comprehensive language assessment as well as on tests of naming abilities. rTMS may be a suitable treatment to use in conjunction with speech language therapy.

There is moderate (Level 1b) evidence that the effects of treatment with rTMS may be durable over a period of months.

Treatment with repetitive transcranial magnetic stimulation may have positive and durable effects on naming performance in individuals with chronic post-stroke aphasia.

14.3.10 Transcranial Direct Current Stimulation

Like transcranial magnetic stimulation, transcranial direct current stimulation (tDCS) is used to provoke changes in excitability in the brain. The polarity of the current flow determines whether excitability is increased (anodal tDCS) or decreased (cathodal tDCS) (Floel et al. 2008). In healthy adults, application of anodal tDCS over Wernicke's area has been associated with improved acquisition of novel vocabulary (Floel et al. 2008), suggesting that this technique may be useful in the rehabilitation of language.

Table 14.20 Transcranial Direct Current Stimulation (tDCS)

Author, Year Country PEDro Score	Methods	Outcomes
Monti et al. (2008) Italy No Score	8 individuals with chronic non-fluent aphasia participated in sessions of anodal, cathodal and sham tDCS over i) Broca's region or ii) occipital areas. 2 months lapsed between i and ii. tDCS of 2mA, for 10 minutes was delivered via a constant current electrical stimulator connected to 2 electrodes. Patients were assigned to an "anodal" (anodal stimulation + sham) or "cathodal" (cathodal stimulation + sham) group. Testing of active (anodal or cathodal) and sham tDCS were conducted in random order and at least one week lapsed between sessions. Picture naming was assessed both for accuracy and response time immediately before and following each session.	Neither anodal or sham tDCS over Broca's region were associated with any significant change in picture naming. Cathodal tDCS over the same area did produce significant improvement in naming accuracy. No significant changes were noted for response times. When applied over the occipital region, there were no significant effects noted for anodal or cathodal tDCS in terms of either picture naming accuracy or response time.
Baker et al. (2010) USA 8 (RCT)	10 patients with chronic aphasia (6 fluent, 4 nonfluent) received 5 consecutive days of either anodal tDCS (1mA for 20 minutes while simultaneously performing a picture-word matching task or sham tDCS (+ picture-word matching). All patients received both interventions, separated by a 7-day rest period between sessions. The order or treatment presentation was randomized. For sham tDCS, stimulation was turned off after 30 seconds give that the sensation of DCS tends to fade by this time. A computerized naming test (25 nouns used for the training task) was administered at baseline, after each 5-day treatment phase and then again 1 week following the final session. In addition 2 additional, untrained word lists were tested (1 for each stimulation type).	All patients tolerated treatment. No adverse events related to tDCS were reported. 2X2 ANOVA revealed a main effect for stimulation type ($p<0.04$) such that more trained items were named correctly following anodal tDCS than sham DCS ($p<0.04$). A post hoc 1-tailed t-test revealed a benefit associated with anodal tDCS immediately following treatment and at 1-week post treatment ($p<0.015$ & $p<0.042$, respectively). For untrained items, the corresponding analysis (stimulation X time) revealed no significant main effect ($p<0.07$). However, a *post hoc* analysis using 1-tailed t-tests revealed a significant benefit associated with anodal tDCS ($p<0.046$).
Kang et al. (2011) Korea No Score	In a crossover study, 10 Korean patients received either cathodal tDCS applied over the healthy right Broca's homologue area or a sham treatment, both alongside word retrieval training. Patients received treatment for 5 days and then given a one week rest, followed by 5 days of the other treatment. Word retrieval training occurred for 30 minutes per day. A Korean version of the Boston Naming Test (BNT) was used to assess picture naming skills 1 hour following the final session.	Following the treatment, there were no significant changes in reaction time within groups (p=NS for both groups) or between groups. A significant trend towards the tDCS group having a higher number of correct responses than the sham group was found (F=4.72, p=0.058), with both groups improving significantly over time (F=6.02, p<0.05). Treatment had no significant effect on speed of response or % of cued responses.
Marangolo et. al. (2013) Italy	Seven participants with left hemisphere stroke at least 6 months prior to study baseline were included. Participants received tDCS (1mA) therapy of anodic	A significant effect of time vs. 5th training day vs. condition was observed ($F_{2,12} = 8.88$; $p=0.004$). The mean percentage of correct responses was

No Score	simulation on Wernicke's area, anodic simulation of Broca's area, or sham simulation for 20 minute intervals. During application of tDCS, participants completed an action naming task of video clips of actions as they appeared on a computer screen. Each participant underwent a randomly chosen experimental condition in five consecutive daily sessions over three weeks with 6 days of intersession interval during which subjects underwent intensive language training. Follow up naming assessments were completed 1 week and 4 weeks following training.	significantly greater in the anodic Broca's condition than in the other two conditions (p=0.004). This was also observed at both follow up time points.

Discussion

A single small randomised crossover trial demonstrated significant benefit for naming tasks associated with multiple sessions of anodal tDCS applied over the left frontal cortex paired with a picture-word naming task (Baker et al. 2010). Some possible generalisation of benefit was noted beyond the specific naming task used for training. These results are in contrast to those reported in by Monti et al. (2008) which suggested that improvement in naming was associated cathodal tDCS applied over the left frontotemporal area. This improvement was both polarity and site specific. Baker et al. (2010) suggest that increasing and decreasing cortical excitability may not have mutually exclusive effects and, therefore, both anodal and cathodal tDCS may be of benefit.

Cathodal tDCS was also evaluated in a study by Jung et.al. and found to be effective as an adjuvant therapy to conventional speech therapy in a group of individuals with stroke (n=37) (Jung et al. 2011). Good response to therapy was demonstrated in the study population as a whole, however, sub analysis showed a greater effect in individuals with a stroke onset of less than 30 days, as well as in individuals with a lower initial aphasia severity.

No adverse events were reported by participants in either of the earlier studies and the treatment appeared both safe and well-tolerated (Baker et al. 2010; Monti et al. 2008). Further investigation is warranted.

Conclusions Regarding Transcranial Direct Current Stimulation

Based on single, small RCT, there is moderate (Level 1b) evidence that anodal tDCS applied over the left frontal cortex is associated with improved naming performance in individuals with chronic post-stroke aphasia.

Site and polarity specific tDCS may improve naming ability in chronic aphasia.

14.4 Rehabilitation of Specific Aphasic Deficits

14.4.1 Specific Treatment for Word-Retrieval Deficits

Word finding difficulty, also known as a lexical retrieval deficit, is a phenomenon whereby an individual can usually supply an accurate semantic representation of an object, but they are unable to verbally label that same object (Saito & Takeda 2001). This deficit is the main feature of anomic aphasia however it is also a common problem in other types of aphasia. In all cases, this deficit can significantly impact the patient's verbal communication.

It has been hypothesized that word-retrieval deficits stem from "an impaired access to the phonological form of the intended word" (Saito & Takeda 2001). Levelt et al. (1991)claim that lexical access involves two stages: lexical item selection, which accesses the syntactically and semantically appropriate representation of the word, and phonological encoding of the selected item, which allows for its verbal articulation. Semantic and phonological therapies are based on the theory of lexical access and are widely used for remediation of word-finding deficits in aphasia. Therapies usually employ associative learning procedures including semantic and/or phonological cueing to aid lexical access and improve word retrieval abilities. Most studies (see Table 14.16) have administered picture-naming tasks which enable the patient to make a semantic connection with the word, thus if they are to see the picture again, they may be prompted to say the word. Often if the patient fails to name the picture they are prompted by a series of cues until they are able to say the word. The cue can be either semantic, requiring the patient to focus on the meaning of the word (for example, its use in a sentence or its belonging to a certain category), or phonological, requiring the patient to understand the structure of the word (for example, its initial syllable or its proper spelling).

Table 14.21 Treatment of Word-Retrieval Deficits in Aphasia Rehabilitation

Author, Year Country PEDro Score	Methods	Outcomes
Love & Webb (1977) USA No Score	20 subjects with nonfluent aphasia and with no gross comprehension deficits participated in this study. 4 cue conditions were used to examine their effect on word retrieval: initial syllable, sentence completion, printed word and word imitation. 30 black and white pictures were used for the picture-naming task and upon failure to name a picture the cues were given in random order until a correct response was provided.	The mean percentages of successful use of cues were significantly different across the cue conditions. The study ranked the cues in order of effectiveness (from highest to lowest) according to these differences: 1) word imitation, 2) initial syllable, 3) sentence completion/printed word.
Seron et al. (1979) France No Score	8 aphasic subjects having demonstrated word-finding difficulties were included in this study. The 4 patients in the control group received traditional language therapy, while the experimental group received training with a reduced subset of lexicon. The picture-naming test and semantic classification test (picture-word matching test) were administered to all subjects both prior to and after 20 sessions (2 months) of therapy.	3 out of 4 patients in the experimental group improved significantly from pre- to posttest on naming ability while only 1 patient in the control group did. 2 patients from each group improved significantly on semantic classification ability from pre- to posttest.
Howard et al. (1985) UK No Score	12 adult neurological patients with acquired aphasia resulting in word-finding deficits participated in this study. The experimental design separated semantically- and phonologically-based treatments and each patient partook in both types with a 4-week interval between them. 6 patients completed 2 weeks of each treatment method and the other 6 completed only 1 week of each method. Half the patients received semantic followed by phonological treatment, and the other half received treatment in the opposite order. The experimental stimuli were black and white drawings from the 'Cambridge pictures' collection. 2 control conditions were included in the study: naming control pictures (presented during therapy) and baseline control pictures (presented in post-therapy tests). 80 pictures	Both the semantic and phonological treatment methods resulted in significantly improved naming accuracy.

	in total were used in therapy – these were randomly selected failures from the pretests. There were 3 different techniques used in each type of therapy to prompt the subject to either show understanding or retrieve the intended word. Before each therapy session, a pretest was administered and posttests occurred at 1 week and 6 weeks following the end of each therapy period.	
Huntley et al. (1986) USA No Score	16 aphasic patients with known word-retrieval deficits were selected for this study. 96 black and white photographs were used as the experimental stimuli. 5 cue conditions were employed: initial syllable, sentence completion, printed word, word spelled out loud, and 3 non-semantically/phonologically related words. Each subject was evaluated for photo-naming ability under a no cue (baseline measure) and simultaneous cue presentation. The photographs were randomized and matched with a specific simultaneous cue combination.	Simultaneous cueing significantly improved patient performance, with the severe aphasics displaying significantly greater improvement than the mild aphasics.
Freed & Marshall (1995) USA No Score	This study included 10 aphasic adults having suffered a single left-hemisphere stroke at least 12 months prior. 10 age-matched adults with no brain damage also participated. The experimental stimuli used were 40 photographs of dogs and birds that could not be named by any subject. Subjects were taught the names of 20 of these animals through personalized cueing while the remaining 20 photographs served as untrained control items (10 semantically related and 10 semantically unrelated). All subjects participated in the 12 training sessions that were conducted over 4 weeks. Labelling probes were given at 1 week and 30 days post-training.	The subjects without brain damage had significantly better performance than the aphasic subjects on all 3 stimulus sets (trained, untrained-related, untrained-unrelated). Analysis within each of the groups showed a nonsignificant stimulus effect, probe effect, and stimulus by probe interaction for the non-brain damaged subjects, but a significant stimulus effect for the aphasic patients. The latter suggests that the aphasic subjects were more accurate at naming the trained stimuli.
Freed et al. (1995) USA No Score	30 mildly to moderately aphasic patients having suffered a cerebrovascular accident at least 6 months prior were assigned to either a personalized-cue condition or provided-cue condition. Subjects were assigned to experimental groups according to ranked PICA overall percentile scores. The experimental stimuli used were 30 English words paired with 30 abstract, novel symbols – 20 of which were designated as cued stimuli and 10 remained noncued control items. The personalized-cue group had to create their own associations for the 20 cued stimuli, which were then transferred to the provided-cue group. The study consisted of 6 sessions in total involving a sequence of training trials and labelling probes.	Overall the differences between the 2 cueing conditions were nonsignificant; they were equally effective at prompting correct responses and they resulted in similar decreases in naming accuracy over the course of 30 days.
Saito & Takeda (2001) Japan No Score	11 mildly to moderately impaired aphasic patients with word-retrieval deficits but no comprehension problems were included in this within-subject study design. 4 different cueing conditions were investigated for their effect on target retrieval: phonological, semantically-related, semantic category	The phonological cue condition prompted significantly more correct responses than the other cue conditions. There was no significant difference in the number of correct responses received between the category member and baseline cue conditions.

	member, and baseline (no cue). 68 black and white pictures were used as experimental stimuli and 6 cues were chosen for each picture (3 for each type of semantic cue). The study continued for 3 sessions (3 days) during which each subject performed a picture-naming task and then a picture-word matching task.	
Doesborg et al. (2004b) Netherlands 8 (RCT)	55 stroke patients demonstrating semantic and phonological deficits were randomly assigned to receive either semantic treatment focused on interpretation of written words, sentences and text or to a control group treatment that focused on sound structure. Treatment started at 3 to 5 months post stroke onset and last until 10 to 12 months post-onset. Patients' received 40 to 60 hours of individual treatment.	After semantic treatment, patients significantly improved on the Semantic Association Test. Patients receiving sound structure treatment improved significantly on phonological measures. All patients significantly improved on the Amsterdam Nijmegen Everyday Language Test. However no significant differences were noted between groups. The authors' hypothesis that semantic treatment has more effect at the activities level (verbal communication) than phonological treatment was refuted.
De Jong-Hagelstein et al. (2011) The Netherlands 8 (RCT)	75 stroke patients with aphasia were randomized to receive either cognitive-linguistic treatment (CLT), consisting of a semantic treatment program (BOX) and a phonological treatment program (FIKS), or the control treatment, a communicative treatment using verbal and non-verbal strategies such as PACE, role playing and conversational coaching. Assessments were performed at baseline, 3 months, and 6 months post stroke and included the Semantic Association Test (SAT), Semantic Association with low image-ability words (PALPA), Semantic Word Fluency, Nonword repetition Task (PALPA), Auditory Lexical Decision (PALPA), Letter Fluency, Amsterdam-Nijmegen Everyday Language Test (ANELT), the Aachen Aphasia Test, and the Modified Rankin Scale. Treatment was applied 2-5 hours per week for 6 months (or until recovered) and began at least 3 weeks post-stroke.	Individuals assigned to the CLT group demonstrated significantly better scores on fluency tasks (semantic fluency at 3 months, 95% CI 0.4 to 0.6, $p<0.05$ and letter fluency at 6 months, 95% CI 0.3 to 0.6, $p<0.05$) than those in the control group. There were no other significant difference between groups on any other measures at 3 or 6 months post stroke. In addition, there was no between-group difference in proportion of patients demonstrating an improvement of ≥ 7 points on the ANELT-A.

Discussion

All of the non-RCTs found that treatment, whether semantic or phonological, resulted in an improvement in aphasic patients' word-retrieval and naming accuracy. Improvement was observed even with relatively short treatment duration (Saito & Takeda 2001) and in cases of chronic aphasia (Howard et al. 1985). Of the studies that reported significant differences between different cue conditions, it was found that phonological cues were more effective than semantic cues (Love & Webb 1977; Saito & Takeda 2001). Freed et al. (1995)observed no difference in effectiveness between a personalized cue (one that the subject creates) and a provided cue (one that the administrator gives to the subject), suggesting that the semantic meaning attached to a word need not have any personal significance in order to be effective. With all of these findings, it is important to keep in mind that these studies were quite limited in many cases by lack of control conditions and randomization and small sample sizes.

Doesborgh et al. (2004b) observed that at the impairment level, patients improved on semantic measures after semantic treatment and on phonological measures after phonological treatments. Furthermore, therapy-specific correlation between improvements on the Amsterdam Nijmegen Everyday Language Test was observed. The authors challenge the idea that equal improvement in verbal

communication is a result of spontaneous recovery. In addition, the authors note that the different effects found at the impairment level suggest that each treatment is not the result of non-specific effects such as language exercises, receiving attention, or being stimulated.

Conclusion Regarding Word-Retrieval Therapy

There is moderate (Level 1b) evidence that task-specific semantic therapy improves semantic activities and that task-specific phonological therapy improves phonologic activities.

There is moderate (Level 1b) evidence that cognitive linguistic treatment with both semantic and phonological elements may result in improvements in semantic and letter fluency.

There is limited (Level 2) evidence that phonological and semantic cueing improve naming accuracy and word retrieval abilities.

Task-specific semantic therapy and task-specific phonological therapy improves semantic and phonological language activities respectively in aphasia.
Cognitive linguistic therapy with both semantic and phonological elements may improve semantic fluency.

Phonological and semantic cueing may improve naming accuracy in aphasics with word-finding deficits.

14.4.2 Specific Treatment for Global Aphasia

Global aphasia impairs all aspects of language. Patients suffering from global aphasia experience less recovery than any other aphasia category. Language therapy for individuals with global aphasia can be costly. Moreover, efficacy of language therapy is not yet proven for this aphasia type. Specific rehabilitation for global aphasia has evolved from experience and literature and fulfils two purposes:

1. Support the capacities likely to improve with natural recovery, primarily the capacity to make categorical and associational semantic discriminations;
2. Be sufficiently easy that most severe, acute global aphasic adults could comprehend the nature and purpose of the tasks. (Alexander & Loverso 1991).

Table 14.22 Specific Rehabilitation for Global Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Alexander & Loverso (1991) No Score	6 right-handed stroke patients presenting with global aphasia (n=5) and Wernicke's aphasia (n=1) received treatment stimuli of 24 common, everyday objects, realistic pictures of those objects, and realistic pictures of the location in which those objects would unambiguously be found. Therapy was designed to support categorical and associational semantic discrimination using 8-step hierarchy. Therapy was initiated at the level of performance breakdown, in that, patients moved to the next level using a 90% accuracy criterion. Failure was defined as 5 sessions	2 patients with global aphasia completed the treatment program successfully with little evidence of generalization to untreated stimuli. The other 3 patients could not achieve success higher than level 3.

	completed with less than 60% accuracy. Treatment was provided 6 times a week for a range of 4 to 10 weeks following 3-baseline session prior to therapy. Measure of performance was the Western Aphasia Battery (WAB)	
Denes et al. (1996) Italy 4 (RCT)	17 patients with global aphasia (mean duration 2.5 – 4.5 months) were randomly assigned to receive standard or intensive language therapy. Approach to therapy in both groups was "ecological" – emphasis was on restoration of language in a conversational setting. More attention was paid to comprehension than production and production was treated in terms of engagement in conversation rather than single word production. Patients assigned to standard therapy received an average of 60 sessions over a 6-month period while intensive therapy consisted of an average of 130 sessions. All sessions were individual and lasted from 45 – 60 minutes. Assessment of outcome was performed at baseline and at 6 months using the Aachen Aphasia Test (AAT).	T-scores on subtests and at the profile level demonstrated improvement in both groups. There was a significant difference in mean T-scores between groups for the written language subtest only (p<0.05). Single-case analysis procedures demonstrated that, while patients in the intensive therapy group demonstrated a greater number of improvements considered significant on all subtests, this between group difference was statistically significant only for the written language subtest (p<0.05).

Discussion

Although patients with global aphasia may experience less complete or slower rates of recovery following stroke, they may still derive significant benefit from participation in speech and language therapy as part of a comprehensive rehabilitation program (Bakheit et al. 2007a). Denes et al. (1996) provided speech language therapy using an ecological or conversation-based approach and reported that intensive therapy (approximately 130 sessions, 45 – 60 minutes in length over 6 months) was associated with significant improvement in all language modalities. In general, more significant improvements seemed to be made in individuals receiving intensive vs. regular (3 times per week) therapy. Unfortunately, between-group comparisons were limited by small sample size (Denes et al. 1996).

Although patients with global aphasia may experience significant improvement, Alexander and Loverso (1991) reported that only 2 of 5 participants were able to complete their target-specific therapy. The 2 individuals who did complete therapy demonstrated semantic capacity across categorical and associational boundaries. The authors propose that this precondition is necessary to the use communication boards or substituted iconic language.

Conclusions Regarding Target-Specific Therapy for Global Aphasia

There is moderate (Level 1b) evidence, based on a small RCT of "fair" quality, that intensive "ecological" language therapy is associated with improvement across language modalities.

There is an absence of evidence regarding the possible benefit of target-specific for individuals with global aphasia post stroke.

> *Intensive language therapy may be associated with improved language function for individuals with global aphasia.*

14.4.3 Specific Treatment for Alexia In Aphasia

Alexia is an acquired disturbance in reading. Both left and right hemisphere pathology may induce alexia. Reading disturbances that occur after left-hemisphere injury results from linguistic deficits and may occur as an isolated symptom or as part of aphasia (Cherney 2004).

Table 14.23 Specific Treatments for Alexia in Aphasia

Author, Year Country Pedro Score	Methods	Outcome
Cherney et al. (1986) No Score	10 patients received oral reading for language in aphasia (ORLA) consisting of repeated reading aloud of sentences in unison with the clinician. ORLA focuses on the connected discourse rather than on single words, modeling natural intonation and speech.	There was a significant increase in post-treatment score on the Boston Diagnostic aphasia Examination, token Test and the reading comprehension subtest of the Gates-MacGintie Reading Test.

Conclusions Regarding Alexia-Specific Therapy

There is an absence of evidence that specific therapy for alexia in aphasic patients improves language function post-stroke.

There is insufficient evidence regarding the effectiveness of alexia-specific therapy. Further research is required.

14.5 Drug Therapy in Aphasia

An extension to the Cochrane review was made to include pharmacological treatments for aphasia following stroke (Table 14.24) (Greener et al. 2001). The authors identified 10 studies that were suitable for review. Drugs that were used in the selected trials were piracetam, bifemalane, piribedil, bromocriptine, idebenone and Dextran-40. However, it should be noted that the only pharmacological treatment for aphasia available in Canada is bromocriptine. The authors found that in most trials, the methodological quality was not measurable with only one study providing adequate data for review and analyses.

Table 14.24 Drug Treatment in Aphasia

Study	Types of Intervention
Herrschaft 1988 (unpublished) Poek 1993 (conference) Platt 1993 Enderby 1994 De Reuk 1995 (unpublished)	Piracetam vs. placebo
Tanaka 1997	Bifemelane vs. no active substance
Bakchine 1990 (abstract)	Piribedil vs. no active substance
Gupta 1995	Bromocriptine vs. placebo
Price 1992 (abstract)	Idebenone vs. placebo
Spudis 1973	Dextran 40 vs. no active substances

Greener et al. (2001) found evidence that patients were more likely to improve on any language measure at the end of a trial if they had received piracetam, although the treatment effect was small

(odds ratio 0.46; 95% CI 0.3 to 0.7). Moreover, the treatment impact was even smaller when the dropouts were included in the analyses. Greener et al. (2001) was unable to determine whether one drug was more effective than another. The main conclusion of their review was that drug treatment with piracetam *might* be an effective treatment for aphasia following stroke. They suggested that research should examine the long-term effects of piracetam to determine if it is more effective than speech and language therapy alone.

Unlike the Cochrane review of Greener et al. (2001), the present review excluded abstracts, conference proceedings and unpublished studies (Herrschaft 1988, Poek 1993, De Reuk 1995, Bakchine 1990 and Price 1992). Platt et al. (1993) examined the efficacy and tolerance of piracetam as an additional therapy of hydroxyethyl starch and measured its effect on the rate of blood flow in the brain post-stroke. Although this study has been included (see table 14.24), it should be noted that Platt et al. did not address aphasia or the impact of treatment on aphasia specifically (Platt et al. 1993).

14.5.1 Piracetam
Piracetam is a γ-aminobutyrate derivative, a pharmacological agent with a potential effect on cognition and memory. Piracetam is thought to improve learning and memory by facilitating release of acetylcholine and excitatory amino acids, with increases in blood flow and energy metabolism (Kessler et al. 2000).

Table 14.25 Effect of Piracetam on Aphasia Recovery

Author, Year Country PEDro Score	Methods	Outcomes
Platt et al. (1993) Germany 8 (RCT)	56 stroke patients with acute supratentorial first cerebral ischemia within prior 3 days were randomized to receive either piracetam of placebo for 28 days.	85.2% of treatment patients demonstrated a reduction in the area of brain regions displaying an impaired flow rate and only 20.7% of placebo treated patients showed this reduction. Significant improvement in impaired motor function observed in 23 of the 27 treatment patients and in 8 of the 29 placebo patients.
Enderby et al. (1994) Belgium 6 (RCT)	Multi-centre, double blind placebo controlled trial of 158 stroke patients who had sustained their injury 6 to 9 weeks prior to study were randomized to receive either 4.8g/day of piracetam or placebo for 12 weeks.	Aaachen Aphasia Test (AAT) scores showed an overall significant improvement relative to baseline in favour of piracetam at 12 weeks.
Huber et al. (1997) Germany 7 (RCT)	66 patients with aphasia between 4 weeks and 36 months referred to a speech and language clinic of a university department of neurology. Patients were randomised to receive either 4.8g daily and 6 weeks of intensive language therapy or only 6 weeks of intensive language therapy.	Treated patients showed greater improvement than controls on the written language test of the AAT.
Kessler (2000) Germany 7 (RCT)	24 patients with acute aphasia and a diagnosis of a left hemisphere stroke made within 24 hours of study. Patients received 2400mg piracetam or placebo twice daily for 6 weeks.	Piracetam group showed greater increased activation effect than control in the left transverse temporal gyrus, left triangular part of inferior frontal gyrus and left posterior superior temporal gyrus after treatment. Piracetam group improved on 6 language areas while control improved on only 3.
Szelies et al. (2001) Germany	24 patients with mild to moderate aphasia after an ischemic stroke of left hemisphere and a token test score of 50 out of 150 in word repetition. Patients	Patients treated with piracetam demonstrated a significant improvement in syntactic structure of spontaneous speech compared to the controls.

| 6 (RCT) | were randomised to receive either piracetam or placebo for 6 weeks while continuing with comprehensive language therapy, OT and PT. | |

Conclusions Regarding Piracetam in Aphasia

Piracetam's effect on aphasia has been the subject of 4 good (PEDro > 6) RCTs. The evidence from all 4 positive studies provides strong (Level 1a) evidence that there is a significantly positive impact on aphasia recovery in stroke patients also receiving language therapy over the short-term. There also is limited physiological evidence that piracetam serves to increase activation of language processing regions within the brain. Piracetam is not available in Canada.

> *Piracetam when combined with language therapy results in improved aphasia recovery.*

14.5.2 Bromocriptine

Bromocriptine is a dopaminomimetic ergot derivative with D2-type receptor antagonist properties. It is primarily regarded as a dopamine agonist.

Table 14.26 Effect of Bromocriptine on Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Gupta et al. (1995) USA 7 (RCT)	Study involved 20 adult males who had incurred a cerebral infarction resulting in aphasia at least 1 year prior to study and demonstrated a mean phrase length of 1 to 5 words and a score >5 on Auditory Comprehension subsection of WAB. Patients were randomised in Phase I to receive either Bromocriptine (5 mg gradually increased to 15mg by week 3) or placebo. In phase II the treatment was crossed over. Each phase lasted 8 weeks with a 6-week washout period followed between each phase.	No significant differences were found between groups on the WAB BNT, Selected subtests of Weschsler Memory Scale-Revised including Figure Memory, Visual Paired Associates I, Visual Reproduction I and Visual Memory subtests, Raven's Progressive matrices and the Rey-Osterrieth Figures.
Sabe et al. (1995) Argentina 6 (RCT)	Study involved 7 non-fluent aphasics who were 1-year post brain injury and had stable scores on aphasia evaluations with a mean WAB Aphasia Quotient of 68.2 points. Patients started on 3.75mg/d of Bromocriptine and then dosage increased weekly to 7.5 mg/d and then for the final two weeks dose was maintained at 60mg/d followed by a three week wash out period, and then received identical looking placebo. Patients randomized to start on Bromocriptine and then cross-over to placebo or vice-versa.	No significant differences were found between groups on WAB, BDAE, Controlled Oral Work Association Test (FAS test) and BNT.
Bragoni et al. (2000) Italy No Score	Study involved 11 non-fluent chronic aphasic patients following stroke in a double blind protocol trial. All patients went through each phase of study: Phase 1 inclusion; phase 2 language retest to evaluate stability of aphasia; phase 3 placebo treatment combined with speech therapy; phase 4 treatment with Bromocriptine combined with speech therapy; phase 5 treatment with Bromocriptine alone; and phase 6 washout.	Significant improvements during Bromocriptine treatment observed in dictation, reading comprehension, repetition and in verbal latency. Improvement was also observed in qualitative scores reported by patients' relatives during phases 3 and 4 of treatment regime.
Ashtary et al.	Study involved 38 non-fluent acute aphasic stroke	After 4 months of therapy, significant

(2006) Iran 7 (RCT)	patients in a randomized, double-blind, placebo-controlled trial. The first group started on a 2.5mg/d dosage of Bromocriptine which steadily increased to 10mg/d by week 4 – this dosage was maintained for the remaining 12 weeks of treatment. Those randomized to the second group received an identical looking placebo that was administered by the same dosage protocol as the active drug.	improvements were observed in both groups on tests of verbal fluency, gesture to command, naming, single-word response, automatic speech, prosody, repetition, and global score, at the p<0.05 level or better. There were no significant differences between treatment and placebo on any language outcome after 4 months of treatment.

Discussion

Bragoni et al. (2000) reported significant quantitative (e.g. dictation, reading comprehension, repetition, verbal latency) and qualitative improvements associated with the use of bromocriptine. However, 3 RCTs of good quality have not demonstrated significant benefits associated with treatment.

Conclusions Regarding Bromocriptine in Aphasia Recovery

Based on three good quality RCTs, there is strong (Level 1a) evidence that Bromocriptine does not improve aphasia recovery post-stroke.

> ***Bromocriptine does not improve aphasia recovery post-stroke.***

14.5.3 Levodopa

Levodopa is a metabolic precursor of dopamine. Dopamine is involved in a variety of actions or mechanisms many of which may be influential in learning and executive function (Knecht et al. 2004; Seniow et al. 2009). In normal adults, the use of levodopa as an adjunct to massed training of an artificial vocabulary was associated with the speed, success and retention of novel word learning (Knecht et al. 2004). Two RCTs have examined the use of Levodopa combined with speech and language therapy in individuals with aphasia following stroke.

Table 14.27 Use of Levodopa During Speech and Language Therapy

Author, Year Country PEDro Score	Methods	Outcomes
Seniow et al. (2009) Poland 7 (RCT)	40 patients were assigned at random to receive either 100 mg. levodopa or matching placebo 30 minutes prior to speech/language therapy sessions. Therapy was conducted Monday – Friday for 3 weeks. Sessions were 45 minutes in length. The therapy method was similar for all patients, but the difficulty and type of exercises were individualized. Study outcomes were results of the following BDAE subtests: visual confrontation naming, animal naming, body part naming, body part identification, repetition of words, repetition of high and low frequency phrases and sentences, word discrimination, commands, complex ideational material.	Both groups made significant improvements on all BDAE subtests over the 3 week intervention. The treatment group made significantly greater progress on only 2 subtests; animal naming (p=0.011) and repetition of high-frequency phrases and sentences (p=0.028). The most significant predictor of outcome was aphasia severity. Assignment to treatment group was a significant predictor for; animal naming (p=0.003), repetition of high-frequency phrases & sentences (p=0.08) and repetition of low-frequency phrases and sentences (p=0.023). In a comparison of patients with anterior vs. posterior lesions, there were no significant differences (treatment vs. placebo). In individuals with anterior lesions, there were significant differences in body part naming (p=0.048) and word repetition (p=0.005).

| Leeman et al. (2011) Switzerland 7 (RCT) | In a crossover design study, 12 patients were randomized into two groups. Group 1 received computer-assisted therapy on one set of naming lists and associated line drawings (CAT), standard therapy (2-5hrs speech therapy/ week), and treatment with levodopa with beserazide for the first two week interval. Group 2 received CAT + standard treatment + placebo. After a 1 week washout period during which standard therapy was maintained, participants crossed over conditions and a second naming list was used. Oral naming was assessed at baseline and post-treatment. Order of naming list presentation (2 lists) was counterbalanced. | Naming accuracy was equivalent at baseline. Both groups improved significantly (F=48.98, p<0.0001) at the end of CAT + levodopa therapy, but there was no significant difference in improvement between groups. Administration of levodopa did not appear to affect the amount of improvement associated with CAT. |

Discussion

Like Bromocriptine, Levodopa influences neurotransmission via the dopaminergic system. Early studies, both in normal adults and in individuals with aphasia following stroke, suggest that use of levodopa as an adjunct to speech and language therapy may promote learning. Further study is required.

Conclusions Regarding the use of Levodopa

> *There is conflicting evidence with regard to the use of levodopa as an adjunct to speech and language therapy.*

> *The effectiveness of levodopa as an adjunct to speech and language therapy may be limited.*

14.5.4 Amphetamines

The amphetamines belong to the general group of sympathomimetic amines. Effective doses can enhance of performance and wakefulness, decrease feelings of fatigue, increased alertness and mood (euphoria) in humans. Methylphenidate, an amphetamine, blocks the reuptake of serotonin and norepinephrine, and has dopaminergic activity as well.

Table 14.28 Amphetamines in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Walker-Batson et al. (1992) USA No Score (single group intervention study)	Study involved 6 patients with presence of aphasia as defined by an overall score between 10th and 70th percentile on the PICA. Patients received either 10 or 15 mg of d-amphetamine every 4th day for 10 sessions. 30 minutes after drug was administered, patient began a 1-hour session of speech and language therapy.	By 3 months post-onset, 5 of the 6 patients achieved scores in excess of 100% of the 6-month projection on PICA. SPECT neuroimaging revealed significant cortical hypoperfusion in all of the aphasic subjects regardless of lesion site of CT.
Walker-Batson et al. (2001) USA 8 (RCT)	In a prospective, double blind study, 21 aphasic patients with an acute nonhemorrhagic infarction were assigned randomly to receive either 10 mg dextroamphetamine or a placebo. Patients were entered between days 16 and 45 after onset and were treated on a 3-day/4-day schedule for 10 sessions. Thirty minutes after drug/placebo administration,	Although there were no differences between the drug and placebo groups before treatment, by 1 week after the 10 drug treatments ended there was a significant difference in gain scores between the groups, with the greater gain in the dextroamphetamine group. The difference was still significant when corrected for initial aphasia

	patients received a 1-hour session of speech-/language therapy. The PICA was used at baseline, at 1 week off the drug, and at 6 months after onset as the dependent language measure	severity and age. At the 6-month follow-up, the difference in gain scores between the groups had increased.

Conclusion Regarding Amphetamines in Aphasia Recovery

There is moderate (Level 1b) evidence based on one small but "good" (PEDro = 8) RCT, that dextroamphetamine improves aphasia recovery when combined with language therapy.

Dextroamphetamine appears to improve aphasia recovery when combined with language therapy.

14.5.5 Bifemelane

Amaducci et al. (1981) proposed that cholinergic activity could be literalised to the left temporal lobe. Thus, damage to this area may result in anomia and verbal memory deficits. Moreover, Tanaka et al. (1997) suggested that neurological syndromes, other than aphasia (e.g. Alzheimer's disease), where anomia and verbal memory deficits are present, are associated with temporal lobe disease and are thus correlated with reduced cholinergic activity.

Table 14.29 Bifemelane in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Tanaka et al. (1997) Japan and USA 6 (RCT)	This study involved 4 right-handed patients with fluent aphasia and anomia after a unilateral left cerebral infarction 6 to 8 weeks post-stroke. Patients were assigned randomly to a treatment group receiving the cholinergic agent bifemelane 300mg. or to a non-treatment control group. All patients received standard speech therapy. Patients underwent cerebrospinal fluid (CFS) examination for analysis of acetylcholinesterase (AchE).	The non-treated patients did not improve on language scores. CSF AChE decreased slightly. Treated patients showed significant improvement on language scores and CSF AchE increased slightly. Cholinergic treatment was significantly correlated with increased in language scores. Improvement in language function was significantly correlated with increases in CSF AchE.

Conclusion Regarding Bifemelane in Aphasia Recovery

Bifemelane, a cholinergic treatment, has not been sufficiently studied to draw any meaningful conclusions.

Cholinergic treatment has not been studied sufficiently in aphasia recovery.

14.5.6 Dextran-40

Dextran-40, or low molecular-weight dextran, was chosen as a potential treatment for acute stroke because of its role in altering red cell charge and in decreasing platelet aggregation.

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Table. 14.30 Dextran-40 in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Spudis et al. (1973) USA 4 (RCT)	59 patients with onset of moderate to severe paralysis (< 24 hrs duration) were randomly allocated into a treatment group (Dextran 40) or to a control group (no medication).	Treated patients showed less restoration of language than the untreated patients.

Conclusion Regarding Dextran-40 in Aphasia Recovery

There is moderate (Level 1b) evidence that Dextran 40 when given to acute stroke patients results in worse outcomes than the non-treatment control.

Dextran 40 treatment results in worse outcomes than no treatment in aphasia recovery.

14.5.7 Moclobemide

Moclobemide is a reversible monoamine oxidase (MAO)-inhibitor, which causes a general increase in the concentrations of neurotransmitters. On the premise that enhancement of CNS neurotransmission might improve aphasia recovery, one randomized controlled trial has examined the effectiveness of moclobemide in the treatment of aphasia (Table 14.30).

Table 14.31 Moclobemide in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Laska et al. (2005) Sweden 9 (RCT)	90 stroke patients were randomly allocated to receive either 600 mg. Moclobemide or matching placebo daily. Treatment commenced within 3 months of stroke onset and continued for 6 months. Effect on aphasia was assessed using Reinvang's Aphasia Test and the Amsterdam-Nijmegen Everyday Language Test.	At the 6 month assessment, there was a significant improvement in aphasia outcomes in both groups. There was no significant difference between groups.

Conclusions Regarding Moclobemide in Aphasia Recovery

There is moderate evidence (Level 1b) that the use of Moclobemide does not enhance aphasia recovery.

Treatment with Moclobemide, a MAO-inhibitor, does not enhance aphasia recovery.

14.5.8 Donepezil

Donepezil is a selective acetylcholinesterase inhibitor used to stabilize cognitive deficits in individuals with mild to moderate dementia. Use of donepezil in patients with mild to moderate vascular cognitive impairment has been associated with significant improvements in cognitive and global function, including improvements in the performance of activities of daily living (Passmore et al. 2005). The results of an open-label, 20-week pilot study (Berthier et al. 2003) suggested that patients with chronic post stroke aphasia experienced improvement in language function following treatment. The open label

pilot study and subsequent RCT are summarised in Table 14.31.

Table 14.32 Donepezil in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Berthier et al. (2003) Spain No Score	11 patients with chronic aphasia following stroke (mean duration = 4.4 yrs) received 5 mg/day of donepezil for 4 weeks, followed by 10mg/day for 10 weeks. Treatment was followed by a 4-week withdrawal period. All patients also received 2 weekly sessions of conventional speech-language therapy. The primary outcome was the aphasia quotient (AQ) from the Western Aphasia Battery. Secondary outcomes included selected tests (9) from the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA). Testing was conducted at baseline, week 4,16 and 20.	One patient discontinued treatment; data was presented for 10 patients. Compared with baseline, AQ scores were significantly improved at 4 and 16 weeks (p<0.01). Compared to week 16, scores at week 20 (following drug washout) decreased (p<0.05). Similarly, PALPA scores demonstrated significant improvement from baseline to 16 weeks on 6 of 9 subtests, but declined in oral word-picture matching from week 16 – 20. Few side effects were reported – 2 patients experienced irritability and increased sexual drive (10 mg/day).
Berthier et al. (2006) Spain 7 (RCT)	26 patients with chronic post-stroke aphasia (>1 year) and under the age of 70 years were randomly assigned to receive either treatment with donepezil (n=13) or matching placebo (n=13). Treatment consisted of donepezil HCl 5 mg/day for 4 weeks (titration), followed by 10 mg/day for 12 weeks (maintenance – with possible adjustments for tolerability) and 4 weeks washout. Primary outcome measures were mean change scores from baseline to endpoint (week 16) on the aphasia quotient of the Western Aphasia Battery and the Communicative Activity Log (CAL). Secondary measures included PALPA subtests and the Stroke Aphasic Depression Questionnaire (SADQ).	AQ scores and PALPA subtest scores improved more in the treatment group than in the placebo group from baseline to week 16 (p=0.037 & p=0.025, respectively). Comparisons of the CAL revealed no significant differences from baseline to week 16 and by week 20 (post washout) CAL performance had declined in the treatment group relative to the placebo condition (p=0.008). 61% (8) patients in the treatment condition reported adverse events – irritability (4 patients) & insomnia or tiredness (2 patients), recurrence of post stroke seizures (2 patients). Seizures occurred during maintenance only and did not recur following dose reduction.

Discussion

Both studies summarised above (Berthier et al. 2006; Berthier et al. 2003) reported improvement in global language function on the Aphasia Quotient of the Western Aphasia Battery during treatment with donepezil HCl. However, these improvements appeared to fade following the end of treatment. In addition, gains do not appear to extend to functional, everyday communication as evidenced by the lack of improvement on the Communicative Activity Log associated with treatment (Berthier et al. 2006).

Conclusions Regarding Donepezil in Aphasia Recovery

There is moderate evidence (Level 1b) that the use of donepezil may have a positive effect on global language function. However, this improvement is reported only during active treatment and may not extend to everyday communication ability.

Treatment with donepezil HCl may have a positive effect on global language function.

14.5.9 Memantine

Memantine is an antagonist of the N-methyl-D-aspartate (NMDA) receptor. Its use has been evaluated

among patients with Alzheimer's Dementia and those with vascular dementia. A single RCT has examined the use of memantine alone and in conjunction with constraint-induced language therapy for the treatment of chronic aphasia following stroke (Table 14.32).

Table 14.33 Memantine in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Berthier et al. (2009) Spain 8 (RCT)	28 patients were randomized to receive either memantine 10 mg twice daily or matching placebo. All patients in the drug/no drug streams went through the following study phases: 1) 3-week titration 2) drug/placebo only (to end of week 16) 3) Combined treatment – drug or placebo + constraint induced aphasia therapy (CIAT) (weeks 16 – 18) 4) drug or placebo only (weeks 18 – 20) 5) 4-week drug washout (weeks 20 – 24). Following the washout period, all patients were provided with open-label memantine treatment for 24 weeks. CIAT therapy from week 16 – 18 was provided in a small group setting 3/hours per day, 5 days/week. Outcome measures were the change from baseline to end points (16 & 18 weeks) in the AQ of the Western Aphasia Battery (WAB) and the communicative activities log (CAL). Improvement was defined as increase in test score of more than 5% of total range.	In the drug only phase (4 – 16 weeks), patients treated with memantine demonstrated significantly greater improvement on the AQ (p=0.002) and the naming subtest of the WAB (p=0.015) than those in the placebo condition. Within group analysis revealed that both groups made significant improvements from weeks 16 – 18 with the addition of CIAT therapy; however, inidividuals also receiving memantine made greater gains on the AQ (p=0.0001), the spontaneous speech (p=0.024), auditory comprehension (p=0.037) and naming (p=0.009) subtests of the WAB in addition to the CAL (0.04). Outcomes were not affected by duration of aphasia, or treatment with antiepileptic or psychoactive drugs. Following the washout phase, the drug-related benefit associated with memantine treatment appeared to diminish, but scores remained greater than those in the placebo groups (AQ – p=0.41 at week 24). No adverse events associated with drug use were reported.

Discussion

There is some evidence that constraint-induced language therapy may be effective in the treatment of chronic aphasia following stroke. The single study by Berthier et al. identified here provides support for the effectiveness of constraint-induced therapy on its own and when used in conjunction with the memantine (Berthier et al. 2009). In addition, combination therapy appeared to augment the effect of constraint-induced language therapy and, while removal of memantine was associated with some loss of benefit, assessment using the Aphasia Quotient of the WAB demonstrated that patients maintained significant improvements compared to both baseline and placebo conditions. Further study is recommended.

Conclusions Regarding the use of Memantine

On the basis of a single, small RCT of "good" quality, there is moderate (Level 1b) evidence that use of memantine may be beneficial in the treatment of chronic aphasia. Combination therapy using constraint-induced language therapy and memantine may result in greater benefit than either therapy used independently.

> *Significant language and communication gains have been demonstrated following the use of memantine in conjunction with constraint-induced language therapy.*

14.5.10 Galantamine

Galantamine is an acetylcholinesterase inhibitor that also modulates nicotinic receptors (Erkinjuntti et al. 2002; Erkinjuntti et al. 2004). It has primarily been shown to be of benefit in terms of cognition, behaviour and the performance of activities of daily living when used in the treatment of Alzheimer's dementia. A single study has examined the use of galantamine for the treatment of chronic aphasia (Table 14.33).

Table 14.34 Galantamine in Aphasia

Author, Year Country PEDro Score	Methods	Outcomes
Hong et. al. (2012) (7)RCT	45 patients with chronic aphasia were randomly assigned to either a galantamine treatment group (8mg/day for 4 weeks, and 16mg/day for the following 12 weeks), or a control group (no placebo). Patients were evaluated on the sum of the four domains of the WAB-AQ at baseline and endpoint.	Endpoint WAB-AQ score was significantly higher in the galantamine group compared to the control group (p=0.003). Researchers also noted significant improvements in spontaneous speech (54.3-66.7 percentile, p=0.027), comprehension (52.1-58.8 percentile, p=0.018), and naming (49.0-57.2 percentile, p=0.013) domains in the galantamine treatment group. Endpoint WAB-AQ was independently associated with baseline WAB-AQ. No associations were found with age, gender or education level. Significant determinants for good responsiveness (WAB-AQ baseline – WAB-AQ endpoint ≥20 points, assumption 5% increase from baseline) in the treatment group included subcortical dominant lesion pattern, baseline MMSE score and a higher education level. A subcortical dominant pattern was an independent determinant for good responsiveness to treatment (OR 30.3; 95% 1.1 to 805.9, p=0.041)

Discussion

There is some data to support the effective use of galantamine in treating chronic aphasia post stroke. In the single study by Hong et. al., it was demonstrated that the administration of galantamine significantly enhanced linguistic function and lead to improved WAB-AQ scores in the treatment group. This suggests that cholinergic boosting may be an effective means to treat aphasia. This treatment was particularly effective in patients with higher cognitive reserves, as well as those with subcortical lesions.

Conclusions Regarding Treatment with Galantamine

Based on a single RCT of "good" quality, there is moderate (Level 1b) evidence that galantamine may have a beneficial effect on post stroke aphasia

> *Treatment with galantamine may result in improved linguistic function*

14.6 Cochrane Reviews of Therapies for Aphasia

There are currently three Cochrane Reviews examining treatments for aphasia post stroke. All three examine very different treatment approaches including pharmacological treatments, transracial Direct Current Stimulation, and speech and language therapies. These reviews are an important synthesis of the information pertaining to these therapy approaches, and have been summarized in Table 14.35.

Table 14.35 Summary of Cochrane Reviews for aphasia therapies following stroke

Author, Year Country Title	Description	Results
Greener et. al. (2010) UK Pharmacological treatments for aphaisia	10 trials were included in this review (N= 4 to 927 participants) Inclusion Criteria: randomized controlled trials with a pre-specified aim of examining the effects of a pharmacological treatment on language function in a stroke population Objective:+ to assess whether a pharmacological treatment for language function is better than a) no treatment, b) speech language treatment, or c) another drug therapy	Drugs examined in the 10 identified studies included piracetam, bifemelane, piribedil. bromocriptine, idebenone, and dexetran-40. Only piracetam trials contained adequate information for consideration in the review Data from four piracetam trials found a statistically significant difference in speech and language outcomes in favour of the treatment group compared with placebo (OR=0.46, 95%CI 0.3 to 0.7). No statistically significant differences were found in rates of death or adverse events.
Brady et. al. (2012) UK Speech and language therapy for aphasia	39 RCTs were included in the review (N=2518 participants). Inclusion Criteria: Randomized controlled trials examining Speech Language Therapy (SLT) compared with no intervention, social support intervention, or another form of SLT intervention (i.e. differs in intensity, duration, or theoretical approach) Objective: to assess the effectiveness of a SLT intervention compared with a) no intervention, b) a social support intervention, or c) a different SLT intervention	SLT vs. no intervention (19 studies (N=1414)): In meta-analysis, significant between group differences were found on measures of functional communication (p=0.008, SMD=0.26, 95%CI 0.03 to 0.48). Significant differences were also seen in measures of receptive language (reading comprehension: p=0.05, SMD=0.29, 95%CI 0 to 0.58; other comprehension: p=0.02, MD=8.04, 95%CI 1.55 to 14.52), as well as expressive language (general expressive: p=0.02, SMD 0.77, 95%CI 0.14 to 1.39; written language: p=0.002, SMD=0.45, 95%CI 0.16 to 0.74) in favour of SLT. No between group differences were noted in meta-analysis of measure of impairment severity. SLT vs. social support intervention (7 trials (N=279)): No differences were noted between groups on measures of functional communication. Receptive language improved in measures of comprehension only, favouring the control group over SLT therapy (p=0.04, SMD=-0.97, 95%CI -1.70 to -0.04). Expressive language outcomes were somewhat conflicting with greater

		improvements seen in the SLT group in measures of sentence expression (treated items, p=0.01, MD=3, 95%CI 0.63 to 5.37), however, social support control groups were shown to make greater improvements over SLT therapy in single word expression (p=0.003, MD=-7.0, 95%CI -11.67 to -2.33), general expressive language (p=0.0007, MD=-1.56, 95%CI -2.46 to -0.66), and written language (p=0.01, MD=-1.39, 95%CI -2.49 to -0.29). Measures of severity as measured by the PICA also favoured control groups over SLT, with social support control groups experiencing a greater decrease in severity (p=0.005, MD-1.13, 95%CI -1.91 to -0.35) SLT vs. SLT (25 RCTs (N=910 participants)): These studies were grouped into experimental SLT vs. conventional SLT (improved word fluency in SLT group, p=0.005), high intensity vs. low intensity SLT (greater improvements in communication in high intensity SLT group, p=<0.05), group vs. one to one SLT (no between group differences), volunteer vs. professional facilitated SLT (no between group differences), computer facilitated vs. professional facilitated SLT (no between group difference), semantic vs. phonological SLT (greater improvements in phonological SLT (auditory lexical decision) p=0.01), cognitive linguistic vs. communication SLT (no between group difference), verbal comprehension vs. preposition comprehension SLT (no between group difference), functional vs. conventional SLT (greater functional communication improvements in functional SLT group, p=0.001), constraint induced language therapy vs. conventional SLT (no between group difference), and operant training vs. conventional SLT (greater improvements with conventional SLT in expressive language, p=0.02 (word fluency) and p=0.05 (graphic subtest)), and severity of impairment (p=0.05)) Authors concluded that this review provided some evidence that SLT is effective for improved functional communication, receptive and expressive language following stroke. However, study heterogeneity and methodological quality

		precludes the ability to recommend any one SLT therapy over another.
Elsner et. al. (2013) Germany Transcranial direct current stimulation for aphaia post stroke	Five trials (N=54 participants) were included Inclusion Criteria: RCTs and randomized crossover trials were included in the review. All trials compared transcranial Direct Current Stimulation (tDCS) (with or without speech language therapy) with sham tDCS or sham plus speech language therapy Objective: to assess the effectiveness of transracial Direct Current Stimulation treatment for aphasia following stroke	Naming accuracy did not appear to be effected by study group (anodal, cathodal or sham tDCS). No evidence of improvement was observed between groups when divided by time post stroke (acute, subacute or chronic). Subgroup analysis of tDCS location (lesion or non-lesion hemisphere) and type of stimulation (anodal, cathodal, or sham) showed no difference in naming accuracy between groups. There is no evidence that tDCS therapy is able to improve aphasia outcomes.

Overall, the three Cochrane reviews examining interventions for aphasia and communication impairment following a stroke event that have been conducted to date are largely inconclusive. Although a large number of studies have been conducted examining pharmacological treatments for aphasia, only piracetam has been able to demonstrate any effectiveness in the treatment of aphasia. Speech Language Therapy has also been widely studied and has some evidence to support its effectiveness. However, variability between studies, measures of outcome, and interventions themselves lead to difficulties in drawing definite conclusions regarding the efficacy of this intervention approach. Finally, Transcranial Direct Current Stimulation is lacking in evidence to support its effectiveness as a treatment for aphasia and communication disorders following a stroke event.

14.7 Summary

1. *There is conflicting (Level 4) evidence whether speech and language therapy (SLT) is efficacious in treating aphasia following stroke. The most recent meta-analysis reported a consistent, though non-significant, benefit associated with the provision of SLT.*

2. *Based on the results of 2 meta-analyses, there is strong (Level 1a) evidence that intensive SLT produces more significant benefit than conventional SLT. In general, greater benefits are associated with very intense therapy over a relatively short period of time rather than less intense therapy over a longer period.*

3. *There is strong (Level 1a) evidence that trained volunteers can provide speech and language therapy and achieve similar outcomes to speech- language pathologists.*

4. *There is moderate (Level 1b) evidence based on one RCT of fair quality that group intervention results in improvements on communicative and linguistic measures among patients with chronic aphasia.*

5. *There is moderate (Level 1b) evidence, based on one "good" RCT (PEDro = 6), that group therapy results in less improvement in graphic (writing) elements of aphasia when compared to individualized therapy.*

6. *There is limited (Level 2) evidence that a community-based program improves language outcomes at both the impairment and disability level independent of severity, setting, diagnostic type or stage of aphasia.*

7. *There is moderate evidence (Level 1b – based on a single "fair" RCT) that an in-home program administered by trained volunteers improves language outcomes at the impairment and functional levels. However, there is no evidence that a targeted aphasia program is superior to in-home visits for the purpose of simple recreational activity.*

8. *There is moderate (Level 1b) evidence that the technique of training conversation partners, Supported Conversation for Adults with Aphasia (SCA) is associated with enhanced conversational skill for both the trained partner and the individual with aphasia.*

9. *There is limited (Level 2) evidence that training communication partners is associated with improvements in well-being and social participation. However, the majority of studies appear to be very small and of single group design. Further research is required.*

10. *There is moderate (Level 1b) evidence based on a study of 'fair' quality that group-based caregiver education is associated with temporary improvement in caregiver stress, but not with improved use or effectiveness of functional communication strategies.*

11. *There is limited (Level 2) evidence that participation in educational seminars results in improved knowledge, participation in social activities and family adjustment. Further examination of the role of education is warranted.*

12. *There is limited (Level 2) evidence that a community-based aphasia program improves the psychological well-being of patients and their families. Further research needs to be done before definitive conclusions can be made.*

13. *There were 4 RCTs identified; one of fair and three of good quality. Based on the results of these studies, there is strong evidence (Level 1a) that computer-based interventions can improve language skills assessed at the impairment level. There is limited (Level 2) evidence that improvements made via computer-based intervention generalize to functional communication.*

14. *There is limited (Level 2) evidence that the use of teleconferencing for remote assessment is comparable to face-to-face assessment in individuals with aphasia following stroke.*

15. *There is an absence of evidence regarding the use of telerehabilitation for speech and language therapy. Preliminary case series have reported positive results for a program of naming therapy.*

16. *There is moderate (Level 1b; 1 RCT, n=14) evidence that supplementary-filmed programmed language instructions did not provide a benefit in aphasic patients.*

17. *There is moderate (Level 1b; 1 RCT) evidence that Modified Music Intonation Therapy may have some ability to improve the recovery of nonfluent aphasia*

18. *There is moderate (Level 1b) evidence, based on one "good" RCT (PEDro = 6), that forced-use aphasia therapy results in greater language performance in chronic aphasics over a short period of time.*

19. *Based on a single small RCT of fair quality, there is moderate (Level 1b) that CIAT administered by trained laypersons is as effective as CIAT administered by professionals.*

20. *There is limited (Level 2) evidence that improvements in language function are similar following CIAT, CIATplus and PACE therapies.*

21. *Based on the results of 2 RCTs of good quality, there is strong (Level 1a) evidence that treatment with rTMS may result in improvements in performance on comprehensive language assessment as well as on tests of naming abilities. rTMS may be a suitable treatment to use in conjunction with speech language therapy.*

22. *There is moderate (Level 1b) evidence that the effects of treatment with rTMS may be durable over a period of months.*

23. *Based on single, small trial, there is moderate (Level 1b) evidence that anodal tDCS applied over the left frontal cortex is associated with improved naming performance in individuals with chronic post-stroke aphasia.*

24. *There is moderate (Level 1b) evidence that task-specific semantic therapy improves semantic activities and that task-specific phonological therapy improves phonologic activities.*

25. *There is limited (Level 2) evidence that phonological and semantic cueing improve naming accuracy and word retrieval abilities.*

26. *There is moderate (Level 1b) evidence, based on a small RCT of "fair" quality, that intensive "ecological" language therapy is associated with improvement across language modalities.*

27. *There is an absence of evidence regarding the possible benefit of target-specific therapy for individuals with global aphasia post stroke.*

28. *There is an absence of evidence that specific therapy for alexia in aphasic patients improves language function post-stroke.*

29. *Piracetam's effect on aphasia has been the subject of 4 good (PEDro > 6) RCTs. The evidence from all 4 positive studies provides strong (Level 1a) evidence that there is a significantly positive impact on aphasia recovery in stroke patients also receiving language therapy over the short-term. There also is limited physiological evidence that piracetam serves to increase activation of language processing regions within the brain. Piracetam is not available in Canada.*

30. *Based on three good quality RCTs there is strong (Level 1a) evidence that Bromocriptine does not improve aphasia recovery post-stroke.*

31. *Based on a single, small RCT of good quality, there is moderate (level 1b) evidence that treatment with levodopa as an adjunct to speech and language therapy has a positive effect on some language functions such as verbal fluency and repetition.*

32. *There is moderate (Level 1b) evidence based on one small but "good" (PEDro = 8) RCT, that dextroamphetamine improves aphasia recovery when combined with language therapy.*

33. *Bifemelane, a cholinergic treatment, has not been sufficiently studied to draw any meaningful conclusions.*

34. *There is moderate (Level 1b) evidence that Dextran 40 when given to acute stroke patients results in worse outcomes than the non-treatment control.*

35. *There is moderate evidence (Level 1b) that the use of Moclobemide does not enhance aphasia recovery.*

36. *There is moderate evidence (Level 1b) that the use of donepezil may have a positive effect on global language function. However, this improvement is reported only during active treatment and may not extend to everyday communication ability.*

37. ***On the basis of a single, small RCT of "good" quality, there is moderate (Level 1b) evidence that use of memantine may be beneficial in the treatment of chronic aphasia. Combination therapy using constraint-induced language therapy and memantine may result in greater benefit than either therapy used independently.***

38. ***Based on a single RCT of "good" quality, there is moderate (Level 1b) evidence that galantamine may have a beneficial effect on post stroke aphasia.***

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