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[Intervention Review]

Cognitive rehabilitation for attention deficits following stroke

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ABSTRACT

Background

Many survivors of stroke complain about attentional impairments, such as diminished concentration and mental slowness. However, the effectiveness of cognitive rehabilitation for improving these impairments is uncertain.

Objectives

To determine whether (1) people receiving attentional treatment show better outcomes in their attentional functions than those given no treatment or treatment as usual, and (2) people receiving attentional treatment techniques have a better functional recovery, in terms of independence in activities of daily living, mood and quality of life, than those given no treatment or treatment as usual.

Search methods

We searched the Cochrane Stroke Group Trials Register (October 2012), Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* October 2012), MEDLINE (1948 to October 2012), EMBASE (1947 to October 2012), CINAHL (1981 to October 2012), PsycINFO (1806 to October 2012), PsycBITE and REHABDATA (searched October 2012) and ongoing trials registers. We screened reference lists and tracked citations using Scopus.

Selection criteria

We included randomised controlled trials (RCTs) of cognitive rehabilitation for impairments of attention for people with stroke. The primary outcome was measures of global attentional functions, and secondary outcomes were measures of attention domains, functional abilities, mood and quality of life.

Data collection and analysis

Two review authors independently selected trials, extracted data and assessed trial quality.

Main results

We included six RCTs with 223 participants. All six RCTs compared cognitive rehabilitation with a usual care control. Meta-analyses demonstrated no statistically significant effect of cognitive rehabilitation for persisting effects on global measures of attention (two studies, 99 participants; standardised mean difference (SMD) 0.16, 95% confidence interval (CI) -0.23 to 0.56; P value = 0.41), standardised attention assessments (two studies, 99 participants; P value $\geq$ 0.08) or functional outcomes (two studies, 99 participants; P value $\geq$ 0.15). In contrast, a statistically significant effect was found in favour of cognitive rehabilitation when compared with control

for immediate effects on measures of divided attention (four studies, 165 participants; SMD 0.67, 95% CI 0.35 to 0.98; P value < 0.0001) but no significant effects on global attention (two studies, 53 participants; P value = 0.06), other attentional domains (six studies, 223 participants; P value ≥ 0.16) or functional outcomes (three studies, 109 participants; P value ≥ 0.21).

Thus there was limited evidence that cognitive rehabilitation may improve some aspects of attention in the short term, but there was insufficient evidence to support or refute the persisting effects of cognitive rehabilitation on attention, or on functional outcomes in either the short or long term.

Authors' conclusions

The effectiveness of cognitive rehabilitation remains unconfirmed. The results suggest there may be a short-term effect on attentional abilities, but future studies need to assess the persisting effects and measure attentional skills in daily life. Trials also need to have higher methodological quality and better reporting.

PLAIN LANGUAGE SUMMARY

Cognitive rehabilitation for attention deficits following stroke

Many people have problems with attention after stroke. They are not able to concentrate for prolonged periods of time and are distractible, being unable to focus on a specific task in the presence of competing information. Cognitive rehabilitation involves providing therapeutic activities to reduce the severity of a cognitive impairment following damage to the brain. The benefit of cognitive rehabilitation for impairments of attention following stroke is unclear. Our aim was to review the effect of cognitive rehabilitation on attention, and in addition on functional abilities, mood and quality of life. We identified six randomised controlled trials that compared cognitive rehabilitation with a usual care control group for people with impairment of attention. The six studies involved 223 participants. We found a significant effect of cognitive rehabilitation on divided attention at the end of the intervention period, but there was no evidence that these benefits persisted. In addition, there was no evidence to support or refute the effect of cognitive rehabilitation for other types of attention impairment or for any effect on functional abilities, mood or quality of life. The methodological quality of the trials identified and the paucity of studies means that we cannot draw conclusions about the effect of cognitive rehabilitation for attention. More research is needed. People with attentional impairments should continue to receive stroke rehabilitation services but more research is needed to identify the specific effects of specific cognitive rehabilitation.

BACKGROUND

Description of the condition

Deficits in attention are one of the most commonly observed cognitive impairments after stroke. The exact frequency of attentional deficits after stroke is a matter of debate. Within the acute phase, estimates range between 46% and 92% (Stapleton 2001). At discharge from hospital estimates suggest a prevalence of between 24% and 51% (Hyndman 2008). Speed of information processing can also be impaired and estimates have varied between 50% and 70% (Hochstenbach 1998; Rasquin 2004). Attentional deficits may recover over time in some people (Hochstenbach 2003), but in 20% to 50% of stroke survivors there are persistent deficits for years (Barker-Collo 2010; Hyndman 2003).

Attentional impairments manifest themselves in a wide variety of deficits, such as diminished concentration, distractibility, reduced error control, difficulties doing more than one thing at a time, mental slowness and mental fatigability. Being a mediator of other processes, attentional deficits may also impair higher cognitive functions, such as language and memory (Lezak 2004). While there is a consensus that attention is not a unitary process, there is no agreement on the typologies and taxonomies describing the range of attentional processes. For the purpose of the current review we considered the following attentional components: alertness/arousal, selective attention, sustained attention (vigilance) and divided attention (see Table 1). The rehabilitation of deficits in spatial attention is covered in a separate Cochrane Review (Bowen 2007).

Table 1: Domains of attention

Domain of attention	Definition	Functional example
Alertness/arousal	Ability and readiness to respond	Response to warning signals
Selective attention	Ability to focus on a specific stimuli while ignoring irrelevant stimuli	Reading while people talk in the background
Sustained attention (vigilance)	Ability to maintain attention over a prolonged period of time	Driving a car for long distances
Spatial attention	Ability to detect and deploy attention to all sides of space	Attending to people sitting on left and right side of the table
Divided attention	Ability to multitask and to divide attention between 2 or more tasks	Talking on the telephone while cooking

A distinction between different attention domains is potentially important when evaluating rehabilitation. There is some evidence that attentional components need to be trained separately as there is little generalisation of treatment from one attentional domain to another (Sturm 1991; Sturm 1997). Moreover, it has been suggested that cognitive training for certain domains, such as divided and selective attention, may be more effective than training for other domains, such as alertness and sustained attention (Cappa 2005).

The treatment of cognitive deficits is necessary because they have a negative effect on functional abilities (Barker-Collo 2006) and quality of life (Kwa 1996; Mitchell 2010; Nys 2006). Sustained attention (concentration) is an important prerequisite for motor recovery, since sufficient sustained attention is a required for learning (Robertson 1997). Deficits in attention can affect the ability to engage with physiotherapy and are associated with increased risk of falls (Hyndman 2003). Other specific attentional disorders, such as auditory and visual selective attention, and divided attention, also affect functional recovery (Hyndman 2008; Stapleton 2001).

Description of the intervention

Cognitive rehabilitation has been defined as "a systematic functionally orientated intervention of therapeutic cognitive activities based on the assessment and understanding of the patient's brain behaviour deficits" (Cicerone 2000). Cognitive rehabilitation comprises the provision of therapeutic activities to reduce the severity of a cognitive deficit. This includes tasks designed to restore attention abilities, such as computerised activities and pencil-and-paper tasks requiring attention. The alternative approach is teaching people strategies to compensate for their attention impairments. Attempts to retrain attention skills have mainly relied on a restitution approach, although trials of attention retraining for people with traumatic brain injury have emphasised the development of compensatory strategies rather than the restoration of basic aspects of attention (Cicerone 2005).

The European guidelines (Cappa 2005) and a narrative review (Cicerone 2011) both concluded that during the acute phase there was insufficient evidence to support the effects of specific attention training for people with stroke. Although recommendations were made for attention training at a later stage, this was based mainly on evidence from people with traumatic brain injury rather than stroke.

How the intervention might work

Cognitive rehabilitation is based on two main principles. One is restitution, which aims to restore cognitive function through repeated practice. The other is compensation, which aims to reduce the effects of cognitive impairment on functional abilities using strategies that minimise demands on attention skills.

Why it is important to do this review

Impairments of attention are a major problem for people with stroke and affect rehabilitation outcome, but the effectiveness of cognitive rehabilitation for attention is uncertain. In a survey of stroke survivor needs, 41% of respondents reported that they did not get the help they needed to address their concentration problems (McKevitt 2010). Although attention training has been provided for some people with stroke it needs further evaluation. There have been few studies that have used control groups and most evaluations have been based on single-case experimental de-

signs. Although these indicate treatment can be effective, they do not evaluate the general applicability of the findings. This updated review aimed to consider the evidence from randomised controlled trials (RCTs) on the effectiveness of cognitive rehabilitation for attention systematically.

OBJECTIVES

To determine whether:

1. people receiving attentional treatment show better outcomes in their attentional functions than those given no treatment or treatment as usual;

2. people receiving attentional treatment techniques have a better functional recovery, in terms of independence in activities of daily living, mood and quality of life, than those given no treatment or treatment as usual.

METHODS

Criteria for considering studies for this review

Types of studies

In the first version of this review we sought all controlled trials in which cognitive rehabilitation was compared with a control treatment. However, in this updated version we have excluded all non-randomised trials to reduce selection bias. This was decided in advance of searching the literature. We sought RCTs in which an attentional treatment was compared with a control for inclusion.

Types of participants

This review was confined to trials that included people with attentional deficits following stroke. We excluded trials in which participant selection for attentional training was based on general cognitive impairments or other cognitive functions (e.g. aphasia). The participants were restricted to those with stroke. We excluded trials of participants with mixed aetiologies unless data were available relating to those with stroke or if the trials had more than 75% of people with stroke in their sample.

Types of interventions

We included trials in which there was a comparison between a treatment group that received one of various attentional treatment strategies and a control group that received either an alternative form of treatment or no attentional intervention. We considered attention treatments to be any form of intervention with the aim of improving attention abilities. Alternative forms of treatment included computerised activities with low attentional demands and social activities. We excluded interventions that specifically aimed to improve spatial attentional deficits (see Cochrane review on rehabilitation of spatial neglect: Bowen 2007). We did not consider listening to music to be a form of cognitive rehabilitation. We did not include trials with only a single treatment session or drug studies.

Types of outcome measures

The primary outcome was measures of global attentional functions, and the secondary outcomes were measures of the domains of attention, functional abilities in activities of daily living, mood and quality of life. We assessed the outcomes at the end of treatment and at follow-up. We defined 'long-term' as more than three months after intervention. We did not include studies in which the outcome was related exclusively to car driving.

Primary outcomes

Subjective reports of global attention as measured by validated rating scales, such as:

- Rating Scale of Attentional Behaviour (Ponsford 1991);
- Moss Attention Rating Scale (Whyte 2003);
- Attention Rating and Monitoring Scale (Cicerone 2002);
- Cognitive Failures Questionnaire (Broadbent 1982).

If more than one of these scales was reported, we used the scale listed first.

Objective reports of global attention as measured by validated batteries assessing a wide range of attentional domains

We were not aware of any assessment batteries with a global score of attention at the start of this review. Batteries such as Test of Everyday Attention (Robertson 1994) do not provide a total score. We included any validated assessments reporting global scores of attention.

Secondary outcomes

Objective reports of domains of attention as measured by:

- tests of alertness/arousal;
- tests of selective attention;
- tests of sustained attention;

- tests of divided attention.

We assigned each attentional test to a primary and a secondary attentional domain (see Appendix 1). For each trial we only included one test measure in the analysis for a specific domain. We chose measures allocated to a primary domain over those allocated to secondary domains. We used the following hierarchy if a trial provided several measures for the same domain: combined error/speed measures > error measures > speed measures (median reaction times (RTs) > mean RTs). In the case when several tests were used to assess the same attentional domain within the same trial, we chose validated tests in preference to non-validated tests. If two or more standardised tests were used to assess the same attentional domain, we chose the one with the higher reliability and validity rating in the *Compendium of Neuropsychological Tests* (Strauss 2006). If we could not reach a decision with the above criteria, we selected one of the tests at random. We did not consider measures deriving from programs used for treatment for analysis. We defined tests of sustained attention as lasting for more than three minutes.

Reports of functional abilities in daily living, mood and quality of life

- functional abilities as measured by scales such as the Nottingham Extended Activities of Daily Living (NEADL: Nouri 1987), Functional Independence Measure (Granger 1994) and Barthel Index (Mahoney 1965);
- mood as measured by scales such as the General Health Questionnaire (GHQ: Goldberg 1972) and Hospital Anxiety and Depression Scale (HADS: Zigmond 1983);
- quality of life, as measured by the World Health Organization Quality of Life (WHOQOL) (WHOQOL Group 1998) and Short Form (SF)-36 (Ware 1992).

If more than one of these scales was reported, we used the scale listed first.

Search methods for identification of studies

See the 'Specialized register' section in the Cochrane Stroke Group module. We searched for relevant trials in all languages and arranged for translation of trial reports published in languages other than English where necessary.

Electronic searches

We searched the Cochrane Stroke Group Trials Register (last searched October 2012). In addition, we searched the following databases and registries:

- Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*, October 2012);
- MEDLINE (1948 to October 2012) (Appendix 2);
- EMBASE (1947 to October 2012) (Appendix 3);
- PsycINFO (1806 to October 2012) (Appendix 4);
- Cumulative Index to Nursing and Allied Health Literature (CINAHL) (1981 to October 2012) (Appendix 5);
- Psychological Database for Brain Impairment Treatment Efficacy (PsycBITE, www.psycbite.com/) (October 2012);
- REHABDATA (www.naric.com/research/rehab/) (October 2012);
- ClinicalTrials.gov (www.clinicaltrials.gov/) (October 2012);
- Stroke Trials Registry (www.strokecenter.org/trials/) (October 2012);
- Current Controlled Trials (www.controlled-trials.com/) (October 2012).

The Cochrane Stroke Group Trials Search Co-ordinator designed the MEDLINE and EMBASE search strategies and we adapted them for the other databases.

Searching other resources

In an effort to identify further published, unpublished and ongoing trials we used Science Citation Index Cited Reference Search for forward tracking of all primary study articles and we scanned reference lists from review articles and books identified in the searches.

For the previous version of this review we conducted a handsearch of the following journals was conducted:

American Journal of Occupational Therapy (1947 to 1998); *Aphasiology* (1987 to 1998), *Australian Journal of Occupational Therapy* (1965 to 1998); *British Journal of Occupational Therapy* (1950 to 1998); *British Journal of Therapy and Rehabilitation* (1994 to 1998); *Canadian Journal of Occupational Therapy* (1970 to 1998); *Clinical Rehabilitation* (1987 to 1998); *Disability and Rehabilitation* (1992 to 1998) formerly *International Disability Studies* (1987 to 1991) formerly *International Rehabilitation Medicine* (1979 to 1986); *International Journal of Language and Communication Disorders* (1998) formerly *European Journal of Disorders of Communication* (1985 to 1997) formerly *British Journal of Disorders of Communication* (1977 to 1984); *Journal of Clinical Psychology in Medical Settings* (1994 to 1998) formerly *Journal of Clinical Psychology* (1944 to 1994); *Journal of Developmental and Physical Disabilities* (1992 to 1998) formerly *Journal of the Multihandicapped Person* (1989 to 1991); *Journal of Rehabilitation* (1993 to 1998); *International Journal of Rehabilitation Research* (1977 to 1998); *Journal of Rehabilitation Sciences* (1989 to 1996); *Neuropsychological Rehabilitation* (1987 to 1998); *Neurorehabilitation* (1991 to 1998); *Occupational Therapy International* (1994 to 1998); *Physiotherapy Theory and Practice* (1990 to 1998) formerly *Physiotherapy Practice* (1985 to 1989); *Physical Therapy* (1988 to 1998), *Rehabilitation Psychology* (1982 to 1998); *Journal of Cognitive Rehabilitation* (1988 to 1998) formerly *Cognitive Rehabilitation* (1983 to 1987).

Since handsearching these journals in 1999 many of these journals have been updated as part of The Cochrane Collaboration's

handsearching effort. After checking the Master List of Journals that is maintained by the Collaboration (us.cochrane.org/master-list) we are confident that relevant trials would be found from the search of CENTRAL. We therefore did not repeat handsearching of these journals are they are now covered by electronic databases.

Data collection and analysis

Selection of studies

One review author (TL) screened the titles and abstracts of records obtained from the searches of the electronic databases and excluded those that were clearly not relevant. We obtained the full text of the remaining studies and the two review authors independently assessed which studies met the inclusion criteria in relation to study type, participants, interventions, comparisons and outcomes. We resolved any disagreements by discussion.

Data extraction and management

For each of the studies meeting the inclusion criteria we extracted the following characteristics:

1. method of participant assignment and blinding;
2. setting and participant details (including age, gender, time since stroke, eligibility criteria);
3. intervention (including comparison intervention, treatment durations);
4. outcome measures (including assessment methods and time points of assessments);
5. results.

One review author (TL) extracted the study characteristics, and the second review author (NL) checked the details.

Assessment of risk of bias in included studies

We applied The Cochrane Collaboration's recommended approach for assessing risk of bias in studies included in Cochrane reviews (Higgins 2011). Both review authors assessed the methodological quality of each study in the following six domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and 'other issues'. We judged each of these domains as either having a 'low', 'unclear' or 'high' risk of bias.

Measures of treatment effect

We summarised ordinal scales using methods for continuous data. We expressed the intervention effect as a mean difference (MD) or standardised mean difference (SMD) with the corresponding 95% confidence interval (CI). Some scales increased with disease severity while others decreased, so we multiplied the mean values from one set of studies by -1 to ensure that all the scales pointed in the same direction.

Dealing with missing data

We sought data that were not available or were unclear from the reports through correspondence with the first author of the publication. If we could not obtain the required information for an included study we did not include that study in the analysis.

Assessment of heterogeneity

We assessed the heterogeneity between trial results by I^2 estimates (Higgins 2011). We considered an I^2 value above 50% as indicating substantial heterogeneity between trial results.

Data synthesis

We conducted a meta-analysis using a fixed-effect model with 95% CI where there was acceptable heterogeneity between trials (I^2 < 50%). Otherwise, we used a random-effects model for the meta-analysis.

Subgroup analysis and investigation of heterogeneity

If sufficient data were available, we planned to do subgroup analyses to determine whether outcomes varied according to time since onset of stroke, frequency of intervention (number of sessions per week), intensity of intervention (total hours of intervention) and type of intervention. However, we were unable to do this, as there were insufficient data available.

Sensitivity analysis

We planned a sensitivity analysis on the methodological quality of studies (allocation concealment, blinding of outcome assessor). However, we were unable to do this, as there were insufficient data available.

RESULTS

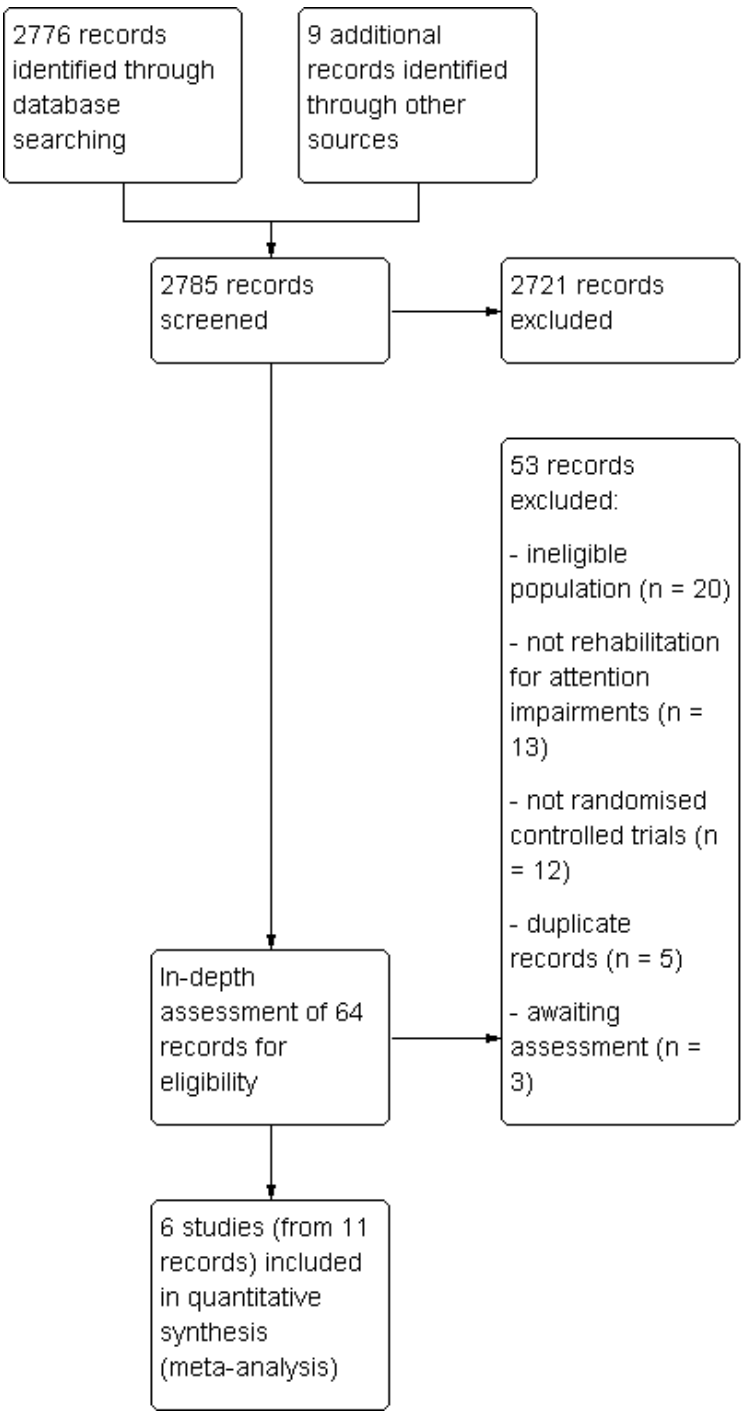
Description of studies

Results of the search

The initial search in August 2011 and the updated search in October 2012 retrieved over 2776 records. We identified a further nine from other sources. Initial screening of the 2785 abstracts identified 64 possibly relevant studies. An in-depth assessment of

these papers identified six studies (from 11 records) that met the inclusion criteria. The study selection process is outlined in Figure 1.

Figure 1. Study flow diagram.



Of the 53 studies that we excluded, five were duplicate papers of studies already included and we excluded 45 because they did not meet the inclusion criteria. These 45 are summarised in the Characteristics of excluded studies table. We excluded three studies because there were insufficient participants with stroke, 12 were not RCTs, 17 did not select participants with impairments of attention and 13 did not involve cognitive rehabilitation for attention impairments. Two studies are awaiting classification (Characteristics of studies awaiting classification) because insufficient information was available about them to make a decision, and one study is ongoing (Characteristics of ongoing studies).

Included studies

We included six studies treating attentional deficits after stroke in this review (see Characteristics of included studies). The six studies included a total of 223 participants. Of the six RCTs, four used a parallel group design (Barker-Collo 2009; Schottke 1997; Westerberg 2007; Winkens 2009), and two used a cross-over design (Rohring 2004; Sturm 1991). The method of generating the random schedule was reported in five studies. Two of these used random number tables (Rohring 2004; Sturm 1991), one used an online Internet randomisation service (Barker-Collo 2009), one used coin tossing (Schottke 1997), one used drawing numbers from a bucket (Westerberg 2007), and in one this was unclear (Winkens 2009). The sequence was generated independently in three studies (Barker-Collo 2009; Westerberg 2007; Winkens 2009), and was unclear in the other three (Rohring 2004; Schottke 1997; Sturm 1991). In all studies the participants and therapists were aware of the treatment being given. Outcomes were assessed by a blinded assessor in three studies (Barker-Collo 2009; Rohring 2004; Winkens 2009), in two the therapist conducted the outcome assessments (Schottke 1997; Westerberg 2007), and in one this was unclear (Sturm 1991).

One study was conducted in New Zealand (Barker-Collo 2009), and five in Europe: three in Germany (Rohring 2004; Schottke 1997; Sturm 1991), one in Sweden (Westerberg 2007), and one in the Netherlands (Winkens 2009). The number of participants recruited to the studies varied between 78 (Barker-Collo 2009) and 18 (Westerberg 2007). All studies apart from two (Rohring 2004; Sturm 1991) included only participants with stroke. Two studies recruited most participants within the first two months after stroke (Barker-Collo 2009; Schottke 1997), three mainly within one year of stroke (Sturm 1991; Westerberg 2007; Winkens 2009), and one study recruited participants up to four years after stroke (Rohring 2004). Three studies recruited participants with both right and left hemisphere lesions (Barker-Collo 2009; Schottke 1997; Westerberg 2007), one included those with left hemisphere lesions in the randomised trial (Sturm 1991) and two studies did not report this information (Rohring 2004; Winkens 2009).The mean age of the samples was under 65 years in all except one study (Barker-Collo 2009). The proportion of men ranged between 70% (Sturm 1991) and 51% (Schottke 1997).

Attention deficits were identified on tests of attention using specified cut-offs in two studies (Barker-Collo 2009; Schottke 1997), on tests for attention without specification of cut-offs in two studies (Rohring 2004; Sturm 1991), and based on self or therapist reported attention deficits in two studies (Westerberg 2007; Winkens 2009). Groups were well matched at baseline apart from three studies. In two studies (Schottke 1997; Winkens 2009), the time after stroke was shorter for controls than intervention group participants and in another, the control group had more people with aphasia and lower intelligence (Sturm 1991).

Interventions aimed to either restore attentional functions (Barker-Collo 2009; Rohring 2004; Schottke 1997; Sturm 1991; Westerberg 2007), or provide compensatory strategies (Winkens 2009). One study (Schottke 1997) applied both intervention approaches. Interventions lasted from three weeks (Schottke 1997; Sturm 1991) to 11 weeks (Rohring 2004), and the number of sessions of treatment varied between 13 (Schottke 1997) and 55 (Rohring 2004) for the restorative approaches. The compensatory approach was delivered for 10 hours (Winkens 2009). The control groups in all studies received usual care with no treatment of attention deficits.

The six studies used over 30 psychometric tests with more than 40 test variables as attentional outcome measures. Four out of the seven studies (Barker-Collo 2009; Rohring 2004; Schottke 1997; Winkens 2009) assessed at least one functional outcome. All studies reported outcomes immediately after treatment: two studies also reported outcomes of follow-up assessments (long-term effects) (Barker-Collo 2009; Winkens 2009).

The findings of the individual studies supported the efficacy of treatment for four studies on measures of attention (Barker-Collo 2009; Schottke 1997; Westerberg 2007; Sturm 1991), and two studies found limited evidence of benefit (Rohring 2004; Winkens 2009).

Risk of bias in included studies

The risk of bias for each individual study is summarised in Figure 2. An overview of the risk across all studies is provided in Figure 3. While all six studies were described as randomised there were insufficient details available in one study to judge the risk of bias for the randomisation process (Winkens 2009). In three out of the six studies there was insufficient information to allow judgement

of the risk of an allocation concealment bias (Rohring 2004; Schottke 1997; Sturm 1991). All studies compared the effect of an intervention with care as usual. Blinding of the participants and therapists was not possible once the intervention started and therefore no studies were double blind. Two studies showed a high risk of detection bias as the outcome assessment was not conducted blinded to the group allocation (Schottke 1997; Westerberg 2007). There was no indication of any selective reporting, but the study protocol was not available for any of the studies.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

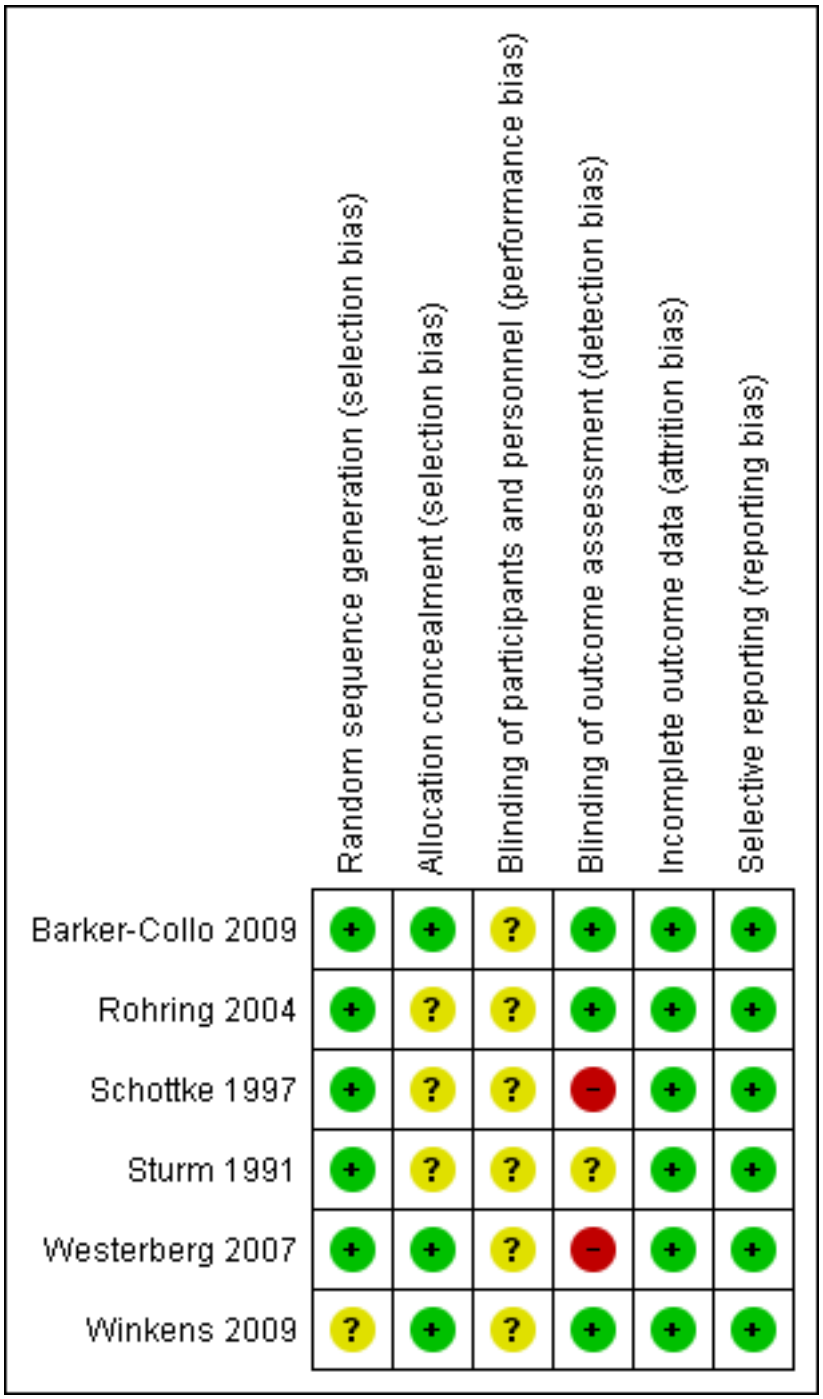
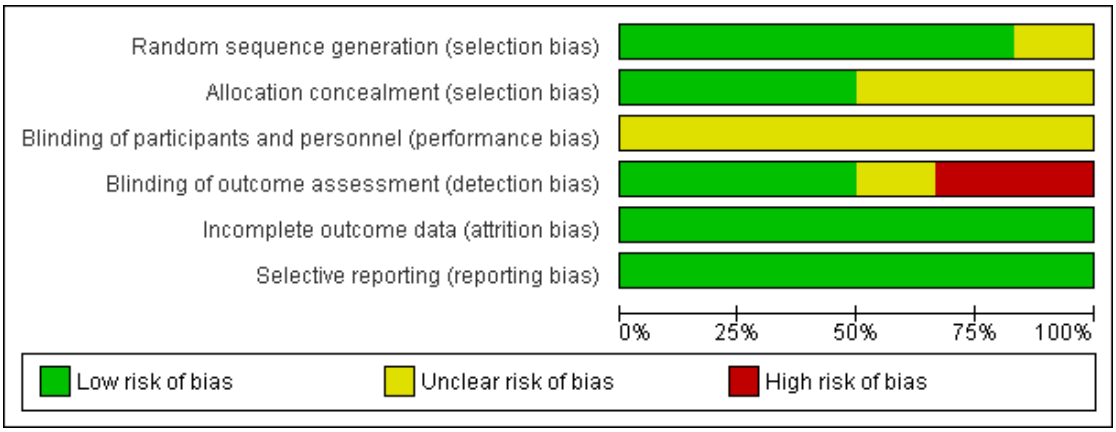


Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Effects of interventions

We assessed the effect of interventions immediately after treatment and at follow-up. The included studies applied a wide diversity of outcome measures. The measures we chose for the analysis of treatment effects on attentional and functional outcomes are listed in Table 1 and Table 2.

Primary outcomes

Effects at end of treatment

Two studies involving 53 participants assessed subjective reports of global attentional functions with either the Cognitive Failures Questionnaire (Westerberg 2007) or the Mental Slowness Questionnaire (Winkens 2009). There was a borderline significant effect in favour of the intervention compared with care as usual (SMD 0.53, 95% CI -0.03 to 1.08; P value = 0.06; Analysis 1.1). We did not identify any studies reporting objective measures of global attention.

Long-term effects

The two studies investigating long-term effects on subjective reports of global attentional functions found no significant effects of treatment (Barker-Collo 2009; Winkens 2009) (99 participants, SMD 0.16, 95% CI -0.23 to 0.56; P value = 0.41; Analysis 2.1). We did not identify any studies that reported objective measures of global attention.

Secondary outcomes

Effects at end of treatment

There was a statistically significant effect of treatment on divided attention. Four studies comprising 165 participants assessed divided attention by the means of the Paced Auditory Serial Addition Test (PASAT) (Barker-Collo 2009; Westerberg 2007; Winkens 2009), or the divided attention subtest from the Tests of Attentional Performance battery (TAP) (Rohring 2004). The analysis found that the intervention was beneficial compared with care as usual (SMD 0.67, 95% CI 0.35 to 0.98; P value < 0.0001; Analysis 3.4).

We found no significant effects on other domains of attention. An effect on alertness was investigated in four studies (Rohring 2004; Schottke 1997; Sturm 1991; Winkens 2009) comprising 136 participants (SMD 0.14, 95% CI -0.20 to 0.48; P value = 0.41; Analysis 3.1). Six studies comprising 223 participants examined the effects on selective attention (SMD -0.08, 95% CI -0.35 to 0.18; P value = 0.53; Analysis 3.2). Four studies comprising 169 participants examined the effects on sustained attention. As the heterogeneity between trials for this measure was high (I^2 > 50%), we used a random-effects model for analysing sustained attention (SMD 0.39, 95% CI -0.16 to 0.94; P value = 0.16; Analysis 3.3). Rehabilitation of attention did not show any significant effects on functional abilities in daily living (two studies (Rohring 2004; Schottke 1997), 75 participants; SMD 0.29, 95% CI -0.16 to 0.75; P value = 0.21; Analysis 4.1), mood (three studies (Rohring

2004; Schottke 1997; Winkens 2009), 109 participants; SMD 0.01, 95% CI -0.36 to 0.39; P value = 0.94; Analysis 4.2) or quality of life (two studies (Barker-Collo 2009; Winkens 2009), 103 participants; SMD 0.02, 95% CI -0.37 to 0.40; P value = 0.94; Analysis 4.3).

Long-term effects

Two studies assessed long-term effects of treatment on divided attention and there was no significant effect of treatment compared with care as usual (Barker-Collo 2009; Winkens 2009) (99 participants; SMD 0.36, 95% CI -0.04 to 0.76; P value = 0.08; Analysis 5.4). There were no significant effects on the other domains of attention. One study comprising 31 participants looked at effects on alertness (Winkens 2009) (SMD -0.26, 95% CI -0.97 to 0.45; P value = 0.47; Analysis 5.1). Two studies comprising 99 participants investigated effects on selective attention at follow-up (Barker-Collo 2009; Winkens 2009) (SMD 0.07, 95% CI -0.32 to 0.47; P value = 0.72; Analysis 5.2) and one study assessed the effect on sustained attention (Barker-Collo 2009) (66 participants; SMD 0.05, 95% CI -0.44 to 0.53; P value = 0.84; Analysis 5.3).

The only study testing for long-term effects on functional abilities in daily living found no significant effect of treatment (Barker-Collo 2009) (SMD 0.02, 95% CI -0.46 to 0.51; P value = 0.92; Analysis 6.1). Two studies with a total of 99 participants found no significant effects on mood (Barker-Collo 2009; Winkens 2009) (SMD 0.29, 95% CI -0.11 to 0.69; P value = 0.15; Analysis 6.2) or on quality of life (SMD 0.26, 95% CI -0.13 to 0.66; P value = 0.19; Analysis 6.3).

DISCUSSION

The review in 2000 included two trials with 56 participants. In this update of the review, we included six trials with 223 participants.

Summary of main results

There was a significant effect of cognitive rehabilitation on divided attention at the end of rehabilitation (SMD 0.67, 95% CI 0.35 to 0.98; P value < 0.0001) but no significant effect at long-term follow-up. There was no evidence to support the effect of cognitive rehabilitation on global attentional function, other specific attentional domains (alertness, selective attention, sustained attention), functional abilities, mood or quality of life.

Overall completeness and applicability of evidence

Some authors provided unpublished data (Barker-Collo 2009; Rohring 2004; Winkens 2009) and others clarified aspects that were not clear from the published reports (Schottke 1997; Sturm 1991; Westerberg 2007). We excluded some studies on the basis of information from authors (Kim 2008) and others confirmed the results were not yet available (ISRCTN45171788).

Trials generally had small sample sizes ranging from 18 to 78, which limits the ability to generalise from these studies. Future studies should be adequately powered to detect the effects of treatment on functional outcomes. The results from these studies should enable a power calculation for future studies.

The studies included a wide variety of interventions. Almost all were computerised. The comparison for most studies was treatment as usual. Future studies could be improved by the use of attention placebo control groups that provide the computerised activities but not including the attention retraining activities. This is feasible as it was used in an excluded study (Gray 1992), but not in any of those included.

Most studies assessed outcomes on measures of attention on standardised tests. The six studies reported 40 different test variables of attentional outcomes. It has been suggested that cognitive training for certain attentional domains might be more effective than for others (see Cappa 2005) and that there is limited generalisation of treatment from one attentional domain to another (Sturm 1997). It seemed therefore important to evaluate treatment effects on different attentional domains. However, it would be beneficial if there were broader consensus on the attentional processes these variables tap into and greater consistency in the choice of outcome measures. In addition, a composite test score assessing several attentional domains would assist with identifying the overall benefit of attention training. Few studies included functional outcomes, yet the effect of cognitive rehabilitation on functional outcomes is needed to inform clinical service developments.

The inclusion criteria for attentional deficits varied considerably across trials, and accordingly, the degree of attentional deficits at start of the treatment differed widely. Whether treatment success is modulated by the severity of attentional impairments in an individual person could not be addressed in this review.

There were insufficient data to evaluate whether treatment is more effective in the postacute phase than in the acute phase of recovery (Cappa 2005; Cicerone 2011). Similarly, the planned subgroup analyses to determine whether outcomes varied according to frequency of intervention (number of sessions per week), intensity of intervention (total hours of intervention) and type of intervention were not carried out as insufficient data were available.

Quality of the evidence

The evidence base was small with few methodologically robust RCTs. Most of the studies identified had small sample sizes and few had a low risk of bias in all aspects considered. Allocation concealment and random sequence generation were not well reported.

Potential biases in the review process

The review was conducted by two authors who independently assessed the included studies and final decisions were made following discussion. The allocation of attention tasks to attentional domains was put forward by one author (TL) and confirmed by the second author (NL). While the assignments are consistent with commonly used typologies and taxonomies of attentional processes in clinical settings, it has to be acknowledged that these assignments are, to some degree, arbitrary as the same test variable may tap into several different attentional domains (Lezak 2004; Strauss 2006). In addition, the exclusion of studies on attention retraining to improve driving ability and the delivery of music as cognitive stimulation was based on the criteria for the review process, but these studies could have been considered to be relevant to this review.

Agreements and disagreements with other studies or reviews

We found some benefits of cognitive rehabilitation for divided attention, but not for other attentional domains. This finding is consistent with suggestions that treatment might be more beneficial for certain attentional domains (Cappa 2005; Sturm 1997). The review concludes that overall there is insufficient evidence to support or refute the effectiveness of cognitive rehabilitation for attention after stroke. This conclusion is consistent with the previous Cochrane review (Lincoln 2000) and another meta-analysis assessing treatment outcome of attention rehabilitation after acquired brain injury (Park 2001). The appraisal of the evidence in favour of rehabilitation is somewhat less positive than two narrative reviews of cognitive rehabilitation for people with acquired brain injury (Cappa 2005; Cicerone 2011). A reason for the discrepancy is probably due to the fact that the current review applied more rigorous inclusion criteria than the two narrative reviews. In Cicerone 2011, for example, six of the eight studies reviewed were class III studies. In addition, Cappa 2005 included non-RCTs as a source of acceptable evidence. An additional reason for the discrepancy could be that the narrative reviews mainly included participants with head injury rather than stroke. It is currently unclear whether different underlying pathologies (e.g. stroke, traumatic brain injury) have different effects on outcome.

AUTHORS' CONCLUSIONS

Implications for practice

The effectiveness of cognitive rehabilitation for attention deficits following stroke remains unconfirmed. Cognitive rehabilitation may improve some specific aspects of attention in the short term. There was no evidence to indicate whether the benefits persist in the long term. However, improving attention in the short term may enable people to engage better in rehabilitation and improve their ability to cope with tasks in which they are required to do two things at the same time, such as walking and talking. It is important that when rehabilitation for attention is carried out the benefits are monitored, as at present no specific rehabilitation approach can be recommended.

Implications for research

There is sufficient evidence to suggest there may be some benefits of cognitive rehabilitation for attentional problems after stroke and that further trials are needed. However, there are few studies and the quality is not consistently high. This may be partly because cognitive rehabilitation is not routinely provided in many rehabilitation settings. It is therefore important that more randomised trials are carried out to inform clinical practice. Outcomes need to be assessed on general indices of attention and the effect on functional abilities determined. The long-term effects of cognitive rehabilitation need to be evaluated in addition to short-term effects. There needs to be more attention to both the design of methodologically sound studies and reporting that conforms with the CONSORT guidelines. Trialists are encouraged to refer to the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011) for the description of the key features of trials that need to be reported. In addition, trials need to have adequate power to detect clinically meaningful differences between groups. It is important that such evaluations are carried out as the best ways to improve cognition after stroke were one of the top 10 research priorities relating to life after stroke reported by people with stroke (Pollock 2012).

This review is ongoing and the authors would like to receive information on ongoing trials for a future update.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Barker-Collo 2009

Methods	RCT, parallel group design Concealed online Internet randomisation service with stratified minimisation Implementation of randomisation sequence by the treating clinician who had no access to assessment data. Randomisation information was not accessible by any other study staff during the study Approach: restoration of attentional functions with the means of APT
Participants	New Zealand, recruited from 2 hospitals Total participant sample 78; 10 lost at 5 weeks, 12 were not assessed at 6 months Treatment group: n = 38; mean age 70.2 ± 15.6 years; 60.5% males; 18.5 ± 12.0 days since onset; hemisphere of lesion: 14 left (44%), 15 right (47%), 3 bilateral or unclear (9%) Control group: n = 40; mean age 67.7 ± 15.6 years; 60.0% males; 18.6 ± 7.6 days since onset; hemisphere of lesion: 25 left (58%), 17 right (40%), 1 bilateral or unclear (2%) Inclusion criteria: attention deficit defined as performance > 1 SD below norm on any attentional tests; stroke using WHO criteria; admitted to 1 of 2 hospitals; within 2 weeks of stroke Exclusion criteria: unable to give consent; MMSE < 20; medically unstable; unable to speak English; other relevant conditions, such as dementia
Interventions	Treatment: up to 30 hours individual APT for 1 hour on weekdays for 4 weeks, mean 13.5 ± 9.4 hours Control: no treatment
Outcomes	Measured at post-treatment (5 weeks) and follow-up (6 months) Primary outcome: • IVA-CPT Full-Scale Attention Quotient (z-scores) Secondary outcomes: • IVA-CPT Auditory attention (z-scores) • IVA-CPT Visual attention (z-scores) • Bells test (omissions of left, central, and right-sided targets) • Trail Making A & B (z-scores) • PASAT (z-scores for 2 and 2.4 sec) • SF-36 (Mental Component Score and Physical Component Score) • Modified Rankin (raw score)* • Cognitive Failures Questionnaire (raw score)* • GHQ-28 (raw score)* * Only measured at 6 months' follow-up
Notes	Provided numbers of side of hemisphere lesions do not add up to total participant sample. Additional data for analysis provided by authors
Risk of bias	

Barker-Collo 2009 (*Continued*)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Internet based and independent
Allocation concealment (selection bias)	Low risk	Concealed
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants and therapist not blinded as aware of intervention being given
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Trained assessor blind to randomisation
Incomplete outcome data (attrition bias) All outcomes	Low risk	Intention-to-treat analysis Last observation carried forward
Selective reporting (reporting bias)	Low risk	No indication in article

Rohring 2004

Methods	RCT, cross-over group design with pair matching Pairs were matched for age, sex, aetiology, side of brain lesion and time since incident. Allocation to groups according to table of random numbers Planned cross-over design, but only results of first phase (group 1 received intervention, group 2 no training) are reported Approach: restoration of attentional functions by computer training
Participants	Germany, single-centre study Total participant sample: 48 (62 people started study, but 7 people lost in intervention group because of: insufficient training (n = 2), personal reasons (n = 2), medical reasons (n = 2), and because of an exclusion criteria defined after start of training (n = 1). The 7 matched participants in the control group were excluded for analysis as well). Participant sample included 5 people with TBI Treatment group: n = 24; mean age 51.6 ± 13.0 years; 62.5% males Control group: n = 24; mean age 54.9 ± 11.4 years; 62.5% males No subgroup data for hemisphere of lesion, aetiology and time since incident (group mean 25.5 ± 13.7 months) Inclusion criteria: attention deficits (tests and cut-off criteria not specified); brain damage > 6 months and < 4 years; available transport opportunity to clinic; being able to keep concentration up for 30 minutes per day Exclusion criteria: age > 70 years; probability of progressing brain disorder; other major neurological or psychiatric disorders; major neuropsychological deficits; any handicap that would prevent independent use of the computer program

Interventions	Treatment: 30-45 minutes computer-based training at home for 5 days per week for 11 weeks in total. Cogpack (evosoft TeleCare/Dr Hein GmbH) was used as training software. Self reported mean training time was 241 ± 135 minutes per week. All participants had 1 therapy session per week at the clinic in addition to the computer training Control: no treatment, but regularly contacted by therapists to learn about the participant' well-being
Outcomes	Measured after intervention (11 weeks) Several measures, but no definition of primary outcome measure: • d2 (Hits-Errors, T-scores provided by authors) • Tests of Attentional Performance (subtests for intrinsic alertness, phasic alertness, divided attention, selective attention) • LGT-3 (Learning/Memory task) • Leistungsprüfsystem L-P-S (subtests out of an IQ test) • Personality Questionnaire • Barthel • FIM • Depression Scale • SF-36 (no data after treatment available)
Notes	No matching for attention deficits or any other outcome measures at baseline. Data for analysis provided by authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number table
Allocation concealment (selection bias)	Unclear risk	No information available
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants and therapists not blinded to intervention
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded (information provided by authors)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing data in treatment group (n = 7) was controlled for by excluding the corresponding matched participant in control group for the analysis
Selective reporting (reporting bias)	Low risk	While not all of the study's specified outcome measures have been reported in the paper (e.g. at 4 months' follow-up only 1

		attentional outcome measure was reported) , all data have been provided by the authors for the current analysis

Schottke 1997

Methods	RCT, multicentre study, parallel group design with pair matching Pairs were matched for side and aetiology of lesion, education level, and participating centre. Allocation of 1 person from each matched pair to treatment group by coin toss. 3 people could not be matched and were allocated to the control group No concealment of intervention or outcome measurement (assessment and training by same person) Approach: restoration of attentional functions and compensatory strategies
Participants	Germany, recruited from 2 hospitals Total participant sample 29; 0 people lost to follow-up Treatment group: n = 16; mean age 64.1 ± 8.5 years; 56.3% males; 51.6 ± 21.5 days since onset; hemisphere of lesion: 5 left, 11 right Control group: n = 13; mean age 65.4 ± 10.9 years; 46.2% males; 37.5 ± 11.4 days since onset; hemisphere of lesion: 2 left, 11 right Inclusion criteria: attention deficit defined as standard scores < 80 in any of the attentional tests; stable cardiovascular system; able to travel to training room; cerebral infarct or haemorrhage; neurological symptoms lasting more than 24 hours Exclusion criteria: aphasia
Interventions	Treatment: 13 training sessions in 3 weeks, which included a wide range of different training methods (e.g. computerised reaction training, paper-and-pencil tasks, scanning training, cognitive-behavioural training and relaxation techniques). Duration of a single session not specified Control: treatment as usual
Outcomes	Measured after intervention (3 weeks) Several standardised measures of attention with no definition of primary outcome measure: • Tempo-Lern-Test (percentile scores for each of the 3 experimental blocks) • Wahl-Reaktions-Test (percentile scores for 2 reaction time measures) • Zahlen-Verbindungstest (percentile scores) • Konzentrations-Verlaufs-Test (standard scores for speed, errors and combined speed/errors scores) • Visual-Discrimination-Conditioner (raw score correct responses) • Line Bisection (deviation in % from true mid-point) • Behavioural Test of Inattentiveness in Daily Life (raw scores) • Barthel completed by self and another (raw scores) • Emotional State Questionnaire (raw scores for the subscales 'depression', 'fear', 'fatigue', 'activity' and 'relaxation')
Notes	Time after stroke significantly shorter for controls compared to the treatment group. Visual-Discrimination-Conditioner programme used for treatment and outcome assessment

Schottke 1997 (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Coin tossing
Allocation concealment (selection bias)	Unclear risk	No information reported
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	Training and assessment by same person
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Low risk	No indication in article, but study protocol not available

Sturm 1991

Methods	RCT, cross-over group design Participants with left brain damage were allocated to 2 comparable groups with respect to age, sex and time post-onset. Allocation of people to treatment group by random number table. There was a third training group with right brain damaged people. They were trained 'late' in the cross-over design and their data were excluded from the current analysis Approach: restore attentional functions by computer training
Participants	Germany Total participants sample: 37; 0 people lost to follow-up Treatment group: n = 13; mean age 51.5 ± 9.5 years; 69.2% males; 15 ± 9.7 weeks since onset; hemisphere of lesion: 13 left, 1 non-stroke participant Control group: n = 14; mean age 49.6 ± 9.5 years; 71.4% males; 16.4 ± 9.2 weeks since onset; hemisphere of lesion: 14 left, 2 non-stroke participants No inclusion or exclusion criteria specified, all participants had attentional deficits according to authors
Interventions	Treatment: 30 minutes' computer-based training at clinic, 14 sessions spread over 3 consecutive weeks. Cognitrone and Wiener Determinationsgerat were used as training software Control: no treatment

Sturm 1991 (*Continued*)

Outcomes	Measured after intervention at 3 weeks, after cross-over at 6 weeks and at 12 weeks' follow-up Several measures, but no definition of primary outcome measure: • Wiener Determinationsgerat (hits and false alarms, z-scores) • Cognitrone (hits and false alarms, z-scores) • Wiener Reaktionsgerat (reaction times for visual, auditory and choice subtests, z-scores) • Wiener Vigilanzgerat (hits and false alarms, z-scores) • d2 (hits minus errors, z-scores) • Non-attentional tasks, such as Raven Standard Progressive Matrices and WAIS subtests
Notes	Cognitrone and Wiener Determinationsgerat were used for training, outcome measures based on these tasks were excluded for analysis Control group was more aphasic and scored significantly lower on WAIS, in the Intelligence structure task and the Ravens than the intervention group

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Use of random number table (personal communication of authors)
Allocation concealment (selection bias)	Unclear risk	No information
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	No information
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data, but it is noteworthy that 90% of people with right brain damage initially agreed to participate in the study refused to participate when contacted later for starting the training
Selective reporting (reporting bias)	Low risk	No indication in article, but study protocol not available

Westerberg 2007

Methods	RCT, parallel group design 3 people who did not take part in the study performed the randomisation. Small identical paper notes with numbers corresponding to each of the participants were put in a bucket. The notes were folded so that it was impossible to see the numbers. 1 person held the bucket, the 2 other people drew notes in an alternating manner. Before the procedure it was determined that all participants drawn by the first person would be in the training group, and the participants drawn by the other person were controls. The principal investigator (not involved in randomisation process) had the key to the correspondence between the numbers and the participant names. The result of the randomisation was kept secret from the therapists. After the first neuropsychological assessment (T1) a sealed, pre-named envelope, which revealed the randomisation to either the treatment or control group condition, was opened by the therapist so that the participants could have the instructions for their intervention Approach: restore attentional functions by computer training of working memory functions
Participants	Sweden, recruited from 1 hospital Total participant sample 21; 3 lost after baseline testing (only data of remaining people reported) Treatment group: n = 9; mean age 55.0 ± 8 years; 89% males; 19.3 ± 6.2 months since onset; hemisphere of lesion: 4 left (44%), 4 right (44%), 1 unclear (11%) Control group: n = 9; mean age 53.6 ± 8 years; 44% males; 20.8 ± 6.2 months since onset; hemisphere of lesion: 3 left (33%), 4 right (44%), 2 unclear (22%) Inclusion criteria: self reported deficits in attention; suffering stroke between 12 and 36 months ago; stroke documented by PET, MRI or CT; aged 30 to 65 years; having daily access to a computer with Internet connection at home Exclusion criteria: IQ < 70; motor or perceptual handicap that would prevent use of the computer program; changing medication during the study period; fulfilling criteria for major, depressive-disorder diagnosis as per the DSM-IV diagnosis code
Interventions	Treatment: 40 minutes of computer-based training at home for 5 days per week for 5 weeks in total. Visuo-spatial and auditory working memory tasks were performed by using the RoboMemo Software (Cogmed Cognitive Medical Systems, Sweden). Sufficient compliance was defined as 20 days of training (achieved by all participants not withdrawing from the study) Control: no training
Outcomes	Measured after intervention (5 weeks) Several measures, but no definition of primary outcome measure: • Cognitive Failures Questionnaire • PASAT (time in seconds at 2.4 seconds ISI) • Ruff 2&7 (time in seconds to complete cancellation task) • Stroop (time in seconds and number of correct responses) • Digit Span from WAIS-R (raw scores) • Span Board from WAIS-R (raw scores) • Raven's progressive matrices (raw scores) • Claeson-Dahl Task (raw scores)

Notes	The study authors informed on an error in the original paper. The correct Ruff 2&7 values for the treatment group were 130.3 (21.9) seconds at pre-training and 115.4 (21. 7) seconds at post-training

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Sealed envelopes prepared by a person unrelated to the study
Allocation concealment (selection bias)	Low risk	Sealed pre-addressed envelope (prepared by persons unrelated to the study) opened after the initial assessment
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants and therapist not blinded
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, lost participants scored within group mean level in the baseline
Selective reporting (reporting bias)	Low risk	No indication in article, but study protocol not available

Winkens 2009

Methods	RCT, multicentre study, parallel group design Random assignment list created before start of trial, independent person used the list to assign people to the 2 groups after recruitment Approach: learning of compensatory strategies
Participants	Netherlands, recruited from 8 rehabilitation centres Total participant sample 37: 2 lost at post-treatment assessment, another 1 at 3-month follow-up Treatment group: n = 20; mean age 49.5 ± 8 years; 45% males; 19.3 ± 29.6 months since onset Control group: n = 17; mean age 53.9 ± 11.1 years; 71% males; 6.9 ± 5.4 months since onset No data for hemisphere of lesion, and aetiology Inclusion criteria: stroke > 3 months; referred for cognitive rehabilitation for mental slowness

	Exclusion criteria: aged < 18 years; stroke < 3 months; severe or disabling premorbid or current (continuing) pathological conditions; severe cognitive, communication, physical, or psychological problems that the person was unable to perform the tasks, based on the clinical judgement of the treating team
Interventions	Treatment: 10-hour teaching in time pressure management session duration varied between 1 and 2 hours a week depending on the individual person Control: care as usual
Outcomes	Measured after intervention (time not explicitly specified, but likely to be around 5 weeks) and at 3-month follow-up Primary outcomes: • information intake task (number of correct responses and used strategies • Mental Slowness Observation test (time, number of correct responses and used strategies) • Mental Slowness Questionnaire (raw score) Secondary outcomes: • PASAT (number of correct responses at 3.2 seconds ISI) • Trail Making A & B (time in seconds for both parts) • Simple Reaction Time (time in seconds) • Stroop (time in seconds for each subtest) • Symbol Digit Modalities test (number of correct responses) • Auditory Verbal Learning test (number of correct responses) • Fatigue Severity Scale (raw scores) • EuroQol-5D (raw scores) • Depression Scale (raw scores)
Notes	People with stroke were relatively young and ADL-independent. Control group were more recent after onset. Additional data for analysis provided by the authors

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	"Random assignment list" was used, no details given
Allocation concealment (selection bias)	Low risk	After selection of participants independent person used random list to assign people to groups
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Participants and therapist not blinded
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessment by blinded research assistant. Analyses showed that assistant had guessed the allocation correctly in 24 of 37 cases (Cohen k = 0.29, P value = 0.05)

Winkens 2009 (*Continued*)

Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	No indication in article, but study protocol not available

ADL: activities of daily living; APT: attention process training; CT: computerised tomography; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; FIM: Functional Independence Measure; GHQ: general health questionnaire; ISI: inter-stimulus interval; IVA-CPT: Integrated Visual and Auditory Continuous Performance Test; MRI: magnetic resonance imaging; MMSE: Mini-mental state examination; PASAT: Paced Auditory Serial Addition Test; PET: positron emission tomography; RCT: randomised controlled trial; SD: standard deviation; SF: Short Form; TBI: traumatic brain injury; WAIS: Wechsler Adult Intelligence Scale; WHO: World Health Organization

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Aivazian 1994	Not rehabilitation of attentional deficits
Akinwuntan 2010	Not selected on the basis of having impairment of attention
Boman 2004	Non-RCT
Brainin 2010	Not rehabilitation of attentional deficits
Bunketorp Kall 2011	Not rehabilitation of attentional deficits
Carelli 2009	Non-RCT
Crotty 2009	Not selected on the basis of having impairment of attention
Dirette 2004	Non-RCT
Edmans 2009	Not selected on the basis of having impairment of attention
Gates 2012	Not selected on the basis of having impairment of attention
Gauggel 1996	Non-RCT
Giaquinto 2003	Not rehabilitation of attentional deficits
Graf 2011	Not selected on the basis of having impairment of attention
Gray 1992	Less than 75% were people with stroke

(*Continued*)

Hashimoto 2006	Non-RCT
Kang 2008	Non-RCT
Kang 2009	Not rehabilitation of attentional deficits
Kim 2008	Not selected on the basis of having impairment of attention
Klonhoff 2010	Non-RCT
Levine 2011	Not selected on the basis of having impairment of attention
Mazer 2003	Not selected on the basis of having impairment of attention
McDonnell 2007	Not rehabilitation of attentional deficits
Mead 2007	Not rehabilitation of attentional deficits
Middleton 1991	Non-RCT
Miotto 2009	Not people with stroke
Otfinowski 2006	Not selected on the basis of having impairment of attention
Piccardi 2006	Non-RCT
Ploughman 2008	Not selected on the basis of having impairment of attention
Pyoria 2007	Not selected on the basis of having impairment of attention
Pyun 2009	Non-RCT
Quaney 2009	Not selected on the basis of having impairment of attention
Rizkalla 2011	Not selected on the basis of having impairment of attention
Shiflett 2002	Not rehabilitation of attentional deficits
Sohlberg 2000	Not people with stroke
Spahn 2010	Not rehabilitation of attentional deficits
Spikman 2010	Not selected on the basis of having impairment of attention
Stapleton 2001	Not rehabilitation of attention deficits
Sturm 1997	Non-RCT

(*Continued*)

Sturm 2006	Not rehabilitation of attentional deficits
Särkämö 2008	Not selected on the basis of having impairment of attention
Särkämö 2010	Not selected on the basis of having impairment of attention
Thimm 2006	Not rehabilitation of attentional deficits
von Koch 2000	Not selected on the basis of having impairment of attention
Wagenaar 1992	Not treatment of attention deficits
Yamamoto 2007	Non-RCT

RCT: randomised controlled trial

Characteristics of studies awaiting assessment *[ordered by study ID]*

Flynn 2000

Methods	
Participants	
Interventions	
Outcomes	
Notes	Investigation into whether psychology-led cognitive rehabilitation of attentional and visuo-spatial skills improves performance in these areas beyond spontaneous recovery. National Research Register Authors contacted twice, but no response

Matz 2007

Methods	RCT
Participants	32 participants
Interventions	"Cognitive training sessions" guided by a neuropsychologist over a 3-month period
Outcomes	No training effect for assessed cognitive functions
Notes	Authors contacted twice, but no response

RCT: randomised controlled trial

Characteristics of ongoing studies *[ordered by study ID]*

ISRCTN45171788

Trial name or title	Neuropsychological rehabilitation: modular cognitive retraining versus compensatory skills training
Methods	
Participants	
Interventions	
Outcomes	
Starting date	
Contact information	p.frommelt@asklepios.com
Notes	ISRCTN45171788. Data collection finished, authors reported that analysis is still in progress

DATA AND ANALYSES

Comparison 1. Attention training versus control - impact on global measures of attention deficits at post-treatment assessment

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Subjective measures	2	53	Std. Mean Difference (IV, Fixed, 95% CI)	0.53 [-0.03, 1.08]

Comparison 2. Attention training versus control - impact on global measures of attention deficits at follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Subjective measures at follow-up	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.16 [-0.23, 0.56]

Comparison 3. Attention training versus control - impact on attentional domains at post-treatment assessment

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Alertness	4	136	Std. Mean Difference (IV, Fixed, 95% CI)	0.14 [-0.20, 0.48]
2 Selective attention	6	223	Std. Mean Difference (IV, Fixed, 95% CI)	-0.08 [-0.35, 0.18]
3 Sustained attention	4	169	Std. Mean Difference (IV, Random, 95% CI)	0.39 [-0.16, 0.94]
4 Divided attention	4	165	Std. Mean Difference (IV, Fixed, 95% CI)	0.67 [0.35, 0.98]

Comparison 4. Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Functional abilities	2	75	Std. Mean Difference (IV, Fixed, 95% CI)	0.29 [-0.16, 0.75]
2 Mood	3	109	Std. Mean Difference (IV, Fixed, 95% CI)	0.01 [-0.36, 0.39]
3 Quality of life	2	103	Std. Mean Difference (IV, Fixed, 95% CI)	0.02 [-0.37, 0.40]

Comparison 5. Attention training versus control - impact on attentional domains at follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Alertness at follow-up	1	31	Std. Mean Difference (IV, Fixed, 95% CI)	-0.26 [-0.97, 0.45]
2 Selective attention at follow-up	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.07 [-0.32, 0.47]
3 Sustained attention at follow-up	1	66	Std. Mean Difference (IV, Fixed, 95% CI)	0.05 [-0.44, 0.53]
4 Divided attention at follow-up	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.36 [-0.04, 0.76]

Comparison 6. Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Functional abilities at follow-up	1	66	Std. Mean Difference (IV, Fixed, 95% CI)	0.02 [-0.46, 0.51]
2 Mood at follow-up	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.29 [-0.11, 0.69]
3 Quality of life at follow-up	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.26 [-0.13, 0.66]

Analysis 1.1. Comparison 1 Attention training versus control - impact on global measures of attention deficits at post-treatment assessment, Outcome 1 Subjective measures.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 1 Attention training versus control - impact on global measures of attention deficits at post-treatment assessment

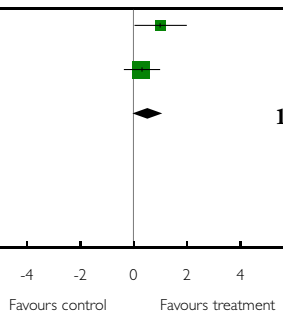
Outcome: 1 Subjective measures

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Westerberg 2007	9	-29.2 (12.1)	9	-43 (13.8)		31.1 %	1.01 [0.02, 2.01]
Winkens 2009	19	-36.6 (37.7)	16	-49.1 (42.2)		68.9 %	0.31 [-0.36, 0.98]
Total (95% CI)	**28**		**25**			**100.0 %**	**0.53 [-0.03, 1.08]**

Heterogeneity: Chi^2 = 1.33, df = 1 (P = 0.25); I^2 =25%

Test for overall effect: Z = 1.86 (P = 0.063)

Test for subgroup differences: Not applicable



Analysis 2.1. Comparison 2 Attention training versus control - impact on global measures of attention deficits at follow-up , Outcome 1 Subjective measures at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 2 Attention training versus control - impact on global measures of attention deficits at follow-up

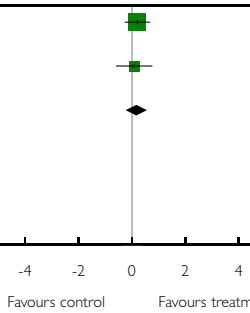
Outcome: 1 Subjective measures at follow-up

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	25.9 (12.53)	35	23.57 (10.3)		66.5 %	0.20 [-0.28, 0.69]
Winkens 2009	17	-38.6 (47.7)	16	-42.9 (44.8)		33.5 %	0.09 [-0.59, 0.77]
Total (95% CI)	**48**		**51**			**100.0 %**	**0.16 [-0.23, 0.56]**

Heterogeneity: $Chi^2 = 0.07$, df = 1 (P = 0.79); $I^2 = 0.0\%$

Test for overall effect: Z = 0.82 (P = 0.41)

Test for subgroup differences: Not applicable



Analysis 3.1. Comparison 3 Attention training versus control - impact on attentional domains at post-treatment assessment, Outcome 1 Alertness.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 3 Attention training versus control - impact on attentional domains at post-treatment assessment

Outcome: 1 Alertness

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Rohring 2004	24	44.2 (11.2)	22	46.5 (12.7)		34.6 %	-0.19 [-0.77, 0.39]
Schottke 1997	16	3.56 (2.09)	13	2.23 (1.79)		20.4 %	0.66 [-0.10, 1.41]
Sturm 1991	13	100.9 (8.7)	14	94.6 (11.9)		19.4 %	0.58 [-0.19, 1.36]
Winkens 2009	18	-0.32 (0.07)	16	-0.31 (0.05)		25.5 %	-0.16 [-0.83, 0.52]
Total (95% CI)	**71**		**65**			**100.0 %**	**0.14 [-0.20, 0.48]**

Heterogeneity: Chi^2 = 5.07, df = 3 (P = 0.17); I^2 =41%

Test for overall effect: Z = 0.82 (P = 0.41)

Test for subgroup differences: Not applicable

Analysis 3.2. Comparison 3 Attention training versus control - impact on attentional domains at post-treatment assessment, Outcome 2 Selective attention.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 3 Attention training versus control - impact on attentional domains at post-treatment assessment

Outcome: 2 Selective attention

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	32	-3.1 (7.1)	36	-1.89 (3.01)		30.7 %	-0.22 [-0.70, 0.25]
Rohring 2004	24	42.5 (9.1)	22	46.7 (13.4)		20.5 %	-0.36 [-0.95, 0.22]
Schottke 1997	16	4.33 (2.02)	13	3.25 (1.66)		12.5 %	0.56 [-0.19, 1.31]
Sturm 1991	13	96.3 (14.2)	14	97.3 (10.9)		12.3 %	-0.08 [-0.83, 0.68]
Westerberg 2007	9	-115.4 (21.7)	9	-112.7 (17.3)		8.2 %	-0.13 [-1.06, 0.79]
Winkens 2009	19	-42.4 (20.3)	16	-43.6 (20.5)		15.8 %	0.06 [-0.61, 0.72]
Total (95% CI)	**113**		**110**			**100.0 %**	**-0.08 [-0.35, 0.18]**

Heterogeneity: Chi^2 = 4.26, df = 5 (P = 0.51); I^2 =0.0%

Test for overall effect: Z = 0.62 (P = 0.53)

Test for subgroup differences: Not applicable

Analysis 3.3. Comparison 3 Attention training versus control - impact on attentional domains at post-treatment assessment, Outcome 3 Sustained attention.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 3 Attention training versus control - impact on attentional domains at post-treatment assessment

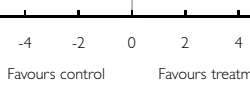
Outcome: 3 Sustained attention

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Barker-Collo 2009	32	-2.23 (3.29)	36	-3.03 (3.39)		30.1 %	0.24 [-0.24, 0.71]
Rohring 2004	24	43.6 (8.7)	22	45.6 (11.5)		27.2 %	-0.19 [-0.77, 0.39]
Schottke 1997	16	88.44 (15.3)	13	72.39 (6.29)		21.0 %	1.28 [0.47, 2.10]
Sturm 1991	12	100.3 (11.1)	14	94.7 (11.4)		21.7 %	0.48 [-0.30, 1.27]
Total (95% CI)	**84**		**85**			**100.0 %**	**0.39 [-0.16, 0.94]**

Heterogeneity: $Tau^2 = 0.20$; $Chi^2 = 8.68$, df = 3 (P = 0.03); $I^2 = 65\%$

Test for overall effect: Z = 1.40 (P = 0.16)

Test for subgroup differences: Not applicable



Analysis 3.4. Comparison 3 Attention training versus control - impact on attentional domains at post-treatment assessment, Outcome 4 Divided attention.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 3 Attention training versus control - impact on attentional domains at post-treatment assessment

Outcome: 4 Divided attention

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	32	-1.13 (0.94)	36	-1.76 (0.66)		40.6 %	0.77 [0.28, 1.27]
Rohring 2004	24	41.5 (9.5)	22	37 (8.8)		28.8 %	0.48 [-0.11, 1.07]
Westerberg 2007	9	53.6 (6.4)	9	47 (8.4)		10.5 %	0.84 [-0.13, 1.82]
Winkens 2009	18	45.3 (9.2)	15	37.7 (14.5)		20.1 %	0.62 [-0.08, 1.33]
Total (95% CI)	**83**		**82**			**100.0 %**	**0.67 [0.35, 0.98]**

Heterogeneity: Chi^2 = 0.70, df = 3 (P = 0.87); I^2 =0.0%

Test for overall effect: Z = 4.15 (P = 0.000034)

Test for subgroup differences: Not applicable

Analysis 4.1. Comparison 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:, Outcome 1 Functional abilities.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:

Outcome: 1 Functional abilities

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Rohring 2004	24	123.66 (5.15)	22	121.13 (8.98)		61.3 %	0.34 [-0.24, 0.93]
Schottke 1997	16	71.88 (27.86)	13	65.39 (31.79)		38.7 %	0.21 [-0.52, 0.95]
Total (95% CI)	**40**		**35**			**100.0 %**	**0.29 [-0.16, 0.75]**

Heterogeneity: Chi^2 = 0.08, df = 1 (P = 0.78); I^2 =0.0%

Test for overall effect: Z = 1.26 (P = 0.21)

Test for subgroup differences: Not applicable

Analysis 4.2. Comparison 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:, Outcome 2 Mood.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:

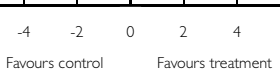
Outcome: 2 Mood

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Rohring 2004	24	-28.17 (5.51)	22	-27.18 (5.33)		42.3 %	-0.18 [-0.76, 0.40]
Schottke 1997	16	-5.56 (3.39)	13	-5.77 (4.11)		26.6 %	0.05 [-0.68, 0.79]
Winkens 2009	18	-10.7 (9.2)	16	-13.2 (11)		31.1 %	0.24 [-0.43, 0.92]
Total (95% CI)	**58**		**51**			**100.0 %**	**0.01 [-0.36, 0.39]**

Heterogeneity: Chi^2 = 0.88, df = 2 (P = 0.65); I^2 =0.0%

Test for overall effect: Z = 0.07 (P = 0.94)

Test for subgroup differences: Not applicable

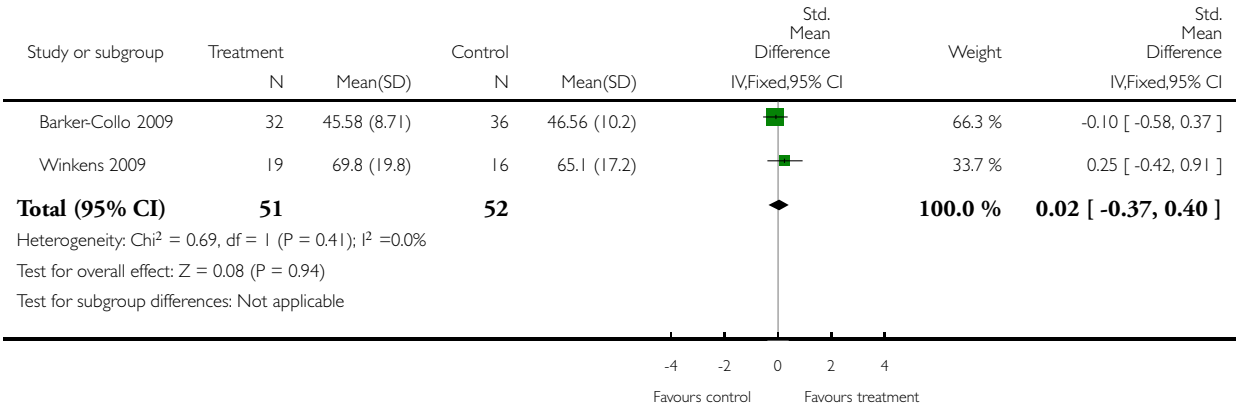


Analysis 4.3. Comparison 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:, Outcome 3 Quality of life.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 4 Attention training versus control - impact on functional abilities in daily living, mood and quality of life at post-treatment assessment:

Outcome: 3 Quality of life

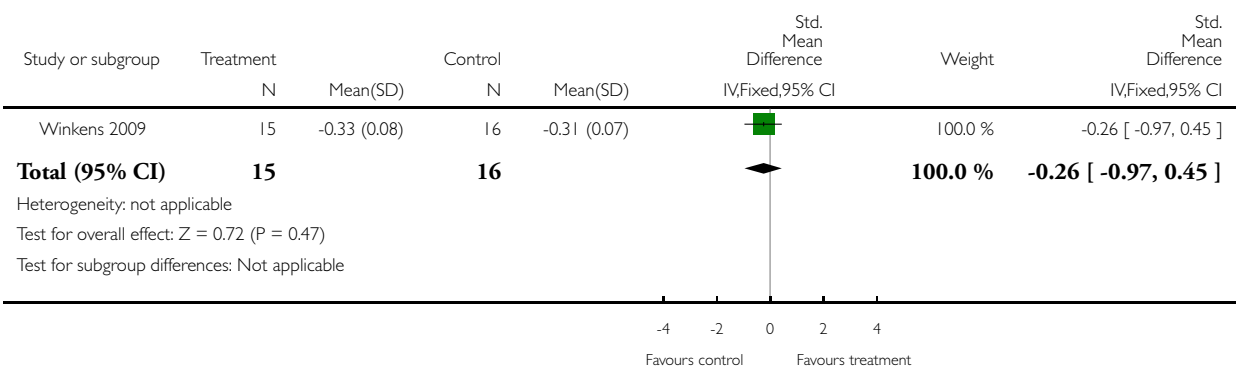


Analysis 5.1. Comparison 5 Attention training versus control - impact on attentional domains at follow-up , Outcome 1 Alertness at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 5 Attention training versus control - impact on attentional domains at follow-up

Outcome: 1 Alertness at follow-up



Analysis 5.2. Comparison 5 Attention training versus control - impact on attentional domains at follow-up , Outcome 2 Selective attention at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 5 Attention training versus control - impact on attentional domains at follow-up

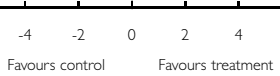
Outcome: 2 Selective attention at follow-up

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	-1.75 (5.59)	35	-2.17 (8.12)		66.6 %	0.06 [-0.42, 0.54]
Winkens 2009	17	-40.8 (14)	16	-42.5 (18.3)		33.4 %	0.10 [-0.58, 0.79]
Total (95% CI)	**48**		**51**			**100.0 %**	**0.07 [-0.32, 0.47]**

Heterogeneity: $Chi^2 = 0.01$, df = 1 (P = 0.92); $I^2 = 0.0\%$

Test for overall effect: Z = 0.36 (P = 0.72)

Test for subgroup differences: Not applicable



Analysis 5.3. Comparison 5 Attention training versus control - impact on attentional domains at follow-up , Outcome 3 Sustained attention at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 5 Attention training versus control - impact on attentional domains at follow-up

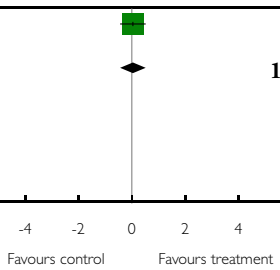
Outcome: 3 Sustained attention at follow-up

Study or subgroup	Experimental N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	-2 (3.29)	35	-2.15 (2.84)		100.0 %	0.05 [-0.44, 0.53]
Total (95% CI)	**31**		**35**			**100.0 %**	**0.05 [-0.44, 0.53]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.20 (P = 0.84)

Test for subgroup differences: Not applicable



Analysis 5.4. Comparison 5 Attention training versus control - impact on attentional domains at follow-up , Outcome 4 Divided attention at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 5 Attention training versus control - impact on attentional domains at follow-up

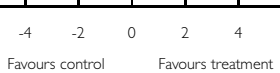
Outcome: 4 Divided attention at follow-up

Study or subgroup	Experimental N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	-1.15 (0.85)	35	-1.4 (0.62)		66.8 %	0.34 [-0.15, 0.82]
Winkens 2009	17	44.8 (14.4)	16	38.4 (16.6)		33.2 %	0.40 [-0.29, 1.09]
Total (95% CI)	**48**		**51**			**100.0 %**	**0.36 [-0.04, 0.76]**

Heterogeneity: Chi^2 = 0.02, df = 1 (P = 0.88); I^2 =0.0%

Test for overall effect: Z = 1.76 (P = 0.078)

Test for subgroup differences: Not applicable



Analysis 6.1. Comparison 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up, Outcome 1 Functional abilities at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up

Outcome: 1 Functional abilities at follow-up

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	-1.94 (1.29)	35	-1.97 (1.22)		100.0 %	0.02 [-0.46, 0.51]
Total (95% CI)	**31**		**35**			**100.0 %**	**0.02 [-0.46, 0.51]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.10 (P = 0.92)

Test for subgroup differences: Not applicable

Analysis 6.2. Comparison 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up, Outcome 2 Mood at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up

Outcome: 2 Mood at follow-up

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	-3.26 (3.2)	35	-3.97 (4.08)		67.3 %	0.19 [-0.29, 0.67]
Winkens 2009	17	-8.3 (7.1)	16	-12.1 (7.9)		32.7 %	0.49 [-0.20, 1.19]
Total (95% CI)	**48**		**51**			**100.0 %**	**0.29 [-0.11, 0.69]**

Heterogeneity: Chi^2 = 0.50, df = 1 (P = 0.48); I^2 =0.0%

Test for overall effect: Z = 1.43 (P = 0.15)

Test for subgroup differences: Not applicable

Analysis 6.3. Comparison 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up, Outcome 3 Quality of life at follow-up.

Review: Cognitive rehabilitation for attention deficits following stroke

Comparison: 6 Attention training versus control - impact on functional abilities in daily living, mood, and quality of life at follow-up

Outcome: 3 Quality of life at follow-up

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Barker-Collo 2009	31	48.99 (9.7)	35	47.3 (10.46)		67.2 %	0.17 [-0.32, 0.65]
Winkens 2009	17	76.3 (14.4)	16	69.7 (13.1)		32.8 %	0.47 [-0.23, 1.16]
Total (95% CI)	**48**		**51**			**100.0 %**	**0.26 [-0.13, 0.66]**

Heterogeneity: Chi^2 = 0.49, df = 1 (P = 0.48); I^2 =0.0%

Test for overall effect: Z = 1.30 (P = 0.19)

Test for subgroup differences: Not applicable

ADDITIONAL TABLES

Table 1. Attentional outcome measures used in the included studies

Study ID	Subjective global measure	Objective global measure	Alertness	Selective attention	Sustained attention	Divided attention
Barker-Collo 2009	Cognitive Failures Questionnaire*	-	-	Trail Making A**	IVA-CPT Full-Scale Attention Quotient**	PASAT (2.4 sec ISI)**
Rohring 2004	-	-	TAP phasic alertness	TAP selective attention	d2 (Hits-Errors)	TAP divided attention
Schottke 1997	-	-	Tempo-Lern-Test (1st block)	Zahlen-Verbindungstest	Konzentrations-Verlaufs-Test (combined speed/errors scores)	-
Sturm 1991	-	-	Wiener Reaktionsgerat Visual RT	Wiener Reaktionsgerat Choice RT	Wiener Vigilanzgerat (Hits)	-
Westerberg 2007	Cognitive Failures Questionnaire	-	-	Ruff 2&7	-	PASAT (2.4 sec ISI)
Winkens 2009	Mental Slowness Questionnaire**	-	Simple reaction time**	Trail Making A (time)**	-	PASAT (3.2 sec ISI)**

* only measured at follow-up, but not after treatment.
** measured after treatment and at follow-up.
ISI: inter-stimulus interval; IVA-CPT: Integrated Visual and Auditory Continuous Performance Test; PASAT: Paced Auditory Serial Addition Test; RT: reaction time; TAP: Tests of Attentional Performance.

Table 2. Functional outcome measures used in the included studies

Study ID	Functional abilities	Mood	Quality of life
Barker-Collo 2009	Modified Rankin*	GHQ*	SF-36 (MCS subscale)*
Rohring 2004	FIM	Depression Scale	-
Schottke 1997	Barthel	EMO-D	-

Table 2. Functional outcome measures used in the included studies (*Continued*)

Winkens 2009	-	CES-D**	EuroQOL VAS**

* only measured at follow-up, but not after treatment.
** measured after treatment and at follow-up.
CES-D: Center for Epidemiologic Studies Depression Scale; GHQ: General Health Questionnaire; MCS: mental component summary; SF: short form; VAS: visual analogue scale.

APPENDICES

Appendix 1. Allocation of outcome measures to attentional domains

Task	Primary attentional domain	Secondary attentional domain	Study ID
Behavioural Test of Inattentiveness in Daily Life	Unclear	-	Schottke 1997
Bells test	Spatial	Selective	Barker-Collo 2009
Cognitive Failures Questionnaire	Functional	-	Barker-Collo 2009; Westerberg 2007
Cognitrone	Selective	Alertness	Sturm 1991
d2	Selective	Sustained	Sturm 1991
Information Intake Task	Unclear	-	Winkens 2009
IVA-CPT Full-Scale Attention Quotient	Sustained	Selective	Barker-Collo 2009
Konzentrations-Verlaufs-Test	Sustained	Divided	Schottke 1997
Mental Slowness Observation Test	Unclear	-	Winkens 2009
Mental Slowness Questionnaire	Functional	-	Winkens 2009
PASAT (Paced Auditory Serial Addition Test)	Divided	Sustained	Barker-Collo 2009; Westerberg 2007; Winkens 2009

(*Continued*)

Ruff 2&7	Selective	Sustained	Westerberg 2007
Simple reaction time	Alertness	Sustained	Winkens 2009
Stroop	Selective	-	Westerberg 2007; Winkens 2009
Symbol Digit Modalities Test	Divided	Sustained	Winkens 2009
TAP subtest divided attention	Divided	Sustained	Rohring 2004
TAP subtest intrinsic alertness	Alertness	Sustained	Rohring 2004
TAP subtest phasic alertness	Alertness	Sustained	Rohring 2004
TAP subtest selective attention	Selective	Sustained	Rohring 2004
Tempo-Lern-Test	Alertness	Sustained	Schottke 1997
Trail Making A	Selective	-	Barker-Collo 2009; Winkens 2009
Trail Making B	Divided	-	Barker-Collo 2009; Winkens 2009
Visual-Discrimination-Conditioner	Sustained	Selective	Schottke 1997
Wahl-Reaktions-Test	Selective	Sustained	Schottke 1997
Wiener Determinationsgerat	Selective	Divided	Sturm 1991
Wiener Reaktionsgerat Auditory RT	Alertness	Sustained	Sturm 1991
Wiener Reaktionsgerat Choice RT	Selective	Alertness	Sturm 1991
Wiener Reaktionsgerat Visual RT	Alertness	Sustained	Sturm 1991
Wiener Vigilanzgerat	Sustained	Selective	Sturm 1991
Zahlen-Verbindungstest	Selective	-	Schottke 1997

IVA-CPT: Integrated Visual and Auditory Continuous Performance Test; RT: reaction time; TAP: Tests of Attentional Performance.

Appendix 2. MEDLINE search strategy (Ovid)

1. cerebrovascular disorders/ or exp basal ganglia cerebrovascular disease/ or exp brain ischemia/ or exp carotid artery diseases/ or exp intracranial arterial diseases/ or exp "intracranial embolism and thrombosis"/ or exp intracranial hemorrhages/ or stroke/ or exp brain infarction/ or vasospasm, intracranial/ or vertebral artery dissection/
2. (stroke or poststroke or post-stroke or cerebrovasc$ or brain vasc$ or cerebral vasc$ or cva$ or apoplex$ or SAH).tw.
3. ((brain$ or cerebr$ or cerebell$ or intracran$ or intracerebral) adj5 (isch?emi$ or infarct$ or thrombo$ or emboli$ or occlus$)).tw.
4. ((brain$ or cerebr$ or cerebell$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage$ or hemorrhage$ or haematoma$ or hematoma$ or bleed$)).tw.
5. brain injuries/ or brain injury, chronic/
6. or/1-5
7. attention/ or arousal/
8. ((attention$ or concentrat$ or arousal or alert$ or vigilance) adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
9. (inattention or distract$).tw.
10. (error adj3 control$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
11. (speed adj3 information adj3 process$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
12. (mental adj5 (slow$ or fatig$)).tw.
13. or/7-12
14. exp rehabilitation/ or cognitive therapy/ or exp computers/ or therapy, computer-assisted/ or exp neuropsychological tests/
15. (training or re-training or retraining or therap$ or rehabilitat$ or neurorehabilitat$ or treatment$ or therapeutic$).tw.
16. rehabilitation.fs.
17. ((attention$ or concentrat$ or arousal or alert$ or vigilance) adj6 (skill$ or abilit$ or function$ or improve$ or enhance$ or increas$ or strateg$ or task$)).tw.
18. or/14-17
19. 6 and 13 and 18
20. random allocation/ or randomized controlled trials as topic/ or controlled clinical trials as topic/ or evaluation studies as topic/
21. control groups/ or double-blind method/ or single-blind method/ or Placebos/ or placebo effect/ or cross-over studies/ or Therapies, Investigational/ or Research Design/ or Program Evaluation/
22. (randomized controlled trial or controlled clinical trial or (evaluation studies or comparative study)).pt.
23. random$.tw.
24. (controlled adj5 (trial$ or stud$)).tw.
25. (clinical$ adj5 trial$).tw.
26. ((control or treatment or experiment$ or intervention) adj5 (group$ or subject$ or patient$)).tw.
27. (quasi-random$ or quasi random$ or pseudo-random$ or pseudo random$).tw.
28. (therapeutic adj5 (trial$ or stud$)).tw.
29. ((control or experiment$ or conservative) adj5 (treatment or therapy or procedure or manage$)).tw.
30. ((singl$ or doubl$ or tripl$ or trebl$) adj5 (blind$ or mask$)).tw.
31. (coin adj5 (flip or flipped or toss$)).tw.
32. (cross-over or cross over or crossover).tw.
33. (placebo$ or sham or assign$ or alternate or allocat$ or counterbalance$ or multiple baseline or controls or (treatment$ adj6 order)).tw.
34. or/20-33
35. 19 and 34
36. exp animals/ not humans.sh.
37. 35 not 36
38. (traumatic not (stroke and traumatic)).ti.
39. 37 not 38

Appendix 3. EMBASE search strategy (Ovid)

1. cerebrovascular disease/ or basal ganglion hemorrhage/ or exp brain hematoma/ or exp brain hemorrhage/ or exp brain infarction/ or exp brain ischemia/ or exp carotid artery disease/ or cerebral artery disease/ or cerebrovascular accident/ or exp intracranial aneurysm/ or exp occlusive cerebrovascular disease/ or stroke/
2. stroke patient/ or stroke unit/
3. (stroke or poststroke or post-stroke or cerebrovasc$ or brain vasc$ or cerebral vasc$ or cva$ or apoplex$ or SAH).tw.
4. ((brain$ or cerebr$ or cerebell$ or intracran$ or intracerebral) adj5 (isch?emi$ or infarct$ or thrombo$ or emboli$ or occlus$)).tw.
5. ((brain$ or cerebr$ or cerebell$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage$ or hemorrhage$ or haematoma$ or hematoma$ or bleed$)).tw.
6. brain injury/
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp attention/ or attention deficit disorder/ or attention disturbance/ or arousal/ or concentration loss/
9. ((attention$ or concentrat$ or arousal or alert$ or vigilance or attentiveness or awareness) adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
10. (inattention or distract$).tw.
11. (error adj3 control$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
12. (speed adj3 information adj3 process$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
13. (mental adj5 (slow$ or fatig$)).tw.
14. 8 or 9 or 10 or 11 or 12 or 13
15. cognitive therapy/ or cognitive rehabilitation/ or rehabilitation/
16. exp computer/ or computer assisted therapy/ or computer interface/
17. (training or re-training or retraining or therap$ or rehabilitat$ or neurorehabilitat$ or treatment$ or therapeutic$).tw.
18. rh.fs.
19. ((attention$ or concentrat$ or arousal or alert$ or vigilance or attentiveness or awareness) adj6 (skill$ or abilit$ or function$ or improve$ or enhance$ or increas$ or strateg$ or task$)).tw.
20. 15 or 16 or 17 or 18 or 19
21. 7 and 14 and 20
22. Randomized Controlled Trial/
23. Randomization/
24. Controlled Study/
25. control group/
26. clinical trial/
27. Crossover Procedure/
28. Double Blind Procedure/
29. Single Blind Procedure/ or triple blind procedure/
30. Parallel Design/
31. placebo/
32. experimental design/ or experimental study/ or quasi experimental study/
33. experimental therapy/
34. research subject/
35. Comparative Study/
36. random$.tw.
37. (controlled adj5 (trial$ or stud$)).tw.
38. (clinical$ adj5 trial$).tw.
39. ((control or treatment or experiment$ or intervention) adj5 (group$ or subject$ or patient$)).tw.
40. (quasi-random$ or quasi random$ or pseudo-random$ or pseudo random$).tw.
41. (therapeutic adj5 (trial$ or stud$)).tw.
42. ((control or experiment$ or conservative) adj5 (treatment or therapy or procedure or manage$)).tw.
43. ((singl$ or doubl$ or tripl$ or trebl$) adj5 (blind$ or mask$)).tw.
44. (coin adj5 (flip or flipped or toss$)).tw.

45. (cross-over or cross over or crossover).tw.
46. placebo$.tw.
47. sham.tw.
48. (assign$ or alternate or allocat$ or counterbalance$ or multiple baseline).tw.
49. controls.tw.
50. (treatment$ adj6 order).tw.
51. or/22-50
52. 21 and 51
53. limit 52 to human

Appendix 4. PsycINFO search strategy (Ovid)

1. cerebrovascular accidents/ or cerebrovascular disorders/ or exp cerebral ischemia/ or cerebral hemorrhage/ or subarachnoid hemorrhage/
2. "brain lesions (disorders)"/
3. (stroke or poststroke or post-stroke or cerebrovasc$ or brain vasc$ or cerebral vasc$ or cva$ or apoplex$ or SAH).tw.
4. ((brain$ or cerebr$ or cerebell$ or intracran$ or intracerebral) adj5 (isch?emi$ or infarct$ or thrombo$ or emboli$ or occlus$)).tw.
5. ((brain$ or cerebr$ or cerebell$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage$ or hemorrhage$ or haematoma$ or hematoma$ or bleed$)).tw.
6. brain injur$.tw
7. or/1-6
8. exp attention/ or exp attention deficit disorder/ or exp concentration/ or exp sustained attention/ or exp divided attention/ or attention span/ or exp visual attention/ or exp selective attention/
9. ((attention$ or concentrat$ or arousal or alert$ or vigilance or attentiveness or awareness) adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
10. (inattention or distract$).tw.
11. (error adj3 control$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
12. (speed adj3 information adj3 process$ adj5 (impair$ or deficit$ or disorder$ or problem$ or diminish$ or decreas$ or reduc$)).tw.
13. (mental adj5 (slow$ or fatig$)).tw.
14. or/8-13
15. cognitive therapy/ or cognitive behavior therapy/ or cognitive rehabilitation/ or rehabilitation/
16. computer assisted therapy/ or exp computers/ or human computer interaction/ or computer training/
17. (training or re-training or retraining or therap$ or rehabilitat$ or neurorehabilitat$ or treatment$ or therapeutic$).tw or training/
18. ((attention$ or concentrat$ or arousal or alert$ or vigilance or attentiveness or awareness) adj6 (skill$ or abilit$ or function$ or improve$ or enhance$ or increas$ or strateg$ or task$)).tw.
19. or/15-18
20. 7 and 14 and 19
21. clinical trials/
22. treatment effectiveness evaluation/
23. exp treatment outcomes/
24. placebo/
25. experimentation/ or experiment controls/ or experimental design/ or experimental subjects/ or exp experimental methods/ or empirical methods/
26. random$.tw.
27. (controlled adj5 (trial$ or stud$)).tw.
28. (clinical$ adj5 trial$).tw.
29. ((control or treatment or experiment$ or intervention) adj5 (group$ or subject$ or patient$)).tw.
30. (quasi-random$ or quasi random$ or pseudo-random$ or pseudo random$).tw.
31. (therapeutic adj5 (trial$ or stud$)).tw.
32. ((control or experiment$ or conservative) adj5 (treatment or therapy or procedure or manage$)).tw.

33. ((singl$ or doubl$ or tripl$ or trebl$) adj5 (blind$ or mask$)).tw.
34. (coin adj5 (flip or flipped or toss$)).tw.
35. (cross-over or cross over or crossover).tw.
36. placebo$.tw.
37. sham.tw.
38. (assign$ or alternate or allocat$ or counterbalance$ or multiple baseline).tw.
39. controls.tw.
40. (treatment$ adj6 order).tw.
41. or/21-40
42. 20 and 41
43. limit 42 to human

Appendix 5. CINAHL search strategy (EBSCO)

1. (MH "Cerebrovascular Disorders") OR (MH "Basal Ganglia Cerebrovascular Disease+") OR (MH "Carotid Artery Diseases+") OR (MH "Cerebral Ischemia+") OR (MH "Cerebral Vasospasm") OR (MH "Intracranial Arterial Diseases+") OR (MH "Intracranial Embolism and Thrombosis") OR (MH "Intracranial Hemorrhage+") OR (MH "Stroke") OR (MH "Vertebral Artery Dissections") OR (MH "Brain Injuries")
2. (MH "Stroke Patients") OR (MH "Stroke Units")
3. TI (stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* or cerebral vasc or cva or apoplex or SAH) or AB (stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* or cerebral vasc or cva or apoplex or SAH)
4. TI (brain* or cerebr* or cerebell* or intracran* or intracerebral) or AB (brain* or cerebr* or cerebell* or intracran* or intracerebral)
5. TI (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*) or AB (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*)
6. S4 and S5
7. TI (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) or AB (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid)
8. TI (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*) or AB (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*)
9. S7 and S8
10. S1 OR S2 OR S3 OR S6 OR S9
11. (MH "Arousal") OR (MH "Attention")
12. (MH "Attention Deficit Hyperactivity Disorder")
13. TI ((attention* OR concentrat* OR arousal OR alert* OR vigilance OR attentiveness OR awareness) N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*)) OR AB ((attention* OR concentrat* OR arousal OR alert* OR vigilance OR attentiveness OR awareness) N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*))
14. TI (inattention OR distract*) OR AB (inattention OR distract*)
15. TI (error N3 control* N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*)) OR AB (error N3 control* N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*))
16. TI (speed N3 information N3 process* N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*)) OR AB (speed N3 information N3 process* N5 (impair* OR deficit* OR disorder* OR problem* OR diminish* OR decreas* OR reduc*))
17. TI (mental N5 (slow* OR fatig*)) OR AB (mental N5 (slow* OR fatig*))
18. S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17
19. (MH "Cognitive Therapy")
20. (MH "Rehabilitation") OR (MH "Rehabilitation, Cognitive")
21. (MH "Therapy, Computer Assisted")
22. (MH "User-Computer Interface")
23. TI (training OR re-training OR retraining OR therap* OR rehabilitat* OR neurorehabilitat* OR treatment* OR therapeutic*) OR AB (training OR re-training OR retraining OR therap* OR rehabilitat* OR neurorehabilitat* OR treatment* OR therapeutic*)

24. TI ((attention* OR concentrat* OR arousal OR alert* OR vigilance OR attentiveness OR awareness) N6 (skill* OR abilit* OR function* OR improve* OR enhance* OR increas* OR strateg* OR task*)) OR AB ((attention* OR concentrat* OR arousal OR alert* OR vigilance OR attentiveness OR awareness) N6 (skill* OR abilit* OR function* OR improve* OR enhance* OR increas* OR strateg* OR task*))
25. S19 OR S20 OR S21 OR S22 OR S23 OR S24
26. S10 AND S18 AND S25
27. PT randomized controlled trial or clinical trial
28. (MH "Random Assignment") or (MH "Random Sample+")
29. (MH "Crossover Design") or (MH "Clinical Trials") or (MH "Double-Blind Studies") or (MH "Intervention Trials") or (MH "Preventive Trials") or (MH "Randomized Controlled Trials") or (MH "Single-Blind Studies") or (MH "Therapeutic Trials") or (MH "Triple-Blind Studies") or (MH "Comparative Studies")
30. (MH "Control (Research)") or (MH "Control Group")
31. (MH "Factorial Design") or (MH "Quasi-Experimental Studies") or (MH "Nonrandomized Trials")
32. (MH "Placebo Effect") or (MH "Placebos") or (MH "Meta Analysis")
33. (MH "Clinical Research") or (MH "Clinical Nursing Research")
34. (MH "Community Trials") or (MH "Experimental Studies") or (MH "One-Shot Case Study") or (MH "Pretest-Posttest Design+") or (MH "Solomon Four-Group Design") or (MH "Static Group Comparison") or (MH "Study Design")
35. TI random* or AB random*
36. TI (controlled N5 (trial* OR stud*)) OR AB (controlled N5 (trial* OR stud*))
37. TI (clinical* N5 trial*) OR AB (clinical* N5 trial*)
38. TI ((control OR treatment OR experiment* OR intervention) N5 (group* OR subject* OR patient*)) OR AB ((control OR treatment OR experiment* OR intervention) N5 (group* OR subject* OR patient*))
39. TI (therapeutic N5 (trial* OR stud*)) OR AB (therapeutic N5 (trial* OR stud*))
40. TI ((control OR experiment* OR conservative) N5 (treatment OR therapy OR procedure OR manage*)) OR AB ((control OR experiment* OR conservative) N5 (treatment OR therapy OR procedure OR manage*))
41. TI ((singl* OR doubl* OR tripl* OR trebl*) N5 (blind* OR mask*)) OR AB ((singl* OR doubl* OR tripl* OR trebl*) N5 (blind* OR mask*))
42. TI (coin N5 (flip OR flipped OR toss*)) OR AB (coin N5 (flip OR flipped OR toss*))
43. TI (cross-over OR cross over OR crossover OR placebo* OR sham) OR AB (cross-over OR cross over OR crossover OR placebo* OR sham)
44. TI (assign* OR alternate OR allocat* OR counterbalance* OR multiple baseline OR controls OR treatment N6 order) OR AB (assign* OR alternate OR allocat* OR counterbalance* OR multiple baseline OR controls OR treatment N6 order)
45. S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44
46. S26 AND S45

WHAT'S NEW

Last assessed as up-to-date: 15 February 2013.

Date	Event	Description
15 October 2012	New search has been performed	We updated the searches and included four new trials. There are now six included trials with a total of 223 participants. We have added a stricter definition of the inclusion criteria and outcome measures. There is also a newly added assessment of long-term effects. The conclusions have not changed since the last version was published

(*Continued*)

15 October 2012	New citation required but conclusions have not changed	New first author

HISTORY

Protocol first published: Issue 4, 2000

Review first published: Issue 4, 2000

Date	Event	Description
4 August 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Nadina Lincoln initiated the 2000 review and was the principal grant holder for the initial review. In this updated version of the review, she co-ordinated the review project, conducted data collection and analysis and contributed to the final report.

Tobias Loetscher conducted the searches, data collection and analysis and prepared the final report for this update.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- NHS Executive Research and Development Physical and Complex Disabilities, UK.
- Swiss National Science Foundation, Switzerland.
- Australian Research Council, Australia.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

This is an update of an earlier review and there was no published protocol.

INDEX TERMS

Medical Subject Headings (MeSH)

*Attention; *Cognitive Therapy; *Stroke Rehabilitation; Cognition Disorders [etiology; *rehabilitation]; Randomized Controlled Trials as Topic; Stroke [complications]

MeSH check words

Humans