Cochrane Library

Cochrane Database of Systematic Reviews

Speech and language therapy interventions for children with primary speech and language delay or disorder (Review)

Law J, Garrett Z, Nye C

Law J, Garrett Z, Nye C.
Speech and language therapy interventions for children with primary speech and language delay or disorder.
Cochrane Database of Systematic Reviews 2003, Issue 3. Art. No.: CD004110.
DOI: 10.1002/14651858.CD004110.

www.cochranelibrary.com

WILEY

TABLE OF CONTENTS

[Intervention Review]

Speech and language therapy interventions for children with primary speech and language delay or disorder

James Law[1], Zoe Garrett[2], Chad Nye[3]

[1]Institute of Health and Society, School of Education, Communication and Language Sciences, Newcastle University, Newcastle-upon-Tyne, UK. [2]Health Economics Research Group (HERG), Gaskell Building, Uxbridge, UK. [3]UCF CARD Center, University of Central Florida, Orlando, Florida, USA

Contact: James Law, Institute of Health and Society, School of Education, Communication and Language Sciences, Newcastle University, Queen Victoria Road, Newcastle-upon-Tyne, NE1 7RU, UK. James.Law@ncl.ac.uk, jcl@juming.u-net.com.

Editorial group: Cochrane Developmental, Psychosocial and Learning Problems Group.
Publication status and date: Edited (no change to conclusions), published in Issue 5, 2015.

Citation: Law J, Garrett Z, Nye C. Speech and language therapy interventions for children with primary speech and language delay or disorder. *Cochrane Database of Systematic Reviews* 2003, Issue 3. Art. No.: CD004110. DOI: 10.1002/14651858.CD004110.

ABSTRACT

Background

It is thought that approximately 6% of children have speech and language difficulties of which the majority will not have any other significant developmental difficulties. Whilst most children's difficulties resolve, children whose difficulties persist into primary school may have long-term problems concerning literacy, socialisation, behaviour and school attainment.

Objectives

To examine the effectiveness of speech and language interventions for children with primary speech and language delay/disorder.

Search methods

The following databases were searched: The Cochrane Controlled Trials Register (Cochrane Library, CENTRAL: 2002/3), CINAHL (1982 - July 2002), EMBASE (1980 - Sept Week 4 2002), ERIC (1965 - 2002), MEDLINE (1966 - Sept Week 3 2002), PsycINFO (1872 - 2002/10 Week 2), The National Research Register (2002/3). In addition to this references were taken from reviews of the literature and reference lists from articles.

Selection criteria

The review considered randomised controlled trials of speech and language therapy interventions for children or adolescents with primary speech and language delay/disorder.

Data collection and analysis

Titles and abstracts were identified and assessed for relevance, before the full text version was obtained of all potentially relevant articles. The data were categorised depending on the nature of the control group and considered in terms of the effects of intervention on expressive and receptive phonology, syntax and vocabulary. The outcomes used in the analysis were dependent on the focus of the study with only the primary effects of therapy being considered in this review.

Main results

The results of twenty-five studies were used in the meta-analysis. The results suggest that speech and language therapy is effective for children with phonological (SMD=0.44, 95%CI: 0.01,0.86) or vocabulary difficulties (SMD=0.89, 95%CI: 0.21,1.56), but that there is less evidence that interventions are effective for children with receptive difficulties (SMD=-0.04, 95%CI: -0.64,0.56). Mixed findings were found concerning the effectiveness of expressive syntax interventions (n=233; SMD=1.02, 95%CI: 0.04-2.01). No significant differences were shown between clinician administered intervention and intervention implemented by trained parents, and studies did not show a difference

between the effects of group and individual interventions (SMD=0.01, 95%CI: -0.26,1.17). The use of normal language peers in therapy was shown to have a positive effect on therapy outcome (SMD=2.29, 95%CI: 1.11,3.48).

Authors' conclusions

The review shows that overall there is a positive effect of speech and language therapy interventions for children with expressive phonological and expressive vocabulary difficulties. The evidence for expressive syntax difficulties is more mixed, and there is a need for further research to investigate intervention for receptive language difficulties. There is a large degree of heterogeneity in the results, and the sources of this need to be investigated.

PLAIN LANGUAGE SUMMARY

Speech and language therapy interventions for children with primary speech and language delay or disorder

Primary speech and language delay/disorder is a common developmental difficulty which, if unresolved, can cause difficulties of both learning and socialisation lasting into adolescence and beyond. This review examines the effectiveness of speech and language therapy interventions for children with primary speech and language delay/disorder.The review concludes that whilst there may be some support for the effectiveness of speech and language therapy for children with expressive phonological and expressive vocabulary difficulties, the evidence concerning the effectiveness of interventions for expressive syntax is mixed, and no evidence is available concerning interventions for children with receptive language difficulties.

BACKGROUND

Speech and language delay/disorder is a common developmental difficulty in childhood. It may present either as a secondary difficulty (where it can be accounted for by a primary condition such as: autism, hearing impairment, general developmental difficulties, behavioural or emotional difficulties or neurological impairment), or it may be considered primary when it cannot be accounted for by any other condition (Stark 1981, Plante 1998). Whilst prevalence figures for speech and language difficulties as a whole vary from 1-15% (Law 2000) depending on inclusion criteria, it is thought that on average approximately 6% of children may have speech and language difficulties (Boyle 1996), of which a significant proportion will have primary speech and language difficulties. It is recognised that there may be overlap between primary and secondary delay/disorders especially when the features of the primary disability are less pronounced but this distinction remains clinically useful and it is one commonly reported in the literature (Leonard 1998).

Presentation of primary speech and language delay/disorder is heterogeneous. Difficulties may be persistent or transient and present as delayed or disordered speech, expressive or receptive language difficulties or a combination of these. There is little consensus on the aetiology of primary language delay/disorder but a number of studies suggest correlations with multiple risk factors such as chronic otitis media, genetic factors, socio-economic status, difficulties in pregnancy, and oral-motor difficulties (Whitehurst 1991, Tomblin 1997). It may be that these act in a cumulative fashion to increase the severity of the presenting disorder (Aram 1980). From current evidence, it is unclear whether primary speech and language delay/disorder represents varying levels of a single condition or a number of different conditions with diverse aetiologies but similar presenting patterns (Law 1998).

Primary speech and language delay/disorder is of significant concern to those involved with child development and has far reaching implications for the child, parent and carer. Studies indicate that language delay may have adverse effects upon school achievement (Aram 1984, Bishop 1990, Catts 1993, Tallal 1997, Baker 1987) and/or be associated with social, emotional and behavioural problems (Huntley 988, Rice 1991, Rutter 1992, Cohen 2000,Stothard 1998). Children with primary language delay/disorder can also have long-term difficulties which persist to adolescence and beyond (Haynes 1991, Rescorla 1990) with some 30-60% experiencing continuing problems in reading and spelling. Therefore, primary speech and language delay/disorder, has the potential to impact significantly on the individual, family and society in both the short and long term.

Because of the range of difficulties within the diagnosis primary speech and language delay/disorder interventions may take many forms. Law et al (2000) define approaches to intervention using three categories: didactic (direct training of linguistic behaviours), naturalistic (teaching the child to respond effectively to the linguistic demands of the environment) and hybrid (a combination of didactic and naturalistic). These terms provide a useful framework to outline approaches to intervention, although, a therapist may use an eclectic approach and adapt interventions according to the response of the client.

Intervention may take place in many different environments, for example, the home, school or clinic and will vary in duration and intensity dependent on the resources available, perceived needs of the child and policies of individual speech and language therapy services. Intervention may also be delivered indirectly through a third person or directly through the clinician. Direct intervention focuses on the treatment of the child either individually or within a group of children depending on the age and needs of the children requiring therapy and the facilities available. Indirect intervention is often perceived to be a more naturalistic approach where adults in the child's environment facilitate communication. Traditionally this approach is used to create an optimum communicative environment for the child by promoting positive parent-child interaction. Indirect approaches are increasingly being employed within a range of settings, where speech and language therapists train professionals and carers who work with the children and provide programmes or advice on how to maximise the child's communicative environment and enhance communicative attempts.

There are no universal guidelines on what type of intervention to offer children with primary speech and language delay/disorder or on its' timing, nor is there consistent evidence upon which to base a decision, meaning that the decision is often left to individual therapists and services. Whilst a number of reviews have been carried out in order to summarise the literature, these have largely been narrative and non-systematic and therefore may be prone to bias and inaccuracies (Enderby 1996, Law 1997, Leonard 1998, McLean 1997, Olswang 1998). Two reviews have also included a meta-analysis (Nye 1987, Law 1998). In the former a variety of study designs were included in the analysis which may have affected the accuracy of the results due to potential bias from the inclusion of poorer quality study designs. In the second review only studies that compared speech and language therapy interventions with no treatment were included, and therefore the conclusions could not make distinctions between the relative effects of different treatments in treating the similar participants. This systematic review is based on randomised controlled trials that are methodologically least prone to potential sources of bias, and it also considers evidence from randomised controlled trials that compare traditional and experimental treatments. In doing this it extends the evidence base and has the potential to help practitioners decide between different types of intervention.

The aim of this review is to search systematically for, and combine evidence from, randomised controlled trials (RCTs) relating to the effectiveness of intervention approaches for primary speech and language delay/disorder in children and adolescents.

OBJECTIVES

To determine the effectiveness of speech and language intervention for children with a primary diagnosis of speech/language delay/disorder.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials of interventions for primary speech and language delay/disorder.

Types of participants

Children or adolescents with a diagnosis of primary speech and language delay/ disorder. No upper age limit was set during the searches, however the oldest participants in studies identified for the review were fifteen. Children whose difficulties arose from stuttering or whose difficulties were described as learned misarticulations e.g. lateral /s/ or labialised /r/ were excluded from this review.

Types of interventions

Any type of intervention designed to improve an area of speech or language functioning concerning either expressive or receptive phonology (production or understanding of speech sounds), expressive or receptive vocabulary (production or understanding of words), or expressive or receptive syntax (production or understanding of sentences and grammar). Three comparisons were investigated:

1. Interventions compared to delayed or no treatment conditions e.g. studies where control children are assigned to a delayed treatment or no treatment condition.

2. Interventions compared to general stimulation conditions e.g. studies where control children are assigned to a control condition designed to mimic the interaction found in therapy without providing the target linguistic input. This may be a cognitive therapy, general play sessions or a speech and language therapy treatment that does not focus on the area of interest in the study.

3. Interventions compared to other speech and language therapy approaches e.g. studies may compare what they consider to be a 'traditional treatment' with what they consider to be an experimental treatment. This may be a different approach carried out by the same person e.g. targeting early versus late developing sounds, or the same approach carried out by different people e.g. focused stimulation given by clinicians versus parents.
A general rule was applied to studies comparing treatments:

- Group therapy was considered to be experimental and individual therapy the control
- Indirect interventions were considered to be experimental and direct interventions the control
- Interactive approaches were considered to be experimental and directive approaches the control

If conditions could not be categorised according to these rules, then the conditions were labelled as experimental or traditional according to background information in the literature review.

Types of outcome measures

Types of outcome measure included formal standardised tests, criterion referenced tests, parent report and language samples. Areas measured included aspects of expressive or receptive language functioning in areas of semantics, syntax, and phonology. Non-linguistic outcomes such as behaviour, esteem, and literacy measures were not used in this review.

Outcomes used in the review were dependent on the focus of the intervention e.g. for studies specifying intervention for expressive difficulties effect size was calculated using expressive language measures.

Outcomes for analysis were considered on three levels:
1. At the level of the target for intervention e.g. improvement in targeted speech sounds or syntactic structure.
2. At the level of language functioning e.g. improvement in overall phonological or expressive language maturity.
3. At the level of broader language functioning e.g. improvement in intelligibility, improvement in parent report of language.

Search methods for identification of studies

Studies were identified from the following sources:
The Cochrane Controlled Trials Register (CCTR) (Cochrane Library, central: 2002/3)
Cumulative Index of Nursing and Allied Health (1982 - July 2002)
EMBASE (1980 - Sept Week 4 2002)
ERIC (1965 - 2002)
MEDLINE (1966 - Sept Week 3 2002)
PsychINFO (1872 - 2002/10 Week 2)
The National Research Register (2002/3)
C2PSPECTRE (Database to December 2002)

The following search terms were used to identify articles. MESH terms were adapted to suit the fields of each of the databases:

1. randomi*
2. clin*
3. trial*
4. (clin* adj trial*)
5. singl*
6. doubl*
7. tripl*
8. trebl*
9. mask*
10. blind*
11. (5 or 6 or 7 or 8) and (9 or 10)
12. crossover
13. random*
14. allocate*
15. assign*
16. random* adj (allocat* or assign*)
17. RANDOM ASSIGNMENT
18. exp CLINICAL TRIALS
19. exp META ANALYSIS
20. 16 or 12 or 11 or 4 or 1 or 17 or 18 or 19
21. CHILD
22. child* or infant* or baby or babies or boy* or girl* or pre-school* or preschool* or teen* or adolescen* or schoolchild*
23. 21 or 22
24. COMMUNICATION DISORDERS
25. speech near disorder*
26. speech near delay*
27. language near disorder*
28. language near delay*
29. verbal near disorder*
30. aprosodi*
31. cluttering
32. dysglossia
33. rhinolalia
34. central and auditory and processing and disorder
35. semantic-pragmatic and disorder
36. 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35
37. speech near screen*
38. language near screen*

39. speech near patholog*
40. language near patholog*
41. speech near therap*
42. language near therap*

Further studies were identified through reference lists from articles and reviews of the literature.

Data collection and analysis

Selection of trials

All references from the search strategy were managed using reference manager. The titles and abstracts were screened against the inclusion criteria by the second author (ZG) in order to identify relevant articles. If it was unclear whether an article met the inclusion criteria then the full text version was obtained and the article more fully assessed. Once all potentially appropriate studies had been obtained, each study was evaluated independently by two reviewers (JL) and (ZG) for inclusion. In the event that there was a question as to the possible inclusion or exclusion of any individual study, a final consensus decision was made between JL and ZG. If the primary reviewers could not come to a consensus regarding the inclusion or exclusion of a study, the full article was submitted to the third reviewer (CN). Reviewers were not blinded to the name(s) of the author(s), institution(s) or publication source at any level of review.

Initially the studies were judged on the basis of their allocation concealment. Two reviewers independently assigned one of three quality codes as described in the Cochrane Collaboration Handbook (Clarke 2003):

(A)Indicates adequate concealment of allocation e.g. pre-numbered or coded identical containers administered serially to participants.
(B)Indicates uncertainty about whether the allocation was adequately concealed e.g. where authors did not describe the allocation methods.
(C)Indicates that the allocation was not adequately concealed e.g. alternate assignment.

For this review only studies considered to be of quality (A) or (B) were included in the review. The studies were then critically appraised by asking the following questions.

- Were the assessors blind to treatment allocation?
- Did the authors report a range of baseline characteristics for the participants? If baseline characteristics were reported and tested using significance tests, were significant differences between the groups found?
- Is there an explanation of why children withdrew?
- How were the data from these children used?
- What was the proportion of withdrawals?
- Was an intention-to-treat analysis used?
- Were the eligibility criteria adequately defined?
- Was a power calculation completed to ensure there were adequate participants to see a significant effect?

The studies were labelled using an A/B/C categorisation for each of the above areas:
(A)Component mentioned and adequate
(B)Component not reported
(C)Component mentioned but not adequate
A description of the quality codes for each of the appraised areas is provided in the methodological quality table (Table 1; Table 2).

Data management

Two reviewers independently extracted the data from the articles using a form covering the following:

- Methods,
- Participants,
- Interventions
- Outcomes.

Uncertainty and disagreement was resolved through discussion and consultation with the third reviewer. If further information was required then the first author of the study was contacted. In total fifteen authors were contacted to ask for further information or clarification, and eleven responses were received.

Due to the heterogeneity of controls used in the studies and the potential impact of this on effect size, the studies were initially categorised on the basis of their control groups. Three main comparisons were made:
1. Speech and Language Therapy Intervention versus No Treatment Controls
2. Speech and Language Therapy Intervention versus General Stimulation
3. Speech and Language Therapy Intervention versus Traditional Therapies

For each of the comparisons outcomes were analysed in seven categories, where measured:
1. Expressive phonology outcomes
2. Receptive phonology outcomes
3. Expressive syntax outcomes
4. Receptive syntax outcomes
5. Expressive vocabulary outcomes
6. Receptive vocabulary outcomes
7. Composite language outcomes

And each considered at three levels:
1. At the level of the target for intervention
2. At the level of overall language or speech maturity
3. At the level of broader functioning e.g. improvement in conversation

Data analysis

Missing Data

Authors were contacted and asked to supply missing data. Where authors could not be contacted or data could not be supplied, missing data and drop-outs were assessed for each individual study. The number of participants in the final analysis, as a proportion of all participants in each study is reported in the tables concerning methodological quality (Table 1; Table 2).

Multiple Treatment Arms

Nine studies combined more than one eligible intervention versus control intervention (Fey 1993; Gibbard 1994b; Lancaster 1991; Law 1999; Shelton 1978; Sommers 1964; Sommers 1966; Sommers

1962; Tufts 1959). With the exception of Shelton (1978), all of these studies compared clinician intervention with parent intervention or additional parental intervention. In the study by Shelton (1978) the authors compared two parent interventions with no intervention. The data from all these studies were analysed by pooling the number of participants, means and standard deviations using a pooled standard deviation formula which weighted the conditions on the basis of the number of participants in each trial arm. Sub-group analyses were then used to separate the data in order to compare clinician and parent intervention.

Measures of Treatment Effect

Binary Outcomes
None of the outcomes used in the analysis were reported as binary outcomes.

Continuous Outcomes
Studies reporting continuous outcomes were summarised using standardised mean differences (SMD) to allow the reviewers to combine studies that measured the same outcome using different methods.

Assessment of Heterogeneity

Statistical heterogeneity was assessed using the Chi-squared test for heterogeneity, and through visual inspection of forest plots. Analysis of heterogeneity investigated the potential impact of differences in child language characteristics, duration of treatment and administrator of treatment. Where excessive heterogeneity was found then the studies were not pooled in the analysis.

Data Synthesis

Data synthesis was carried out using Review Manager 4.1.1. A random effects model was used in the analysis so as to take into account the variation in the data due to potential study differences.

Sub-group Analysis

We planned and undertook sub-group analyses to assess the impact of the following study characteristics:

1. The role of administrator. Studies using clinicians as the administrators of intervention were examined separately and the results compared to the primary analysis.
2. The role of duration of treatment as an indicator of efficacy studies. Studies offering longer lengths of therapy were examined separately and the results compared to the primary analysis. It was not possible to analyse the results in terms of intensity as only nine studies that were not comparable included intensities of therapy over two hours a week.
3. The role of age. It was not possible to complete a sub-group analysis based on the age of the participants because only six studies (which were not comparable) included children over the age of seven.

We undertook one post-hoc subgroup analysis of expressive syntax and vocabulary outcomes removing a trial that specified that all children taking part in the study had severe receptive language difficulties. This was carried out to examine unexplained heterogeneity in the results.

Sensitivity Analysis

Sensitivity analyses were considered in order to take into account the potential effects of study quality. Randomisation, attrition and blinding were considered as potentially important factors (Juni 2001):

1. Randomisation: Only three studies reported their methods of randomisation so sensitivity analysis was not carried out.
2. Attrition: No study reported more than 15% attrition, but a fourteen studies did not report attrition levels. These studies were removed from the analysis and the results compared to the primary analysis
3. Blinding: Studies that reported the assessors were blind to group status were examined separately and the results compared to the primary analysis

Publication bias

Since there is a risk of bias associated with relatively low sample size, funnel plots were used to evaluate the relationship between effect size and study precision. Such a relationship could be due to publication or related biases or due to systematic differences between small and large studies. If a relationship was identified the clinical diversity of the studies was further examined for possible explanations (Egger 1997).

RESULTS

Description of studies

In total 630 citations were found from the database searches. On the basis of the titles and abstracts 49 were judged to be potentially relevant and the full text articles were obtained. Reasons for excluding papers generally concerned the research design or the nature of the difficulties of the participants. Having read the articles 21 were judged to have met the inclusion criteria. This number was augmented by a further eight articles identified from systematic reviews of the literature, six articles identified by the review authors and one article from the Campbell Collaboration trials database (C2SPECTRE). In total searches identified 36 papers for the review, reporting a total of 33 different trials (see the table of included studies).

The studies generally focused on a single aspect of therapy either phonology, or expressive or receptive language. Seven studies had a less defined focus of therapy and stated that they included more than one aspect of language as an aim for therapy. Two of these studies addressed the Ward Infant Language Screening Test: Aassessment, Acceleration and Remediation (WILSTAAR) early intervention programme (Ward 1994) and provided a composite language measures of receptive and expressive language development (Evans [forthcoming], Sutton 1999), three were English trials run within health care trusts (Barratt 1992, Glogowska, 2000, Law 1999), and the sixth and seventh studies did not clearly detail the interventions in terms of expressive and receptive components (Cole 1986, Head 1975). The study by Cole et al stated that intervention focused on syntax, semantics and pragmatics whilst comparing a directive to an interactive intervention approach, while that of Head et al compared using recreational games as an intervention approach to using perceptual motor activities. Neither study could be easily categorised due to the quality of reporting, and so the aims of therapy had to be determined by visual inspection of participants baseline expressive and receptive language scores.

The nature of the interventions were described in varying amounts of detail. While the area of focus, duration, intensity and administrator were most frequently described, other aspects of the intervention such as the tasks used and the relative proportions of different techniques were often not described. Although this did not affect the quality of the individual studies, as it is most commonly an artifact of the writing-up process, it did affect our ability to draw judgements concerning the comparability of the studies and will affect the practical application of techniques used in the studies to clinical practice.

Sixteen studies investigated either expressive or receptive phonology interventions. Five of these studies compared intervention provided by the clinician to delayed treatment (Almost 1998, Glogowska, 2000, Matheny 1978, Munro 1998, Reid 1996), three studies compared parent intervention and delayed intervention of which two used multiple conditions to compare parent and clinician intervention (Lancaster 1991, Shelton 1978, Tufts 1959), and a further four studies compared clinician intervention with and without additional parental intervention (Fudala 1972, Ruscello 1993, Sommers 1962, Sommers 1964). Four studies compared specific approaches to therapy investigating the differences in outcomes between using group and individual therapy (Sommers 1966), targetting either earlier or later developing speech sounds (Rvachew 2001), using speech sound discrimination tasks (e.g. hearing the differences between sounds) in addition to speech production tasks (e.g. saying the speech sounds) (Rvachew 1994) and using two different forms of physical education programme (Head 1975). The approaches to intervention used in the phonology studies were generally comparable with clinicians describing a hierarchical approach to therapy to encourage production of sounds in isolation and then in increasingly more complex linguistic structures. A small number of studies used a cycles approach to therapy that targeted sounds in cycles dependent on the phonological process. The interventions combined varying quantities of speech sound discrimination tasks in addition to speech production tasks, but for only three studies was sound discrimination the primary focus of the intervention; either without additional speech production tasks (Shelton 1978), or in addition to speech production tasks (Reid 1996, Rvachew 1994). The client groups described in the phonology studies were relatively homogenous with the majority of participants ranging in age from three to six years of age. In the earlier studies participants tended to be older and five studies reported participants aged over seven (Fudala 1972; Head 1975; Sommers 1964; Sommers 1966; Sommers 1962) The severity of the difficulties was generally at least one standard deviation below the mean on standardised assessment measures, although in several of the earliest studies participants were included with as few as three mis-articulated phonemes. There was a tendency in the phonology studies to exclude participants with other linguistic difficulties such as expressive delay or receptive delay. Most commonly this excluded any child with a receptive delay below one standard deviation from the mean.

Nineteen studies investigated expressive language interventions. The focus of expressive studies was more likely to be concerned with the provision of intervention through parent programmes such as the Hanen parent programme (Manolson 1992). Three studies compared parent implemented therapy to a control group who received delayed (Girolametto 1996a, Girolametto 1996b, Gibbard 1994a) and a further three studies had multiple conditions and compared parent intervention with clinician intervention and delayed intervention either implemented by parents or clinicians or general stimulation (Fey 1993, Gibbard 1994b, Law 1999). In addition, three studies investigated the effectiveness of clinician delivered therapy compared to delayed therapy (Glogowska, 2000; Robertson 1999; Schwartz 1985). Regardless of the administrator of therapy, the approaches used in these studies tended to be based on language stimulation and used more interactive (e.g. child led) and naturalistic methods to encourage word mapping or the development or more complex syntactic structures. Three studies addressed specific approaches to intervention such as the generalisation of 'is' interrogative (Mulac 1977), mimicry and modelling (Courtwright 1979) and play sessions with normal and language impaired play peers (Robertson 1997), and three studies investigated classroom-based interventions. One study compared individual therapy to classroom-based group intervention (Wilcox 1991), one study compared a directive (e.g. clinician led) approach to intervention to an interactive (e.g. child led) approach to intervention within a classroom environment (Cole 1986), and the final study compared weekly intervention to intensive intervention within a nursery setting (Barratt 1992). The participants in expressive language studies were normally of pre-school age, although in one study participants were between six and twelve years old (Head 1975). The children involved in these studies tended to have more severe difficulties with a number of studies specifying two standard deviations below the mean on tests of expressive language. The participants also had a range of other linguistic difficulties; commonly this was in phonology, but this could also be in receptive language and three studies specified that all children had receptive language difficulties (Robertson 1997, Law 1999, Wilcox 1991). Two studies investigated the effectiveness of WILSTAAR intervention looking at language development in children under a year old (Evans [forthcoming], Sutton 1999). These studies aimed to train parents to provide intervention to stimulate language development. To be included in these studies children had to score below one standard deviation in the combined receptive expressive emergent language (REEL) scale (Bzoch 1970).

Five studies investigated interventions for receptive language difficulties. One study specifically investigated comprehension intervention with older children through an approach called Visualising and Verbalising, where children were taught to visualise words and sentences to help them understand language (Dixon 2001). Two studies provided a more general focus to intervention but stated that there were receptive language aims (Glogowska, 2000; Law 1999). These two studies used much younger children than the first study and also included a focus on expressive intervention. The children in the receptive language studies tended to have more severe difficulties than in other studies. The older children in the study by Dixon had receptive language difficulties more than 2 SD below the mean, and the younger children in the studies by Glogowska and Law had receptive difficulties more than 1.25 SD below the mean or 1.5 SD below the mean respectively. In all three of the studies it was stated that children had additional expressive language problems. Two studies were included in this category because the participants were shown to have receptive difficulties, although the studies did not categorise therapy aims in terms of expressive and receptive language specifying instead; semantics, syntax and pragmatics (Cole 1986), and form, content and use (Barratt 1992). Children in the study by Cole had to score 1.5 SD below the mean on either expressive or receptive tests of

language, and those in the study by Barratt had to score 1SD below the mean on receptive and/or expressive language tests.

A variety of measures was used to investigate the outcomes of treatment. Authors investigating the effectiveness of phonology interventions were most likely to use standardised measures of overall phonological development. A smaller number of authors also used narrower measures such as production of target processes (Munro 1998, Ruscello 1993, Rvachew 2001), and broader measures such as percentage of consonants correct in conversation (Almost 1998). Studies investigating expressive language interventions tended to use broader outcome measures, drawing on information from parental report and language samples. These were used to measure the increase in number of words or utterances, and the increase in complexity of utterances (See for example: Fey 1993, Gibbard 1994a, Law 1999). Standardised measures of expressive syntax and vocabulary were also used, but were less likely to be administered than in the phonology studies. The outcomes measured in the studies focusing on receptive language were more diverse due to the differing ages of the client groups and the broader range of intervention targets within the studies. However, there was a tendency for these studies to use standardised outcomes measures. Second-order effects were also investigated and a number of studies reported phonology outcomes following expressive language intervention in separate papers (Fey 1994, Girolametto 1997). Four studies also included non-linguistic second-order effects that may have benefited from the speech and language therapy. These included measures of behaviour or socialisation (Girolametto 1996a; Glogowska, 2000; Law 1999; Robertson 1999), and the effects of intervention on parents in terms of esteem (Law 1999) and stress (Robertson 1999).

Risk of bias in included studies

Each of the studies was assessed for methodological quality and assigned a quality code for a number of potentially important areas: blinding of assessors, reporting of participants' baseline characteristics and assessment of similarity, explanation of withdrawals, discounting of missing values, degree of participant attrition, use of intention to treat analysis, completion of a power calculation and description of eligibility criteria (Table 1; Table 2). In addition the methods of selecting participants and the size of the sample were also noted. The results reported here are for the thirty-three different studies that were used in the review, although methodological quality ratings were also given to follow-up studies and separate papers reporting different outcomes for the same study.

In eighteen instances it was not clear how the participants in the trials had been recruited and selected. In the remaining studies one had used a random sample of participants referred by clinicians (Sommers 1966), and six had enrolled all eligible participants over a specified time span (Almost 1998; Evans [forthcoming]; Glogowska, 2000; Law 1999; Munro 1998; Sutton 1999). Five studies had actively enrolled participants through advertisements (Fey 1993; Girolametto 1996b; Robertson 1999), and letters home from school (Sommers 1962; Tufts 1959), and in another three cases participants agreed to complete the full number of intervention sessions before being included in the study (Dixon 2001; Fudala 1972; Ruscello 1993). The use of self-selecting samples means that in some instances results may need to be interpreted cautiously; these may create larger effect sizes than investigations using a more mixed clinical population.

The sample sizes ranged from eight to 240, although the majority of studies included between ten and 30 participants (18 studies). This size is relatively small and therefore the degree to which some of the studies are able show significant effects needs to be considered. Four studies completed power calculations (Almost 1998; Barratt 1992; Law 1999; Glogowska, 2000). However for two of these studies recruitment problems meant that the study could not achieve the planned level of power.

The papers generally provided clear eligibility criteria, typically excluding children with general developmental delays, neurological impairments and hearing loss. The majority of studies described the main language characteristics of the participants in terms of phonology, and expressive and receptive language skills. In eight studies details were only provided of the linguistic area examined in the study, or were unclear (Courtwright 1979; Fudala 1972; Head 1975; Mulac 1977; Sommers 1964; Sommers 1966; Sommers 1962; Tufts 1959). This is significant because other factors may have had an effect on the response to therapy. There was variability in the reporting of other potentially confounding variables such as socio-economic status and behaviour. Ten studies reported some details of socio-economic status, this was provided typically as social classes (Gibbard 1994a; Gibbard 1994b; Law 1999; Sommers 1964; Sommers 1966), or parent education (Girolametto 1996b; Glogowska, 2000; Robertson 1997; Robertson 1999; Tufts 1959). In addition to this three studies described their participants as being from middle class, or lower class backgrounds without including data (Evans [forthcoming]; Fudala 1972; Sommers 1962). Seventeen studies reported baseline language scores, and twelve of these studies included some other potentially significant variables such as behaviour, esteem, or parent education. Of the papers that statistically analysed baseline scores, three papers found significant differences at baseline in non-linguistic measures (Fey 1993; Girolametto 1996a; Law 1999).

All of the papers described their participants as being randomly assigned although only three papers described their methods (Almost 1998; Law 1999; Glogowska, 2000). In addition, two papers stated that randomisation had been completed by an independent person, but gave no explanation of the method (Lancaster 1991; Munro 1998) and three papers stated that random numbers tables had been used but provided no other details (Barratt 1992; Sommers 1962; Sommers 1964). In the papers describing their methods, random number tables were used to create sealed envelopes that were opened in the presence of the parents once consent had been gained.

In fourteen studies the assessors were blind to the group status of the participants, or had all their assessments marked by blind transcribers. In the other studies two stated that assessors were blind to group allocation at pre-test, and seventeen did not report whether assessors were blind. In a number of cases a sample of papers were independently marked by blind assessors to give a reliability measure.

Twelve studies accounted for their withdrawals and six stated that no withdrawals occurred. There was only one study that showed withdrawals that were not accounted for (Sommers 1966). Withdrawals were mainly discounted from analysis, although in two studies the withdrawals or non-finishers were included in the analysis by using the last score obtained (Almost 1998; Lancaster 1991). The amount of attrition was generally small, no study mentioned attrition rates higher than 15%, and only eight

studies had attrition rates between 10% and 15%. In fourteen studies attrition (e.g. proportion of participants not completing the intervention) and withdrawal (e.g. an explanation of why participants did not complete intervention) were not mentioned and therefore these figures need to be interpreted cautiously; non-reporting may have covered up significant levels of attrition. Two studies reported intention to treat analysis where participant data were analysed according to the group to which they were assigned initially rather than whether they finished the intervention or requested therapy (Almost 1998; Glogowska, 2000). A third study was categorised as an intention-to-treat analysis as participants that had not yet managed to complete the intervention package (e.g. through holidays or illness) were assessed at the end of the study and included in the final analysis (Lancaster 1991).

Effects of interventions

Seven studies were not included in the meta-analysis because further information regarding results could not be obtained (Barratt 1992; Fudala 1972; Mulac 1977; Reid 1996, Ruscello 1993; Rvachew 1994; Sutton 1999). Of these studies, four were phonological interventions, one was an expressive language intervention focusing on 'is' interrogative, one used WILSTAAR intervention, and one was a general language programme carried out within an English healthcare trust. A final study reported outcomes as ratings data and could not be entered into Review Manager (Tufts 1959). A narrative summary of these studies is provided below.

Two of the five phonology studies that could not be used in the meta-analyses compared clinician-delivered intervention to clinician- delivered intervention alongside additional parent-implemented intervention. The first study (Ruscello 1993) used Speech Viewer software and found that involving parents in intervention led to no significant differences in outcomes. The second study (Fudala 1972) found that the children of parents observing the clinician completing the intervention had better speech outcomes than those children whose parents did not observe. Interestingly, no differences were found between the outcomes for children whose parents observed the sessions once a week and those who observed once a month. Another phonology study (Tufts 1959) compared three conditions: parent implemented intervention, clinician implemented intervention and no intervention. The study reported significant differences between the control group and the two intervention groups, but no significant differences between the two intervention groups. Two other phonology studies compared different lengths of intervention (Reid 1996) or specific intervention tasks (Rvachew 1994). The first study (Reid 1996) compared three conditions: no treatment, ten weeks of Metaphon training (levels one and two), and six weeks of Metaphon training (level one only). The study showed significant differences for those children who had attended the ten weeks of speech intervention when compared to either six weeks of intervention and no treatment. The final phonology study (Rvachew 1994) focused on sound discrimination comparing the effects of three conditions: discrimination between a rhyming word pair (e.g., 'sheet' and 'meat'), a non-rhyming word pair (e.g. 'cat' and 'Pete') and a misarticulated word pair where one word of the pair rhymed but did not start with an English consonant. The results suggest that those children listening to either rhyming word pairs or misarticulated word pairs progressed further in sound production tasks than did the children listening to non-rhyming word pairs.

Three studies that could not be used in the meta-analyses focused on language interventions. The first study (Sutton 1999) compared WILSTAAR intervention to no intervention and did not show any significant differences in language outcomes. The second study (Barratt 1992) compared intensive intervention (four days a week for three weeks once every three months) to weekly intervention (once a week for six months) delivered in a nursery setting. The study showed that although children in the intensive group did not receive any more hours of intervention than those in the weekly group, there was more improvement in expressive language scores from those children receiving intensive intervention. The same result was not seen for language comprehension measures. The third expressive language study (Mulac 1977) compared a language intervention programme focusing on 'is interrogative' to the same programme with additional tasks to facilitate generalisation, and to a control programme described a speech sound intervention. The study found that although both experimental groups improved in an 'is interrogative' measure, only the group receiving the additional tasks generalised their use of 'is interrogative' to outside of the clinic setting.

Expressive Phonology Outcomes

Two studies measured outcomes at the level of the production of the target sound (Munro 1998; Rvachew 2001). One of these studies compared intervention to delayed treatment (Munro 1998), and the second compared treatment of early developing phonemes with later developing phonemes (Rvachew 2001). The former did not show a statistically siginificant difference either for the production of the target sounds (n=11; SMD=0.98, 95%CI: -0.35, 2.31) or for the variability in the production of target sounds (n=11; SMD=0.91, 95%CI: -0.41, 2.23). The latter showed a statistically significant effect that favoured the treatment of early developing phonemes (n=48; SMD=-1.00, 95%CI: -1.60, -0.40).

Eleven studies measured the effects of treatment through standardised measures of overall phonological development. Seven of these provided a comparison of speech and language therapy with no therapy (Almost 1998; Glogowska, 2000; Lancaster 1991; Matheny 1978; Munro 1998; Rvachew 2001; Shelton 1978), and six studies compared different therapies (Lancaster 1991; Rvachew 2001; Shelton 1978; Sommers 1964; Sommers 1966; Sommers 1962). The overall effect estimate was statistically significant favouring the use of speech and language therapy when compared to no treatment (n=264; SMD=0.44, 95%CI: 0.01, 0.86). This estimate increased when parent administered treatments were removed (n=214; SMD=0.67, 95%CI: 0.19, 1.16), and when interventions lasting less than eight weeks were removed (n=213; SMD=0.74, 95%CI: 0.14, 1.33). Studies comparing treatments were varied and could not be combined. One study (Lancaster 1991) showed no significant difference between intervention administered by trained parents and clinicians (n=10; SMD=-0.90, 95%CI: -2.25, 0.44), although two studies (Sommers 1962; Sommers 1964) showed a statistically significant effect favouring the use of trained parents in addition to clinician intervention (n=120; SMD=1.20, 95%CI: 0.17, 2.23). One study (Sommers 1966) did not show a difference between group and individual therapy (n=216; SMD=0.01, 95%CI: -0.26, 1.17), and a final study (Shelton 1978) did not show a difference between parent delivered auditory discrimination therapy and no treatment (n=30; SMD=-0.21, 95%CI: -0.83, 0.41).

Three studies measured broader outcomes for phonology intervention, of which two used the percentage of consonants correct in conversation (Almost 1998; Rvachew 2001), and the third focused on the number of correct target consonants when the child was re-telling a story (Munro 1998). The effect estimates for the two studies comparing phonological therapy with no treatment showed a statistically significant effect favouring phonological therapy when measured as the percentage of consonants correct in conversation (n=26; SMD=1.91, 95%CI: 0.96, 2.86), but not for the re-telling of a story with target consonants (n=11; SMD=1.29, 95%CI: -0.11, 2.69). The third study did not show a significant difference between targeting later and earlier developing sounds in intervention when measured as percentage of consonants correct in conversation (n=48; SMD=0.12, 95%CI: -0.45, 0.68).

The confidence intervals in most of these analyses were over one standard deviation wide, showing a wide range of response to intervention. This reflects the small number of studies and the small number of participants in each of the analyses. One exception to this was the overall measure of treatment compared to no treatment and measured using standardised assessment measures. This had a much larger number of participants (264) and the confidence interval was 0.01-0.86 reflecting less variation in response than other outcome measures.

Receptive Phonology Outcomes

One study focused on receptive phonology intervention as a means of improving productive phonology and measured outcomes using a test for auditory association (Shelton 1978). The effect estimate showed that parental listening and reading-talking intervention was not significantly effective for receptive phonology compared to no intervention (n=45; SMD=0.53, 95%CI: -0.10, 1.16), and that neither intervention showed a more favourable outcome against the other (n=30; SMD=0.00, 95%CI: -0.72, 0.72), nor made any improvement on productive phonology (n=45; SMD=-0.21, 95%CI: -0.83, 0.41).

Expressive Syntax Outcomes

Three studies measured outcomes at the level of the target of therapy. One study compared an intervention approach involving mimicry of sentences to an approach to intervention involving modelling of sentences (Courtwright 1979) and did not show a significant difference between the two approaches (n=24; SMD=0.57, 95%CI: -0.25, 1.39). A second study (Schwartz 1985) also found no statistically significant differences when they compared focused stimulation to general stimulation (n=10; SMD=0.74, 95%CI: -0.87, 2.34). The third study investigated the number of play related speech acts used by children when they were paired with either a normal language play peer or a language impaired play peer (Robertson 1997). This study showed a significant effect favouring the use of normal language peers within play sessions (n=30; SMD=3.20, 95%CI: 1.79, 4.62).

Seven studies measured the outcomes of expressive interventions using tests of overall expressive syntax. Five studies compared expressive interventions to no treatment or to cognitive therapy (Fey 1993, Gibbard 1994a, Gibbard 1994b, Matheny 1978, Law 1999, Glogowska, 2000). The effect estimate from these studies was not statistically significant when compared to no treatment (n=271; SMD=0.70, 95%CI: -0.14, 1.55), although a significant effect was shown when speech and language intervention was compared to cognitive therapies (n=25; SMD=0.93, 95%CI: 0.05, 1.82). The effect size of the no treatment comparison decreased when only data from clinician studies were included (n=214; SMD=0.28, 95%CI: -0.19, 0.75), and increased when studies using clinician administered therapy with duration less than eight weeks were excluded (n=187; SMD=0.43, 95%CI: -0.06, 0.93). However, in neither case did differences reach statistical significance. A post-hoc subgroup analysis was performed on the basis of child characteristics when it became apparent that children were often excluded from trials if they had significant receptive language difficulties. Removing the study where all children had a severe receptive language difficulties showed a significant effect favouring speech and language therapy (n=233; SMD=1.02, 95%CI: 0.04, 2.01). Three studies directly compared parent delivered interventions with clinician interventions (Fey 1993, Law 1999; Gibbard 1994b). These studies did not show a statistically significant difference between the two approaches (n=66; SMD=-0.04, 95%CI: -0.56, 0.48).

Six expressive intervention studies included measures of parental report of phrase complexity, and total number of utterances and mean length of utterance from language samples (Cole 1986, Gibbard 1994a; Gibbard 1994b; Girolametto 1996b; Law 1999; Robertson 1999). Studies measuring the total number of utterances in a language sample produced an effect estimate that was not statistically significant when compared to no intervention (n=99; SMD=0.68, 95%CI: -0.45, 1.82), or to cognitive therapy (n=25; SMD=0.88, 95%CI: 0.00, 1.76). The same result was seen when the effect size was measured as mean length of utterance; no treatment (n=95; SMD=0.74, 95%CI: -0.33, 1.81), cognitive therapy (n=25; SMD=1.36, 95%CI: 0.42, 2.29), and measured as parental report of phrase complexity; no treatment 1.02 (n=99; 95%CI: -0.17, 2.22), cognitive therapy 0.78 (n=25; 95%CI: -0.09, 1.65). When a subgroup analysis was performed excluding the study where all children had receptive language difficulties, the effect estimates significantly favoured speech and language therapy for total number of utterances (n=61; SMD=1.20, 95%CI: 0.33, 2.07), mean length of utterance (n=57; SMD=1.28, 95%CI: 0.66, 1.89), and parent report of phrase complexity (n=61; SMD=1.54, 95%CI: 0.42,2.65). Two studies (Gibbard 1994b; Law 1999) compared interventions with administration by parents and clinicians. These studies did not show a significant difference for total utterances (n=45; SMD=0.15, 95%CI: -0.45, 0.74), mean length of utterance (n=45; SMD=0.28, 95%CI: -1.41, 1.96), and parental report of sentence complexity (n=45; SMD=0.01, 95%CI: -0.63, 0.66).

The confidence intervals for these analyses show a much wider range of responses than those for phonology interventions. Even when a larger number of participants are included in the analyses the confidence intervals remain broad e.g. a comparison of treatment versus no treatment and measured using standardised assessments included 271 participants and produced confidence intervals of -0.14-1.55. This is twice the breadth of the measure obtained from expressive phonology interventions.

Expressive Vocabulary Outcomes

Four studies measured outcomes at the target of therapy. Two of these studies measured the number of target words used during a probe exercise (Girolametto 1996a; Girolametto 1996b), one study measured the number of target words used productively within the clinic setting (Wilcox 1991), and the final study measured the number of words used in play scripts (Robertson 1997). The first two studies compared indirect parent administered therapy with

no treatment, and showed a significant effect supporting the use of indirect therapy (n=41; SMD=0.93, 95%CI: 0.27, 1.58). The third study compared the use of individual sessions and group sessions within the class context and did not show a significant difference between individual and class based intervention (n=20; SMD=0.35, 95%CI: -0.53, 1.24). The final study compared the use of normal language and language impaired play peers for SLI children and showed a significant effect supporting the use of normal language peers (n=20; SMD=2.29, 95%CI: 1.11, 3.48).

Three studies used standardised measures to measure the effect of expressive interventions on vocabulary (Gibbard 1994a; Gibbard 1994b; Law 1999). The studies did not show a significant difference when compared to no therapy (n=74; SMD=0.98, 95%CI: -0.59, 2.56), or cognitive therapy (n=25; SMD=0.76, 95%CI: -0.11, 1.63). Subgroup analysis produced a significant difference favouring speech and language therapy when children only had expressive language difficulties (n=36; SMD=1.79, 95%CI: 1.01, 2.58). Data from trials directly comparing parent and clinician administered interventions did not show a significant difference between parent and clinician administered interventions (n=45; SMD=0.20, 95%CI: -0.40, 0.79).

Six expressive intervention studies measured outcomes using broader measures of language functioning, either through parent report of vocabulary size or the total number of words in a language sample (Gibbard 1994a; Gibbard 1994b; Girolametto 1996a; Girolametto 1996b; Law 1999; Robertson 1999). The effect estimate of total number of different words in a language sample significantly favoured speech and language therapy when compared to no intervention (n=82; SMD=1.08, 95%CI: 0.61, 1.55) but not when compared to cognitive therapy (n=25; SMD=0.62, 95%CI: -0.24, 1.49). A similar effect estimate was seen when considering parental report of vocabulary as an outcome measure (n=136; SMD=0.89, 95%CI: 0.21, 1.56). Studies that directly compared parent administered and clinician administered treatments did not show significant differences when outcomes were measured using parent report of vocabulary size (n=45; SMD=-0.16, 95%CI: -0.76, 0.44), or the number of words in language samples (n=17; SMD=-0.50, 95%CI: -1.48, 0.47).

Receptive Syntax Outcomes

Four studies used standardised measures of receptive syntax to measure the outcomes of interventions for receptive language (Cole 1986; Dixon 2001; Glogowska, 2000; Law 1999). The latter two studies compared speech and language therapy intervention to no treatment, these studies did not show a statistically significant difference (n=193; SMD=-0.04, 95%CI: -0.64, 0.56). When subgroup analyses were performed removing parent administered interventions (n=182; SMD=0.01, 95%CI: -0.53, 0.55), and trials carried out over a shorter duration (n=155; SMD=0.19, 95%CI: -0.12, 0.51), no changes in effect were seen. Three studies compared speech and language therapy interventions, though none showed statistically significant differences between the comparators. Law 1999 compared parent and clinician administered interventions (n=28; SMD= -0.11, 95%CI: -0.87, 0.65), Dixon 2001compared traditional speech and language therapy with a technique called Visualising and Verbalising (n=4; SMD=-0.07, 95%CI: -2.08, 1.93), and Cole 1986 compared directive and interactive treatment programmes (n=44; SMD=-0.33, 95%CI: -0.93, 0.27).

Receptive Vocabulary Outcomes

One study used a standardised measure of receptive vocabulary to measure the outcomes of an intervention for receptive and expressive language (Cole 1986). This study compared directive with interactive speech and language therapy, and did not show a significant difference between the two approaches (n=44; SMD=-0.22, 95%CI: -0.82, 0.38).

Composite Language Outcomes

One study with a focus on the development of expressive and receptive language used composite language measures to measure the outcomes of therapy in terms of expressive and receptive language (Evans [forthcoming]). This study compared WILSTAAR intervention to no treatment and did not show a significant difference between the two approaches (n=55; SMD=0.22, 95%CI: -0.32, 0.76).

Quality

Sensitivity analyses were performed on data from studies comparing intervention to no treatment that measured the overall development of phonology, expressive or receptive abilities. Two sensitivity analyses were performed investigating the effect of non-reporting of attrition and blinding of assessors on effect size. When studies that did not report attrition were removed from the analyses the results did not change either the effect size of expressive phonology (n=211; SMD=0.40, CI: -0.08, 0.89), or expressive syntax (n=217; SMD=0.67, CI: -0.33, 1.66). In both analyses the confidence intervals became broader as a result of the removal of the study. Removing studies where authors did not state that the assessors were blinded to group allocation had a larger effect on the effect sizes. Positive results for phonology increased when lower quality studies were removed (n=188; SMD=0.66, CI: -0.07, 1.40), but expressive measures decreased in both expressive vocabulary (n=38; SMD=0.19, CI: -0.54, 0.91) and expressive syntax (n=219; SMD=0.14, CI: -0.47, 0.75).

DISCUSSION

The objective of this review was to consider the effectiveness of speech and language therapy for children with primary speech and language delay/disorder. The review located 33 different trials of which 25 included sufficient data to be used in the meta-analyses. All of the studies located were written in English, although no language limits were set during the searches. The data were analysed with particular consideration given to the primary effects of intervention at the level of the target of therapy, overall development and broader levels of linguistic functioning. Subgroup analyses were carried out to help explain the results and the variation in response to therapy. Due to the focused nature of the analyses and the heterogeneity of the comparisons some of the effect sizes are based on small numbers of participants and the results of single studies are drawn on. Some of these results therefore need to be considered tentatively.

The findings of this review provide some support for the effectiveness of speech and language therapy for children with phonological and expressive vocabulary difficulties. It is possible that therapy may be effective for children with expressive syntax difficulties if they do not have concomitant difficulties in receptive language. This result is based on sub-group analyses and therefore no causal relationships can be drawn; however this finding corresponds with what is known about the long-term prognosis

for children with speech and language difficulties (Law 1998). For children with receptive language difficulties there is still less evidence that interventions are effective. This needs careful consideration and further evaluation as natural history studies have shown that children with receptive language problems are least likely to resolve without intervention and most likely to have longer term difficulties (Law 1998).

The effect sizes in a number of the meta-analyses were relatively large favouring speech and language interventions, however the confidence intervals were generally broad due to the heterogeneity of the studies included in the analyses and the wide variation in response. The majority of the confidence intervals crossed zero, and are therefore non-significant results. Children with phonological difficulties tended to vary in their response to treatment within studies (e.g. Munro 1998; Reid 1996), but between studies showed similar patterns of variation, as shown in their narrower confidence intervals. This is in contrast to children with expressive language difficulties who showed a much wider range of response between studies, as shown in much wider confidence intervals. There is a need for more clearly defined interventions and analyses that are stratified on the basis of participant characteristics, so that the sources of the variation can be more fully understood.

Within the categories of analysis e.g. expressive and receptive phonology, syntax and vocabulary, a wide range of outcomes were measured, and not all outcomes within any one area were significant. It is hard to make judgements on which outcomes are the most important; while narrow outcomes measuring the target of therapy may best measure what the clinician is working on and the short term aims for the child, standardised assessments allow for comparison with same age peers, and broader measures best show generalisation of skills to everyday situations. In addition important outcomes that were not measured in this review may have improved such as the communication skills of communicative partners e.g. parents or teachers. For some children the most important outcome may not be improvement in their abilities, but an improvement in those around them to support their communicative environment. For this reason it is also hard to make judgements about the size of effect required to benefit the child. A better understanding of natural history and the long term outcomes for children with primary speech and language delay/ disorder would help to clarify whether the goals of intervention for particular client groups should focus on changing the child's speech and language abilities or in improving the communication skills of other people within the child's environment.

The results of this review generally complement those other reviews (e.g. Nye 1987; Law 1998), although the effect sizes in some instances are smaller. This can be explained in two ways; firstly, the effect sizes for each of the linguistic outcomes only includes studies where authors said that they had an explicit language focus in that area. A number of studies reported larger effects of intervention for receptive language (e.g. Gibbard 1994a; Shelton 1978), but these studies did not have explicit receptive language aims, and the children had not been identified as having receptive language difficulties. Therefore the outcomes were not included in this analysis. Secondly, a larger number of trials in this review were completed within British health care trusts (7 out of 25) and tended to produce lower effect sizes than those completed in America, possibly due in general to the smaller number of hours of contact time.

No statistically significant differences were found between using trained parents and clinicians as the administrators of intervention. Results of a number of the studies showed that response to treatment is more varied when using parent administrators, and suggest that some parents may be more suited to parent treatment than others (Fey 1997; Gibbard 1994a). Further research is required to assess parent characteristics that may lead to better outcomes. There is an indication that interventions carried out over longer periods of time may be more effective than those carried out over shorter periods. This result is based on a subgroup analysis rather than the direct results of any randomised studies and therefore needs to be interpreted cautiously due to potential confounding variables. There needs to be further randomised studies comparing interventions over different lengths of time in order to test this hypothesis. A small number of studies have investigated the impact of different lengths of treatment; Fey et al (1997) showed much smaller gains in a second five month phase of therapy following an initial five months of therapy, and a previous meta-analysis reported a larger effect size for treatments lasting four to twelve weeks (Nye 1987). In considering the impact of differing lengths of treatment it is also important to consider the role of intensity on treatment outcome; the studies included in this review could not be reliably grouped to consider the impact of intensity on treatment outcomes. However, one study that could not be used in the analysis found that children who received intensive therapy had better outcomes than those who received weekly therapy, even though they received no more contact time (Barratt 1992). Further research is also required to investigate the impact of intensity on outcomes. Studies comparing the use of individual and group therapies showed no difference in the effectiveness of therapy (Sommers 1966; Wilcox 1991). However a study that employed the use of normal language peers in play sessions with language impaired children found a statistically significant difference in outcomes (Robertson 1997). These findings support the use of collaborative approaches in schools where therapists have the potential to draw on normal language peers.

Studies that address specific aspects of phonology intervention support clinician treatment of earlier rather than later developing phonemes (Rvachew 2001), but do not support the use of parent delivered auditory discrimination therapy as a means of improving productive phonology (Shelton 1978). While the majority of the studies used in the review included aspects of auditory discrimination, few of them focused on the effectiveness of auditory discrimination or phonological awareness therapy. Two papers that could not be used in the meta-analyses provide positive indicators for the use of metaphon therapy (Reid 1996), and auditory discrimination in addition to articulation therapy (Rvachew 1994). Given the widespread use of these approaches within therapy, this area of intervention may benefit from randomised controlled trials to assess effectiveness.

Studies comparing different approaches to expressive language interventions did not show any statistically significant differences between interactive and directive approaches (Courtwright 1979; Cole 1986). There is some research evidence that suggests that higher functioning children and children with learning disabilities may benefit from interactive learning, whilst children who have more severe difficulties but normal intelligence measures

may benefit from a directive approach (Yoder 1991). Further research is required considering different learning styles and child characteristics to ensure that children receive an intervention most suited to them. This review found no significant effect of WILSTAAR early intervention (Evans [forthcoming]). This suggests that further evaluation of this technique is required as these results are smaller and less conclusive than those obtained from a large "first generation" non-randomised control trial (e.g. Ward 1999). Finally this review found no evidence to support the use of Visualising and Verbalising as an approach to receptive intervention when compared to traditional therapy involving inference making, identifying main ideas, and following sequences (Dixon 2001).

Studies often provided a range of outcome measures, measured at the target of therapy, overall development and broader measures of linguistic functioning. Results of the meta-analysis generally complemented each other at each of the levels of analysis. In general larger effect estimates were obtained from either measures of the therapy target or broader measures of either language sample data or parent report. However, in most cases these measures were also associated with broader confidence intervals.

The quality of the studies used in the review was variable. A number of studies did not report potentially important factors such as attrition, method of randomisation and baseline characteristics. While sensitivity analyses did not show that this consistently altered the effect sizes, it is possible that non-reporting and poor methodology may have had an effect on the results gained in the trials which may have exaggerated the meta-analysis effect estimates (Juni 2001).

The lack of information in some older studies concerning participant characteristics also made it hard to analyse the impact of the language difficulty on the effectiveness of therapy. This was made more difficult because of the variability in reporting standard scores and the variation in the range of assessments used. A number of papers gave baseline characteristics as raw scores making it difficult to identify the severity of participants' difficulties, and making comparisons between papers difficult. In addition, while it is recognised that the causes of primary speech and language delay/disorder are likely to be multi-factorial, the reporting of non-linguistic characteristics was also variable. This meant it was difficult to consider other potentially important factors that may have influenced therapy outcomes e.g. behaviour, esteem, socio-economic status and developmental history. The final concern reflects the fact that the sources of the samples were not always well described, and in some cases were actively recruited through advertisements or letters. The use of self-selecting samples may mean that effect sizes are higher than could be expected in a true clinical population. The high rate of compliance in a number of the studies may also contribute to this effect and is likely to be partially as a result of the way participants were selected.

Funnel plots were investigated to assess the possibility of small sample bias and publication bias. Overall the studies had relatively large amounts of variance and were widely scattered on both sides of the pooled estimate. This produced symmetry in the plots, but meant that some lost their characteristic funnel shape. This can be explained by the inclusion of small studies that included both significant and non-significant results.

Limitations

The majority of the interventions reported in the present review can be described as being delivered with a clinical model, that is they are separate from other contexts in which the children learn - namely early years provision and school. Furthermore they are circumscribed in terms of intensity and duration. The implicit understanding is that these relatively short "innoculation" interventions are effectively adjusting the child's developmental trajectory. While a number of the interventions report significant results it is not clear that children's speech and language development is "normal" post intervention. Indeed the follow-up literature would suggest that many of these children go on to have persistent problems. Furthermore it is not clear that the additional input that many children receive equates to this clinical model. Many of these children receive a comprehensive package of interventions over an extended period of time of which these periods of speech and language therapy are only a part.

Measures of second-order effects were sometimes reported in the included studies, but were not included in this review. For example, interventions for expressive language sometimes included an analysis of the effect on phonology, and a number of studies show positive second order effects of expressive language intervention on phonology measures (Girolametto 1997; Matheny 1978; Robertson 1999). A number of other studies also included broader non-linguistic outcome measurements including behaviour gains, esteem and stress. These studies provide positive indicators that speech and language therapy interventions can have a positive effect on socialisation (Robertson 1999), and behaviour (Girolametto 1996a; Law 1999), as well as parental stress (Robertson 1999) and self-esteem (Law 1999). It is a limitation of this review that the analysis does not consider second-order effects of therapy, as there is a need to address the wider potential of speech and language therapy interventions. The authors will seek to address this deficit in future updates of the review.

Studies rarely included a measure of longer term follow-up, and therefore it is hard to know how the effects of speech and language therapy maintain over time. Five studies followed up children after intervention had finished at three weeks (Robertson 1997), eight weeks (Sommers 1964), four months (Almost 1998), five months (Fey 1997), and six months post intervention (Law 1999). Sommers (1964) showed that children continued to make gains in phonology measures following intervention, although Almost (1998) reported that at four months post intervention gains in phonology were maintained but not improving. In terms of expressive language skills, Robertson (1999) reported that expressive language gains were maintained at three weeks post intervention, as did Fey (1997) at five months, although Law et al (1999) report that the overall effects of speech and language therapy had largely worn off at six months post intervention. Of interest is the fact that parent interventions which aim to change the nature of the interaction between parent and child did not show further gains following therapy (Fey 1997, Law 1999). Further research is needed in this area to examine the long-term impact of speech and language therapy.

In a large number of the studies the focus of the comparison was either on the overall effectiveness of speech and language therapy compared to no treatment, or on the effectiveness of using parent administrators in therapy. A small number of studies compared other aspects of intervention including group and individual therapy, and directive and interactive approaches.

There is a need to identify and investigate other potentially important factors that lead to positive outcomes both in terms of intervention approaches used and the physical characteristics of the intervention process. While two randomised controlled trials will hopefully add to the knowledge concerning the intervention approaches and participant characteristics that lead to better clinical outcomes (Boyle, Ongoing; Broomfield, FC), there is a need to consider other forms of research that may help identify a broader range of potential indicators that could be used to focus more rigorously controlled studies.

Homogeneity

There was a large degree of variation in the studies even when similar intervention techniques were desribed. This was most apparent in the expressive language interventions. In part the variation in effect size can be explained by differences due to having different administrators of treatment. Once parent interventions are removed from the analysis the studies become more homogenous. However even having taken this into consideration differences in response still occurred, which may have been due to factors such as; socio-economic status, comprehension levels, and duration and intensity of therapy. There is a need for trials to more closely define their intervention procedures and to stratify analyses on the basis of participant characteristics so that some of the variation can be more easily explained.

AUTHORS' CONCLUSIONS

Implications for practice

- This review concludes that there may be some support for the effectiveness of the use of speech and language therapy interventions for children with expressive phonological and expressive vocabulary difficulties. The evidence suggests that there is a differential effect of intervention and that therapy for expressive syntax difficulties may be effective when children do not also have severe receptive language difficulties. The nature of these mixed findings means that further research would be beneficial to the field.
- For children with receptive language disorders the evidence base is limited, but evidence from studies in this review suggests that the effect of speech and language therapy interventions on language outcomes for this group is much smaller than for other client groups.
- Studies directly comparing administrators of intervention did not show a statistically significant difference between the use of trained parents and clinicians.
- Studies comparing group and individual interventions did not show a statistically significant difference. This conclusion is drawn from a limited number of studies that mainly focused on phonological interventions. Its application to expressive or receptive language interventions may be limited.
- Subgroup analysis indicated that interventions lasting longer than eight weeks may be more effective than those lasting less than eight weeks. This result needs to be interpreted tentatively due to the limited range of studies in the analyses and differences between the individual studies. This should be viewed as a possible indicator of better clinical outcome, with further research required.
- The evidence supports the use of normal language peers in intervention as language models for children with language impairment.

Implications for research

- Many of the basic questions about natural history and the appropriateness of outcomes would at this stage best be answered by an examination of appropriate cohort data in order to develop a fuller picture of the factors that can influence intervention. However this review provides a partial set of indicators that would benefit from further experimental research.
- There needs to be further research investigating the effects of intervention for children with receptive language disorders and how the outcomes of therapy may be optimised. This is particularly important in light of research that shows these children are least likely to resolve and are more likely to have long term sequelae.
- It is important that research is carried out on the relative value of these more systemic, contextualised interventions within the educational setting, using educational outcome measures as well as more traditional speech/language outcomes. Before this can happen protocols need to be developed of the different "care pathways" available to individual children.
- Interventions need to be clearly defined to help explain variation in response to treatment both within studies and between studies. The use of stratified analysis on the basis of participant characteristics needs to be considered so as to identify potential effect modifiers.
- Research is needed exploring the optimum starting point for intervention. It is tempting to think that early intervention is the obvious solution because it will reduce the need for subsequent support and thus reduce the call on resources. However, there is also a case to be made for targeting intervention to the point where the child is ready to change.
- Research is needed that investigates the impact of severity on therapeutic outcome. It is currently not known whether those children who have the most severe difficulties are likely to show the most change because they start at a lower level and have most potential for change, or if they may show the least change because they start at a lower level and their difficulties prevent them from benefiting from intervention.
- A variation in response is shown to parent administered interventions amongst children with expressive language difficulties. Further research is required to consider the parent characteristics that lead to better therapy outcomes, and the characteristics of therapy that best help to engage parents.
- There needs to be consideration of the learning styles of children with different language difficulties and the influence of this on the child's responsiveness to therapy.
- The long term impact of therapy needs to be investigated to look at the maintenance over time of the skills that have been acquired in therapy. It is unclear to what extent "downstream" effects are primarily linguistic or whether they include other aspects of behaviour.
- It may be appropriate to include preference arms in randomised control trials, giving parents the choice of which treatment they would like to receive. This would ascertain the potential effect on therapeutic outcome of having parents who were receiving what they perceive to be the best possible treatment for their child.

- Non-linguistic factors need to be included in intervention reports both as baseline characteristics and outcome measures. This is because therapy may be influenced by non-linguistic factors and because the therapeutic process may influence additional non-linguistic factors.
- Linguistic baseline characteristics need to be presented as age equivalent or standardised scores to allow comparison between studies. Due to the variety of assessments available, further research on the comparability of assessments would also facilitate the interpretation of results.
- The interpretation of the studies would be facilitated by the use of the CONSORT statement to structure report writing (Moher 2001).

ACKNOWLEDGEMENTS

The reviewers wish to acknowledge the support of Jo Abbott, Ester Coren, Jane Dennis, Julian Higgins, Stuart Logan and Geraldine Macdonald and to thank Marc Fey, Deborah Gibbard, Sue Roulstone, Shari Robertson, Joe Reynolds, Jan Broomfield, Anne O'Hare, Charmian Evans, Ralph Shelton, Louise Sutton and Janet Baxendale for providing extra data and information.

REFERENCES

References to studies included in this review

Almost 1998 *{published and unpublished data}*

Almost D, Rosenbaum P. Effectiveness of speech intervention for phonological disorders: a randomised controlled trial. *Developmental Medicine and Child Neurology* 1998;**40**:319-325.

Barratt 1992 *{published data only}*

Barratt J, Littlejohns P, Thompson J. Trial of intensive compared to weekly speech therapy in preschool children. *Archives of Disease in Childhood* 1992;**671**:106-108.

Cole 1986 *{published data only}*

Cole KN, Dale PS. Direct language instruction and interactive language instruction with language delayed preschool children: a comparison study. *Journal of Speech and Hearing Research* 1986;**29**:206-217.

Courtwright 1979 *{published data only}*

Courtwright JA, Courtwright IC. Imitative modeling as a language intervention strategy: the effects of two mediating variables. *Journal of Speech and Hearing Research* 1979;**22**:366-388.

Dixon 2001 *{published data only}*

Dixon G, Joffe B, Bench RJ. The efficacy of visualising and verbalising: are we asking to much?. *Child Language Teaching and Therapy* 2001;**17**(2):127-141.

Evans [forthcoming] *{unpublished data only}*

Evans C. The Kenilworth project: a randomised controlled trial of WILSTAAR. Unpublished manuscript (Forthcoming).

Fey 1993 *{published data only}*

Fey ME, Cleave PL, Long SH, Hughes DL. Two approaches to the facilitation of grammar in children with language impairment: an experimental evaluation. *Journal of Speech and Hearing Research* 1993;**36**:141-157.

Fey 1994 *{published data only}*

Fey ME, Cleave PL, Ravida AI, Long SH, Dejmal AE, Easton DL. Effects of grammar facilitation on phonological performance of children with speech and language impairments. *Journal of Speech and Hearing Research* 1994;**37**:594-607.

Fey 1997 *{published data only}*

Fey ME, Cleave PL, Long SH. Two models of grammar facilitation in children with language impairments: Phase 2. *Journal of Speech and Hearing Research* 1997;**40**:5-19.

Fudala 1972 *{published data only}*

Fudala JB, England G, Ganoung L. Utilisation of parents in a speech correction programme. *Exceptional Children* 1972;**30**:407-412.

Gibbard 1994a *{published data only}*

Gibbard D. Parental-based intervention with pre-school language-delayed children (Study 1). *European Journal of Disorders of Communication* 1994;**29**:131-150.

Gibbard 1994b *{published data only}*

Gibbard D. Parental-based intervention with pre-school language-delayed children (Study 2). *European Journal of Disorders of Communication* 1994;**29**:131-150.

Girolametto 1996a *{published data only}*

Girolametto L, Pearce PS, Weitzman E. The effects of focused stimulation for promoting vocabulary in young children with delays: a pilot study. *Journal of Children's Communication Development* 1996;**17**(2):39-49.

Girolametto 1996b *{published data only}*

Girolametto L, Steig Pearce P, Weitzman E. Interactive focused stimulation for toddlers with expressive vocabulary delays. *Journal of Speech and Hearing Research* 1996;**39**:1274-1283.

Girolametto 1997 *{published data only}*

Girolametto L, Steig Pearce P, Weitzman E. Effects of lexical intervention on the phonology of late talkers. *Journal of Speech Language and Hearing Research* 1997;**40**:338-348.

Glogowska, 2000 *{published and unpublished data}*

Glogowska M, Roulstone S, Enderby P, Peters TJ. Randomised controlled trial of community based speech and language therapy in preschool children. *BMJ* 2000;**321**:923-6.

Head 1975 *{published data only}*

Head DG, Smith D. Speech remediation of children involved in two different physical education programs. *Perceptual and Motor Skills* 1975;**40**:261-262.

Lancaster 1991 *{unpublished data only}*

Lancaster G. The effectiveness of parent administered input training for children with phonological disorders [unpublished MSc thesis]. London: City University, 1991.

Law 1999 *{unpublished data only}*

Law J, Kot A, Barnett G. A comparison of two methods for providing intervention to three year old children with expressive/receptive language impairment [unpublished project]. London: City University, 1999.

Matheny 1978 *{published data only}*

Matheny N, Panagos JM. Comparing the effects of articulation and syntax programmes on syntax and articulation improvement. *Language Speech and Hearing Services in Schools* 1978;**9**:50-56.

Mulac 1977 *{published data only}*

Mulac A, Tomlinson CN. Generalisation of an operant remediation program for syntax with language delayed children. *Journal of Communication Disorders* 1977;**10**:231-243.

Munro 1998 *{published and unpublished data}*

Munro J. A study of speech and language therapy for particular speech sounds in children [unpublished MSc thesis]. London: City University, 1999.

Reid 1996 *{published data only}*

Reid J, Donaldson ML, Howell J, Dean EC, Greive R. The effectiveness of therapy for child phonological diosorder: the Metaphon approach. In: Aldridge M editor(s). Child Language. Clevedon, Avon: Multilingual Matters, 1996.

Robertson 1997 *{published and unpublished data}*

Robertson SB. The influence of peer models on the play scripts of children with specific language impairment. *Journal of Speech, Language, and Hearing Research* 1997;**40**:49-61.

Robertson 1999 *{published and unpublished data}*

Robertson SA. The effects of treatment on the linguistic and social skills of late talkers [unpublished dissertation]. Wisconsin: University of Wisconsin-Madison, 1997.

* Robertson SB, Weismer SE. Effects of treatment on linguistic and social skills in toddlers with delayed language development. *Journal of Speech, Language and Hearing Research* 1999;**42**:1234-1248.

Ruscello 1993 *{published data only}*

Ruscello DM, Cartwright LR, Haines KB, Shuster LI. The use of different service delivery models for children with phonological disorders. *Journal of Communication Disorders* 1993;**26**:193-203.

Rvachew 1994 *{published data only}*

Rvachew S. Speech perception training can facilitate sound production learning. *Journal of Speech and Hearing Research* 1994;**37**:347-357.

Rvachew 2001 *{published data only}*

Rvachew S, Nowak M. The effect of target-selection strategy on phonological learning. *Journal of Speech, Language and Hearing Research* 2001;**44**:610-623.

Schwartz 1985 *{published data only}*

Schwartz RG, Chapman K, Terrell BY, Prelock P, Rowan L. Facilitating word combination in language-impaired children through discourse structure. *Journal of Speech and Hearing Disorders* 1985;**50**:31-39.

Shelton 1978 *{published data only}*

Shelton RL, Johnson AF, Ruscello DM, Arndt WB. Assessment of parent-administered listening training for preschool children with articulation deficits. *Journal of Speech and Hearing Disorders* 1978;**18**:242-254.

Sommers 1962 *{published data only}*

Sommers RK. Factors in the effectiveness of mothers trained to aid in speech correction. *Journal of Speech Hearing Disorders* 1962;**27**(2):178-186.

Sommers 1964 *{published data only}*

Sommers RK, Furlong AK, Rhodes FE, Fichter GR, Bowser DC, Copetas FG, Saunders ZG. Effects of maternal attitiudes upon improvement in articulation when mothers are trained to assist in speech correction. *Journal of Speech and Hearing Disorders* 1964;**29**(2):126-132.

Sommers 1966 *{published data only}*

Sommers RK, Schaeffer MH, Leiss RH, Gerber AJ, Bray MA, Fundrella D, Olson JK, Tomkins ER. The effectiveness of group and individual therapy. *Journal of Speech and Hearing Research* 1966;**9**:219-225.

Sutton 1999 *{published data only}*

Sutton L, Tapper L. Investigating WILSTAAR. *Bulletin of the Royal College of Speech and Language Therapists* 1999;**August**.

Tufts 1959 *{published data only}*

Tufts LC, Holliday AR. Effectiveness of trained parents as speech therapists. *Journal of Speech and Hearing Disorders* 1959;**24**(4):395-401.

Wilcox 1991 *{published data only}*

Wilcox MJ, Kouri TA, Caswell SB. Early language intervention: a comparison of classroom and individual treatment. *American Journal of Speech-Language Pathology* 1991;**1**(1):49-61.

References to studies excluded from this review

Allen 1986 *{published data only}*

Allen JA, Koike KJM. Use of filtered speech model in articulation therapy. [Proceedings of] American Speech Language Hearing Association Convention, Detroit Michigan. 1986.

Christensen, 1981 *{published data only}*

Christensen M, Hanson M. An investigation of the efficacy of oral myofunctional therapy as a precursor to articulation therapy for pre-first grade children. *Journal of Speech and Hearing Disorders* 1981;**46**:160-165.

Clarke 1993 *{published and unpublished data}*

Clarke CE. The removable r-appliance as a practice device to facilitate correct production of /r/. *American Journal of Speech-Language Pathology* 1993.

Corte 2001 *{published data only}*

Corte ED, Verschaffel L, Van De Ven A. Improving text comprehension strategies in upper primary school children: a design experiment. *British Journal of Educational Psychology* 2001;**71**:531-559.

Costello 1978 *{published data only}*

Costello D, Schoen J. The effectiveness of para-professional and a speech clinician as agents of articulation intervention using programmed intervention. *Language Speech and Hearing Services in Schools* 1978;**9**(2):118-128.

Elliot 2002 *{published data only}*

Elliot J, Prior M, Merrigan C, Ballinger K. Evaluation of a community intervention programme for preschool language behaviour problems. *Journal of Paediatric Child Health* 2002 38:41-50;**38**:41-50.

Evans 1974 *{published data only}*

Evans CM, Potter RE. The effectiveness of the /s/ pack when administered by sixth grade childen to primary grade children. *Language Speech and Hearing Services in Schools* 1974;**5**:85-90.

Gillam 2001 *{published data only}*

Gillam RB, Crofford JA, Gale MA, Hoffman LM. Language change following computer assisted language instruction with Fast-Forword or Laureate learning systems software. *American Journal of Speech-Language Pathology* 2001;**10**:231-247.

Groher, 1976 *{published data only}*

Groher M. The experimental use of cross-age relationships in public school speech remediation. *Language Speech and Hearing Services in Schools* 1976;**12**:250-258.

Hesketh 2000 *{published data only}*

Hesketh A, Adams C, Nightingale C, Hall R. Phonological awareness training and articulatory training approaches for children with phonological disorders: A comparative outcome study. *International Journal of Language and Communication Disorders* 2000;**35**(3):337-354.

Kot 1995 *{published data only}*

Kot A, Law J. Intervention with preschool children with specific language impairments: a comparison of two different approaches to treatment. *Child Language Teaching and Therapy* 1995;**11**(2):144-162.

Mowrer 1987 *{published data only}*

Mowrer DE, Conley D. Effect of peer administered consequences upon articulatory responses of speech defective children. *Journal of Communication Disorders* 1987;**20**:319-326.

Powell 1984 *{published data only}*

Powell TW, Elbert M. Generalisation following the remediation of early and later developing clusters. *Journal of Speech and Hearing Disorders* 1984;**49**:211-218.

Robertson 1997b *{published data only}*

Robertson SB, Weismer SE. The influence of peer models on play scripts of children with specific language impairment (Study 2). *Journal of Speech and Hearing Research* 1997;**40**:49-61.

Ruscello 1979 *{published data only}*

Ruscello DM, Shelton RL. Planning and self-assessment in articulatory training. *Journal of Speech and Hearing Disorders* 1979;**44**:504-512.

Sage 2001 *{published data only}*

Sage R. Supporting primary and secondary pupils with communication and behaviour problems. *International Journal of Language and Communication Disorders* 2001;**36 (suppl)**:423-428.

Shelton 1978b *{published data only}*

Shelton RL, Johnson AF, Ruscello DM, Arndt WB. Assessment of parent-administered listening training for pre-school children with articulation problems (Study 2). *Journal of Speech and Hearing Disorders* 1978;**43**:242-254.

Torgesen 1996 *{published data only}*

Torgesen JK, Davis C. Individual difference variables that predict response to training in phonological awareness. *Journal of Experimental Child Psychology* 1996;**63**:1-21.

Tyler 1991 *{published data only}*

Tyler AA, Watterson KA. Effects of a phonological versus a language intervention in preschoolers with both phonological and language impairment. *Child Language Teaching and Therapy* 1991;**7**(2):141-160.

Zdon 1968 *{unpublished data only}*

Zdon MM. The efficacy of auditory discrimination training in the correction of a selected misarticulation [Unpublished masters' thesis]. St. Cloud, MN: St. Cloud State College, 1968.

References to ongoing studies

Boyle, Ongoing *{unpublished data only}*

Evaluation of Speech and Language Therapy. Ongoing study ns.

Broomfield, FC *{unpublished data only}*

Evaluation of the clinical effectiveness of speech and language therapy for children with a primary speech/ language disability. Ongoing study 01.02.1999.

O'Hare, Ongoing *{unpublished data only}*

The effects of adaptive training in auditory temporal processing on specific language impairment: a randomised controlled trial of 'FastForWord' on Scottish children. Ongoing study 01.08.00.

Additional references

Aram 1980

Aram DVM, Nation JE. Preschool language disorders and subsequent language and academic difficulties. *Journal of Communication Disorders* 1980;**13**:159-170.

Aram 1984

Aram D, Ekelman B, Nation J. Preschoolers with language disorders: 10 years later. *Journal of Speech and Hearing Research* 1984;**27**:232-244.

Baker 1987

Baker L, Cantwell DP. A prospective psychiatric follow-up of children with speech/language disorders. *Journal of the American Academy of Child and Adolescent Psychiatry* 1987;**26**:546-553.

Bishop 1990

Bishop D, Adams C. A prospective study of the relationship between specific language impairment, phonology and reading retardation. *Journal of Child Psychology and Psychiatry* 1990;**31**:1027-1050.

Boyle 1996

Boyle J, Gillham B, Smith N. Screening for early language delay in the 18 - 36 month age-range: the predictive validity of tests of production and implications for practice. *Child Language Teaching and Therapy* 1996;**12**:113-127.

Bzoch 1970

Bzoch KR, League R. The receptive expressive emergent language scale for the measurement of language skills in infancy. Florida: Tree of Life Press, 1970.

Catts 1993

Catts HW. The relationship between speech-language impairments and reading disabilities. *Journal of Speech and Hearing Research* 1993;**36**:948-958.

Clarke 2003

Clarke M, Oxman AD editors. Cochrane Reviewers' Handbook 4.2.0 [updated March 2003]. In: The Cochrane Library, Issue 2, 2003. Oxford: Update Software, Updated quarterly.

Cohen 2000

Cohen NJ, Vallance DD, Barwick M, Im N, Menna R, Horodezjy NB, Issacson L. The interface between ADHD and language impairment: an examination of language, achievement and cognitive processing. *Journal of Child Psychology and Psychiatry* 2000;**41**:353-362.

Egger 1997

Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple graphical test. *British Medical Journal* 1997;**315**(7109):629-34.

Enderby 1996

Enderby P, Emerson J. Speech and language therapy: does it work?. *British Journal of Medicine* 1996;**312**:1655-1658.

Haynes 1991

Haynes C, Naidoo S. Children with Specific Speech and Language Impairment. Oxford: Blackwell, 1991.

Huntley 988

Huntley RMC, Holt K, Butterfill A, Latham C. A follow-up study of a language intervention programme. *British Journal of Disorders of Communication* 1988;**23**:127-140.

Juni 2001

Juni P, Altman GA, Egger M. Assessing the quality of randomised control trials. In: Egger M, Davey Smith G, Altman DG editor(s). Systematic Reviews in Health Care: Meta-Analysis in Context. 2nd Edition. London: BMJ Books, 2001:87-108.

Law 2000

Law J, Boyle J, Harris F, Harkness A, Nye C. Prevalence and natural history of primary speech and language delay: Findings from a recent systematic review of the literature. *International Journal of Language and Communication Disorders* 2000;**35**:165-188.

Law 1997

Law J. Evaluating intervention for language impaired children: a review of the literature. *European Journal of Disorders of Communication* 1997;**32**:1-14.

Law 1998

Law J, Boyle J, Harris F, Harkness A, Nye C. Screening for speech and language delay: a systematic review of the literature. Health Technology Assessment (available on line: http://www.hta.ac.uk/fullmono/mon209.pdf). Vol. **2**, Havant, UK: Health Technology Assessment NHS R&D HTA Programme, 1998.

Leonard 1998

Leonard LB. The nature and efficacy of treatment. In: Leonard LB editor(s). Children with Specific Language Impairment. Cambridge, MA: MIT Press, 1998:193-210.

Manolson 1992

Manolson A. It takes two to talk. Toronto: The Hanen Centre, 1992.

McLean 1997

McLean LK, Woods Cripe JW. The effectiveness of early intervention for children with communication disorders. In: Guralnick MJ editor(s). The Effectiveness of Early Intervention. Baltimore MD: Paul H Brookes, 1997.

Moher 2001

Moher D, Schultz KF, Altman D. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *Journal of the American Medical Association* 2001;**285**(15):1987-1991.

Nye 1987

Nye C, Foster SH, Seaman D. Effectiveness of language intervention with language/learning disabled children. *Journal of Speech and Hearing Disorders* 1987;**52**:348-357.

Olswang 1998

Olswang LB. Threatment Efficacy Research. In: Fratelli C editor(s). Measuring Outcomes in Speech and Language Pathology. New York: Thieme, 1998.

Plante 1998

Plante E. Criteria for SLI: the Stark and Tallal legacy and beyond. *Journal of Speech, Language and Hearing Research* 1998;**41**:951-957.

RCSLT 1998

Royal College of Speech and Language Therapists. Clinical Consensus Guidelines by Consensus for Speech and Language Therapists. London: The Royal College of Speech and Language Therapists, 1998.

Rescorla 1990

Rescorla L, Schwartz E. Outcomes of toddlers with specific language delay. *Applied Psycholinguistics* 1990;**11**(4):393-407.

Rice 1991

Rice ML, Sell MA, Hadley PA. Social interactions of speech and language impaired children. *Journal of Speech and Hearing Research* 1991;**34**:1299-1307.

Rutter 1992

Rutter M, Mahwood L, Howlin P. Language delay and social development. In: Fletcher P, Hall D editor(s). Specific Speech and Language Disorders in Children. London: Whurr, 1992.

Stark 1981

Stark RE, Tallal RP. Selection of children with specific language deficits. *Journal of Speech and Hearing Disorders* 1981;**46**:114-180.

Stothard 1998

Stothard SE, Snowling MJ, Bishop DVM, Chipchase BB, Kaplan CA. Language-impaired preschoolers: a follow-up into adolescence. *Journal of Speech, Language and Hearing Research* 1998;**41**:407-418.

Tallal 1997

Tallal P, Allard L, Miller S, Curtiss S. Academic outcomes of language impaired children. In: Hulme C, Snowling M editor(s). Dyslexia: Biology, Cognition and Intervention. London: Whurr, 1997.

Tomblin 1997

Tomblin JB, Smith E, Zhang X. Epidemiology of specific language impairment: pre- and perinatal factors. *Journal of Communication Disorders* 1997;**30**:325-344.

Ward 1994

Ward S, Birkett D. Ward Infant Language Screening Test Assessment Acceleration Remediation - Manual and Assessment. Manchester: Central Manchester Health Care Trust, 1994.

Ward 1999

Ward S. An investigation into the effectiveness of an early intervention method for delayed language development in young children. *International Journal of Language and Communication Disorders* 1999;**34**:243-265.

Whitehurst 1991

Whitehurst GJ, Arnold DS, Smith M, Fischel FE, Lonigan CJ, Valdez-Menchaca MC. Family history in developmental expressive language delay. *Journal of Speech and Hearing Research* 1991;**43**:1150-1157.

Yoder 1991

Yoder PJ, Kaiser AP, Alpert CL. An exploratory study of the interaction between language teaching methods and child characteristics. *Journal of Speech and Hearing Research* 1991;**34**:155-167.

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

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

Almost 1998

Methods	Randomised Controlled Trial
Participants	30 participants age range 2;09 - 5;01 21 males and 5 females SES details not mentioned
Interventions	Clinician administered phonology therapy 80 minutes a week over 4 months 13 participants received immediate treatment 13 participants received delayed treatment
Outcomes	Goldman Fristoe % consonants correct in conversation Outcomes not used: APPR, MLU
Notes	At baseline children had to score severe on APPR

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

Barratt 1992

Methods	Randomised Controlled Trial
Participants	42 participants age range 3;01-3;07

Barratt 1992 *(Continued)*

	27 males and 12 females were present at end SES data not provided, but children could be included on basis of delay due to deprivation
Interventions	Clinician administered interactive language therapy focusing on expressive and receptive skills. Provided over six months either weekly (40 mins) or as part of two intensive therapy blocks (40 mins 4 days a week for 3 weeks in each 3 month block). 21 participants received weekly therapy and 18 received intensive therapy.
Outcomes	Reynell Expressive and Receptive scales
Notes	Children had to score less than 1SD below mean on expressive and/or receptive subtests

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Cole 1986

Methods	Randomised ControlledTrial
Participants	44 participants age range 3;02 - 5;09 34 males and 10 females participated Information on SES characteristics not provided
Interventions	Clinician administered intervention using either a directive approach or an interactive approach. 600 minutes a week given for 8 months. Targets stated as being syntax, semantics and pragmatics. 19 participants received a directive approach 25 participants received an interactive approach
Outcomes	MLU Preschool language scale: overall scores Basic language concepts test PPVT Outcomes excluded: DSS, Basic language concepts test, northwestern syntax test
Notes	At baseline children had to score 1.5SD below mean on either an expressive test or a receptive test of language (see the outcomes measures for possible tests)

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Courtwright 1979

Methods	Randomised Controlled Trial
Participants	36 participants age range 3;11-6;11

Courtwright 1979 *(Continued)*

	24 males and 12 females SES details not given
Interventions	Clinician administered syntax intervention looking at effectiveness of mimicry and modelling approaches delivered over five months of intervention 12 children in mimicry condition 12 children in modelling condition 12 children in 3rd person modelling condition
Outcomes	Utterances correct on 20 unusual sentences
Notes	At baseline children scored below 10%tile on DSS. Unusual sentence structure taught noun-means to-verb-ing

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Dixon 2001

Methods	Randomised study Authors do not describe it as a randomised controlled trial
Participants	8 participants age range 9;00 - 15.01 children described as being from two towns with potentially different SES groups. Gender details not provided
Interventions	Clinician administered receptive syntax therapy: Visualing and Verbalising Given for 30 minutes a week for 10 weeks 2 children received traditional therapy 4 received half of traditional and half experimental therapy and 2 received experimental therapy
Outcomes	Analytic Reading Inventory
Notes	Children had to score 2SD below mean on CELF receptive test Only subjects receiving traditional only and experimental only used in analysis

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Evans [forthcoming]

Methods	Randomised Controlled Trial
Participants	60 participants aged 0;08 Children from middle class area

Evans [forthcoming] *(Continued)*

	Gender mix not stated
Interventions	Parent administered general language intervention with training from clinician: WILSTAAR intervention 24 participants assigned to WILSTAAR condition 36 participants assigned to no treatment condition
Outcomes	REEL Language Quotients
Notes	At baseline children had to have REEL scores 1SD below mean

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Fey 1993

Methods	Randomised Controlled Trial
Participants	30 participants aged 3;08 - 5;10 21 male and 9 female SES details not provided
Interventions	Parent or Clinician administered expressive syntax intervention based on focused stimulation delivered for 180 minutes a week for 4.5 months 11 children assigned to clinician treatment 10 assigned to parent treatment 9 assigned to delayed treatment
Outcomes	DSS composite Outcomes not used: DSS subtests
Notes	At baseline children had to score below the 10%tile in expressive language

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Fey 1994

Methods	Randomised Controlled Trial Phonology measures for Fey 1993
Participants	26 participants aged 3;08 - 5;10 17 males and 9 females SES details not provided

Fey 1994 *(Continued)*

Interventions	Parent or Clinician administered expressive syntax intervention based on focused stimulation over 10 months 10 received clinician therapy 8 received parent therapy 8 received delayed therapy
Outcomes	Indirect outcomes not used in main meta-analysis Percentage of consonants correct derived from the APPR assessment
Notes	Indirect outcomes looking at the impact of expressive interventions on phonology

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Fey 1997

Methods	Randomised Controlled Trial Follow up of Fey 1993
Participants	28 participants aged 3;08 - 5;10 Details of gender and SES as Fey 1993
Interventions	Parent or Clinician administered expressive syntax intervention based on focused stimulation. Provided in addition to that which was provided in Fey 1993 9 had further parent treatment as Fey 1993 9 had further clinician treatment as Fey 1993 10 had no more treatment except the 4.5 months they received in Fey 1993
Outcomes	Follow-up study not used in main meta-analysis DSS composite DSS verbs DSS sentence points
Notes	At baseline children had to score below the 10%tile in expressive syntax

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Fudala 1972

Methods	Randomised Controlled Trial
Participants	92 participants aged between first and fifth grade Stated that all socio-economic and ethnic populations represented Gender details not provided

Fudala 1972 *(Continued)*

Interventions	Clinician administered phonology therapy with or without parental observation of the therapy sessions All received clinician therapy: 25 minutes a week for 4.5 months, but 23 parents also attended therapy once a week and 23 parents also attended therapy once a month
Outcomes	Arizona articulation proficiency scale
Notes	Child had mild phonological impairment

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Gibbard 1994a

Methods	Study 1 Randomised Controlled Trial
Participants	36 participants aged between 2;03 - 3;03 Majority of participants in social classes I, II, or IIIM. Mean mother age 30, mean father age 33 25 males and 11 females took part
Interventions	Parental administered expressive syntax intervention emphasising how to maximise language use in everyday environment Therapy administered on average 40 minutes a week over 6 months 18 children received parental intervention 18 children received delayed intervention
Outcomes	Reynell expressive measure Language samle one word scores and total scores RAPT: information Mothers description of vocabulay and phrase complexity MLU from language sample Outcomes not used: Comprehension measures, Derbyshire measures, Renfrew Grammar
Notes	Children had less than 30 words and be at a one word stage of development based on mother report

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Gibbard 1994b

Methods	Study 2 Randomised Controlled Trial
Participants	25 participants aged between 2.03 - 3; 03

Gibbard 1994b *(Continued)*

	Majority of participants in social classes II, IIIM and IIIN. Average mother age 28 and 29, avarage father age 29 and 33.5 19 males and 6 females took part
Interventions	Clinician or parent administered expressive syntax intervention. Clinician therapy for 30 minutes a week for six months, parent therapy for an average of 40 minutes a week for six months. Controls received a cognitive parent therapy based on Portage 8 children received clinician therapy 9 children received parent therapy 8 children received the parent control therapy
Outcomes	Reynell expressive measure Langauge sample one word score, total scores and MLU Parent Report of vocabulary and phrase complexity RAPT information Outcomes excluded: As Gibbard (study 1)
Notes	Children has less that 30 words and be at the one word stage of development

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Girolametto 1996a

Methods	Randomised ControlledTrial
Participants	16 participants aged between 1;10 - 3;02 Details of education, employment and family provided. Most participants had finished school and were in employment 11 boys and 5 girls took part
Interventions	Parental administered expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation Therapy administered for 150 minutes a week for 10 weeks 8 children received parent therapy 8 children received delayed therapy
Outcomes	Parent report of vocabulary size Number of target words in probe exercise Outcomes excluded: probe control words, parent report of symbolic gestures, behaviour scales
Notes	Children were below the 5%tile on CDI vocabulary measure

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Girolametto 1996b

Methods	Randomised Controlled Trial
Participants	25 participants aged between 1;11 - 2;11 All participants were middle class, most had completed post secondary education and all were either house wives or working Gender details not given
Interventions	Parental administered expressive vocabulary intervention based on HANEN priniciples adapted for focused stimulation. Delivered over 11 weeks for 150 minutes a week 12 children received parent intervention 13 children received delayed intervention
Outcomes	Range of mother outcomes that were not used Child outcomes: Vocabulary and phrase complexity as determined by the CDI Number of different words, and utterances from a language sample Post test probes for target words Outcomes Excluded: Control word measures, Target words in interaction, multi-word utterances
Notes	Children were below the 5%tile on vocabulary as determined by the CDI

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Girolametto 1997

Methods	Randomised Controlled Trial Phonology outcomes for Girolametto (b)
Participants	25 participants aged between 1;11 - 2;11 SES details as Girolametto 1996b all participants middle class Provides gender details: 22 males and 3 females took part
Interventions	Parental administered expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation 12 received parent intervention 13 received delayed intervention
Outcomes	Indirect phonology outcomes not used in main meta-analysis: Different vocalisation Syllable structure at level 1,2,3 Consonants inventory: early, middle, late Consonant position; initial and final Proportion of consonants correct
Notes	This study reports the indirect effects of an expressive treatment on phonology

Risk of bias

Girolametto 1997 *(Continued)*

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Glogowska, 2000

Methods	Randomised ControlledTrial
Participants	159 participants aged between 1;06-3;06 Just over half of children were receiving child care. Most mothers had completed 'O' level education a minority either had no qualifications or had 'A' levels 120 males and 39 females took part
Interventions	Clinician administered intervention focusing on a variety of language areas. Participants on average received therapy for 10 minutes a week for 8.4months 71 children received clinician intervention 88 children received delayed intervention
Outcomes	Primary: PLS: Auditory Comprehension and Expressive language Phonological Errors Outcomes excluded: Bristol Language Development Scale Improvement in 12 months Therapy outcome measures: impairment, disability, handicap, wellbeing Attention Play Socialisation Eligibility for therapy 12 months later
Notes	Children needed to be 1.25SD below mean Included children who could have just phonology difficulites, just expressive difficulties or both expressive and receptive difficulties. However all participants analysed together

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

Head 1975

Methods	Randomised ControlledTrial
Participants	28 participants aged between 6;00 - 12;00 No details given concerning gender or SES
Interventions	Clinician administered language intervention as part of a summer camp for children with severe speech and language difficulties. 14 children received recreation games 14 children received percpetual motor activities

Head 1975 *(Continued)*

Outcomes	Northwest Syntax Test: expressive Goldman Fristoe Test of Articulation Outcomes excluded: Basic Concept Inventory Oral Commission Detroit Test Part 7, Peabody Picture Vocabulary Test Northwest test of receptive syntax
Notes	Severity levels or difficulties of children not specified

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Lancaster 1991

Methods	Randomised Controlled Trial
Participants	15 participants aged between 3;04-4;05 12 males and 3 females took part. Details provided on family history and early development. Majority had family incidence of speech difficulties and two had a language delay
Interventions	Clinician or parent administered phonology intervention Clinician provided an eclectic approach, parent therapy was based on auditory bombardment Therapy administered over 6 months. On average children received 17 minutes of therapy a week while parents received a maximum of 9 minutes of training a week 5 children received clinician therapy 5 children received parent therapy 5 children received delayed therapy
Outcomes	Composite Deviancy Score
Notes	Children needed to have a standard score of below 80 on the EAT

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Law 1999

Methods	Randomised Controlled Trial
Participants	43 participants aged between 2;09 - 3;03 24 males and 14 females at the end of the project. Majority were from lower SES and were from ethnic minorities.

Law 1999 *(Continued)*

Interventions	Clinician or Parent administered expressive and receptive language intervention. Clinician therapy focused on auditory processing and word mapping. Parent therapy used HANEN principles Therapy was 450 minutes a week for 6 weeks (clinician) or 150 minutes for 10 weeks (parent) 17 children received clinician therapy 11 children received parent therapy 10 children received delayed therapy
Outcomes	BPVS PLS: expressive and receptive Parent Report: vocabulary, and phrase complexity Language sample: total communication acts, MLU Outcomes excluded: Reynell Irregular nouns and verbs CDI Behaviour Child and Self: Family Grid Language sample: initiation, responsiveness, discourse maintainers, echos, nouns, verbs, parent behaviours
Notes	Child were below 1.5SD on comprehension measures

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	A - Adequate

Matheny 1978

Methods	Randomised ControlledTrial
Participants	24 participants aged between 5;05 - 6;10 All participants were described as white, no details of gender are given
Interventions	Clinician administered therapy programmes: Monterey Language Programmes delivered over five months 8 participants received articulation therapy 8 participants received expressive syntax therapy 8 participants received no therapy
Outcomes	PAT (phonology) PCLT (syntax)
Notes	Children had relatively mild difficulties: 7 consonants errors on PAT and not above level 6 on PCLT. Looked at indirect effects as well as direct effects e.g. children who had syntax programme also got assessed on phonology and vice versa

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Mulac 1977

Methods	Randomised Controlled Trial
Participants	9 participants aged 4;04 - 6;03 6 males and 3 females participated, no details of SES are given
Interventions	Clinician administered Monterey operant language programme with additional outdoor activities and home activities for the children in the programme and additional lessons condition. On average children received 67 minutes of therapy a week for 4 weeks. Focus of the intervention was on 'is' interrogative 3 children received articulation therapy 3 children received Monterey language programme 3 children received Monterey language programme and additional exercises to facilitate generalisation
Outcomes	Extra clinic measures of 'is' interrogative measures
Notes	Focus on the generalisation of 'is' interrogative Children only had to fail this component in order to be included in the study.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Munro 1998

Methods	Randomised Controlled Trial (not all participants could be randomised)
Participants	13 participants aged 3;11-5;05 6 boys and 5 girls participated, no details of SES were provided
Interventions	Clinician administered intervention for phonology /k/ and /g/. Therapy administered for 60 minutes a week for 6 weeks 7 received immediate therapy 4 received delayed therapy
Outcomes	EAT target sounds in intial position Re-telling a story with target sounds repetition of five lexical items four times each Outcomes excluded: CVC imitation task using target sounds
Notes	Not all children had significant phonological delays. The average mean SS was <70 but the range was broad 48-101

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Reid 1996

Methods	Randomised Controlled Trial (sub-group analysis)
Participants	30 participants aged 3;06-5;06 No details are provided of gender or SES
Interventions	Clinician administered phonology intervention using Metaphon. 30 minutes given a week lasting up to 10 weeks 8 children received metaphon stage 1 only 7 children received metaphon stages 1 and 2 15 children received delayed therapy
Outcomes	EAT Occurance of Phonological Process: subtest from Metaphon resources
Notes	Children had to get less than 85SS on EAT This is a sub-group analysis of what was an on-going trial: groups acknowledged to be unequal and median figures reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Robertson 1997

Methods	Randomised Controlled Trial (Study 1)
Participants	20 SLI participants and 10 age matched peers aged between 3;08 - 5;01 Provides the mean amount of maternal education: experimental group: 14 years control group: 15.4 years In SLI group 13 participants were male and 7 were female
Interventions	Play intervention for expressive narrative language. 20 minutes of therapy a week provided over 3 weeks 10 SLI children played with each other in pairs 10 SLI children were paired with a normal peer
Outcomes	Language Sample: Number of words in script, number of different words, number of play related themes Outcome excluded: number of linguistic markers
Notes	Children had severe recpetive difficulties as well as expressive difficulties (2SD below mean)

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Robertson 1999

Methods	Randomised Controlled Trial
Participants	24 participants aged 1;09 - 2;06 Participants are described as coming from white middle-class households 12 males and 9 females finished the programme
Interventions	Clinician administered intervention for expressive vocabulary and syntax. Child centred approach to provide general stimulation. Therapy administered for 150 minutes a week for 12 weeks 12 children received clinician intervention 12 children received delayed intervention
Outcomes	Language Sample: MLU, total number of words Parent report of vocabulary (CDI) Outcomes excluded: Stress and behaviour measures, % of intelligible utterances
Notes	This study was also an unpublished Phd thesis. Children could have receptive difficulties but only two did. Most only had expressive difficulties below 10%tile on vocabulary measure of CDI

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Ruscello 1993

Methods	Randomised study (author does not say it is a randomised controlled study)
Participants	12 participants aged between 4;01-5;08 8 males and 4 females participated in the study no SES characteristics are given
Interventions	Clinician administered phonology intervention with additional intervention from parents using Speech Viewer software. One group received clinician administered intervention for 120 minutes a week for 8 weeks. A second group received both parent and clinician administered treatment with one 1 hour session provided by the clinician and one 1hour session provided by the parent
Outcomes	30 item naming sample including words, phrases, and sentences Khan Lewis Phonological Assessment
Notes	Children had to score below the 15%tile on Khan Lewis phonological analysis.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Rvachew 1994

Methods	Randomised Controlled Trial
Participants	27 participants aged 3;06 - 5;06 21 males and 6 females participated, no SES characteristics are provided
Interventions	Clinician administered phonological therapy with additional auditory discrimination task. Therapy delivered for 45 minutes a week over 6 weeks. Experimental group had to identify correct and incorrect pronunciations of the same word Traditional group had to discriminate between a minimal pair The third group had to discriminate between a non minimal pair of words 10 children received an experimental auditory discrimination task 9 children received a traditional auditory discrimination task 8 children received a discrimination game not based on minimal pairs
Outcomes	Auditory word discrimination test Object naming speech sample Outcomes excluded: /sh/ centroid
Notes	The criteria stated that children had to be non-stimulable to /sh/ however all but two children also had moderate or severe phonological delay as shown by CAPP

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Rvachew 2001

Methods	Randomised Controlled Trial
Participants	48 participants aged mean 4;02 Gender and SES characteristics are not provided
Interventions	Clinician administered phonological intervention with traditional therapy targeting the early developing sounds was compared to intervention that targeted the later developing sounds 24 children received treatment for early developing sounds 24 children received treatment for late developing sounds Intervention delivered for 30 minutes a week for 12 weeks.
Outcomes	Probes for each target sound PPKP: phonological profile Percentage of consonants correct in conversation
Notes	Children had moderate to severe phonological delay majority fell below the first percentile (39 participants), all fell below 9%tile.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Schwartz 1985

Methods	Randomised Controlled Trial
Participants	10 participants aged 2;08 - 3;04 All participants were male, no SES characteristics were provided
Interventions	Clinician administered expressive syntax intervention. Therapy administered over 3 weeks 8 received experimental intervention 2 served as control group receiving intervention without target utterances
Outcomes	Multiword utterances used with the target stimuli
Notes	Children had a receptive difficulty approximately 6-9 months behind CA, and an expressive difficulty approx 12-16 months behind CA

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Shelton 1978

Methods	Randomised Controlled Trial
Participants	60 participants aged approximately between 3;00 -4;06 The gender of participants was not stated. Bilingual children were included with two in each condition
Interventions	Parent administered speech programmes. Listening therapy based on auditory discrimination compared to more traditional reading and talking therapy and delayed treatment Therapy administered for 57 days (listening for 5 minutes a day and reading and talking for 15 minutes a day) 20 children received an experimental listening therapy 20 children received a reading and talking therapy 20 children received delayed treatment
Outcomes	Auditory association subtest of ITPA McDonald Screening Articulation Test Outcomes Excluded: Test of auditory discrimination: quiet and noise Northwest Syntax Screening: Receptive measure Discrimination test: phone identification Error Recognition Templin Darley Articulation Screening subtests /s/ /r/ /k/ /f/ of McDonald
Notes	Child had to score below their age range on Templin Darley

Risk of bias

Bias	Authors' judgement	Support for judgement

Shelton 1978 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	B - Unclear

Sommers 1962

Methods	Randomised Controlled Trial
Participants	80 participants but data from 40 participants considered 'slow learners' was not used. Participants had a mean age of 7.44 The study contained fewer middle class mothers than the authors described as representative, gender details are not provided
Interventions	Clinician administered speech therapy with parental training in half of the conditions. Therapy was administered for 200 minutes a week for 4 weeks 10 children received individual and parent training 10 children received individual and no parent training 10 children received group and parent training 10 children received group and no parent training
Outcomes	McDonald Deep Test of Articulation
Notes	As well as trained and untrained parents also compares group and individual therapy The severity of these children is unclear but most improved the equivalent of 2-3 phonemes.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Sommers 1964

Methods	Randomised ControlledTrial
Participants	80 participants with a mean age of 7;09 (approx) Gender details are not provided, participants were mostly drawn from social classes V and VI Mothers had to have either what was considered a healthy or unhealthy attitude as measured by the PARI attitide test
Interventions	Clinician administered speech therapy with additional intervention from trained parents for half the participants Therapy administered for 200 minutes a week for 4 weeks
Outcomes	McDonald Deep Test of Articulation
Notes	Parent attitudes graded on basis of scores from the Parental attitude research instrument. Note this has limitations in its applicability to current culture Children had approximately six sounds that they misarticulated

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Sommers 1964 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	B - Unclear

Sommers 1966

Methods	Randomised Controlled Trial
Participants	240 participants aged between grades 2 and 6 with mild or moderate speech difficulties Participants were predominently from a middle class background: social classes I, II or III, gender details were not provided
Interventions	Clinician administered speech therapy with half of the participants receiving individual therapy and half receiving group therapy. On average children received 40 minutes of therapy a week for 8.5 months. Participants split by age and severity to receive either group or individual treatment
Outcomes	McDonald Deep Test of Articulation
Notes	Children were split into 12 conditions e.g. 1. grade 2, mild, individual 2. grade 2, moderate, individual e.t.c Children with mild disorders may only have had approximately 3 mis-articulations

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Sutton 1999

Methods	Randomised Controlled Trial
Participants	22 participants aged 0;07 No SES characteristics or gender details are provided
Interventions	WILSTAAR: Parent administered general language intervention designed to facilitate language development in first year of life. Children received 5 home visits over four months, control children received two visits 13 children received WILSTAAR intervention 9 children assigned to no treatment control
Outcomes	REEL language quotients
Notes	Therapists had to provide a fixed number of sessions so this differs from the original WILSTAAR programme Children had to fail Wscreen and have a standard score of below 85 on REEL to be included

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Sutton 1999 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	B - Unclear

Tufts 1959

Methods	Randomised Controlled Trial
Participants	30 participants aged mean 5;00 Of the parents in the intervention groups none had college degrees and 2 had not finished high school. Gender details were not provided
Interventions	Clinician or parent administered speech therapy Therapy administered for 60 minutes a week for 7 months 10 children received clinic therapy 10 children received parent therapy 10 children received no therapy
Outcomes	Ranks as given by a panel of judges
Notes	Children with mild and severe difficulties as rated by the panel of judges were excluded from the study

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

Wilcox 1991

Methods	Randomised Controlled Trial
Participants	20 participants age range 1;08 - 3;11 Gender details and SES characteristics are not provided
Interventions	Clinician administered expressive vocabulary intervention. Therapy provided for 90 minutes a week for 3 months in individual condition and 360 minutes a week in group condition for three months 10 participants received individual intervention 10 participants received classroom based group intervention
Outcomes	Overall use of target words in clinic sessions. Outcomes excluded: seperate productive and additional use of target words measured in clinic Home measures
Notes	Children had to score 1.5SD below mean on both expressive and receptive scales of the sequenced inventory of communication development

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	B - Unclear

APPR: Assessment of Phonological Processes, BPVS: British Picture Vocabulary Scale, CA: Chronological Age, CAPP: ?, CDI: Communicative Developmental Index, CELF: Clinical Evaluation of Language Fundamentals, DSS: Developmental Sentence Score, EAT: Edinburgh Articulation Test, HANEN: ?, ITPA: Illinois Test of Psycholinguistic Properties, MLU: Mean Length of Utterance, PLS: Pre-school Language scale PAT: Picture Articulation Test, PCLT: PPKP: PPVT: Peabody Picture Vocabulary Test, RAPT: Renfrew Action Picture Test, REEL: Receptive Emergent Language Scale, SES: Socio-Economic Status, SLI: Specific Language Impairment, SS: Standard Score, WILSTAAR: Ward infant Language Screening Test: Assessment, Acceleration, Remediation.

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

Study	Reason for exclusion
Allen 1986	Study focuses on mis-articulation of /s/ without significant phonological delay
Christensen, 1981	Study investigates children with tongue thrusting behaviour
Clarke 1993	Study focuses on children who mis-articulate /r/ who do not have significant phonological delay.
Corte 2001	Study focuses on reading with no language measures
Costello 1978	Study focuses on mis-articulation of /s/
Elliot 2002	Study focuses on behaviour and while it is correlated to a language outcome, this is only measured at follow-up
Evans 1974	Study focuses on mis-articulation of /s/ without significant phonologcial delay. Participants could have no more than five mis-articulated sounds and the mean was 2.2 sounds
Gillam 2001	Study of four participants randomly assigned to four different conditions. None of the four participants takes part in what is described as a control therapy
Groher, 1976	Study does not employ the use of a control group. The study uses three different conditions but none are specified as being a control condition.
Hesketh 2000	Randomisation process described as semi-random and therefore not included.
Kot 1995	The study focuses on changes in communication behaviours rather than on measures of language improvement
Mowrer 1987	Study focuses on mis-articulation of /s/ and /z/ without significant phonological problems
Powell 1984	Study focuses on mis-articulation of stop and liquid, and fricative and liquid clusters without a significant phonological delay. Describes itself as a multiple baseline design.
Robertson 1997b	(Study 2) Multiple baseline experiment
Ruscello 1979	Study focuses on mis-articulation of /s/ and /r/ without a significant phonological delay.
Sage 2001	Participants were randomly sampled but no mention is made of random allocation
Shelton 1978b	(Study 2) Uses participants from study 1 and has a large degree of attrition from one study to the next (66%).
Torgesen 1996	Study measures outcomes using literacy measures
Tyler 1991	Study does not use a control group. All participants receive either an expressive or phonological approach to their difficulties

Study	Reason for exclusion
Zdon 1968	Study focuses on mis-articulation of /er/ without significant phonological difficulty. Participants could have no more than three speech mis-articulations.

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

Boyle, Ongoing

Trial name or title	Evaluation of Speech and Language Therapy
Methods	
Participants	Approximately 250 children with persisting expressive and/or receptive difficulties
Interventions	Group or Individual therapy delivered by a therapist or a clinician compared to children receiving community delivered speech and language therapy
Outcomes	No data available
Starting date	ns
Contact information	Prof James Boyle Department of Psychology, University of Strathclyde, Graham Hills Building, 40 George Street, G1 1QE
Notes	

Broomfield, FC

Trial name or title	Evaluation of the clinical effectiveness of speech and language therapy for children with a primary speech/ language disability
Methods	
Participants	730 participants of whom 75% were aged between 2-6 years old. All children involved had been identfied as having a primary speech and language delay/disorder
Interventions	Routine clinic therapy as it was normally offered. Clinician interventions in group or individual situations
Outcomes	Overall difference between treated and non-treated children at six months was .32 this was statistically significant difference. Subgroup analyses by type of disorder not available at time pr review publication
Starting date	01.02.1999
Contact information	Ms Jan Broomfield Tees and North East Yorkshire NHS Trust, 157 Southfield Road, Middleborough, Teeside, TS1 3HF.
Notes	

O'Hare, Ongoing

Trial name or title	The effects of adaptive training in auditory temporal processing on specific language impairment: a randomised controlled trial of 'FastForWord' on Scottish children
Methods	
Participants	Children aged 6-8 with specific language impairment
Interventions	FastForWord: Software programme
Outcomes	No data available
Starting date	01.08.00
Contact information	Dr AE O'Hare Lothian University Hospitals NHS Trust, Community Child Health Services, 10 Chalmers Crescent, Edinburgh, Mid-Lothian, EH9 1TS
Notes	

DATA AND ANALYSES

Comparison 1. Speech and language intervention vesus delayed or no treatment

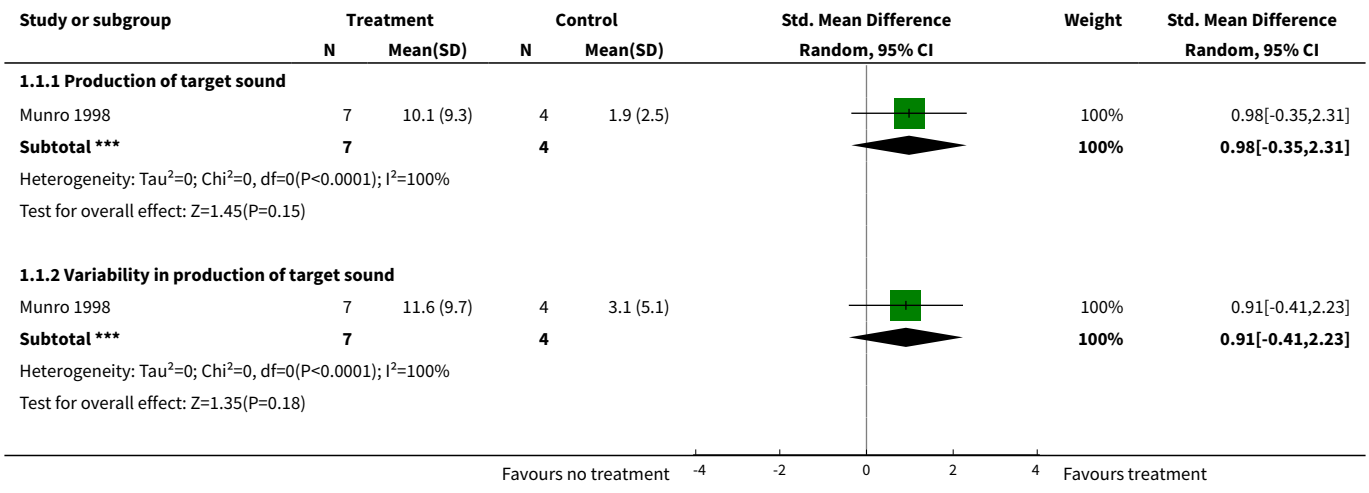
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Expressive phonology outcomes	6		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Production of target sound	1	11	Std. Mean Difference (IV, Random, 95% CI)	0.98 [-0.35, 2.31]
1.2 Variability in production of target sound	1	11	Std. Mean Difference (IV, Random, 95% CI)	0.91 [-0.41, 2.23]
1.3 Measures of overall phonological development	6	264	Std. Mean Difference (IV, Random, 95% CI)	0.44 [0.01, 0.86]
1.4 Percentage of consonants correct in conversation	1	26	Std. Mean Difference (IV, Random, 95% CI)	1.91 [0.96, 2.86]
1.5 Re-telling a story with target sound	1	11	Std. Mean Difference (IV, Random, 95% CI)	1.29 [-0.11, 2.69]
2 Receptive phonology outcomes	1		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Auditory association test	1	45	Std. Mean Difference (IV, Random, 95% CI)	0.53 [-0.10, 1.16]
3 Expressive syntax outcomes	7		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only

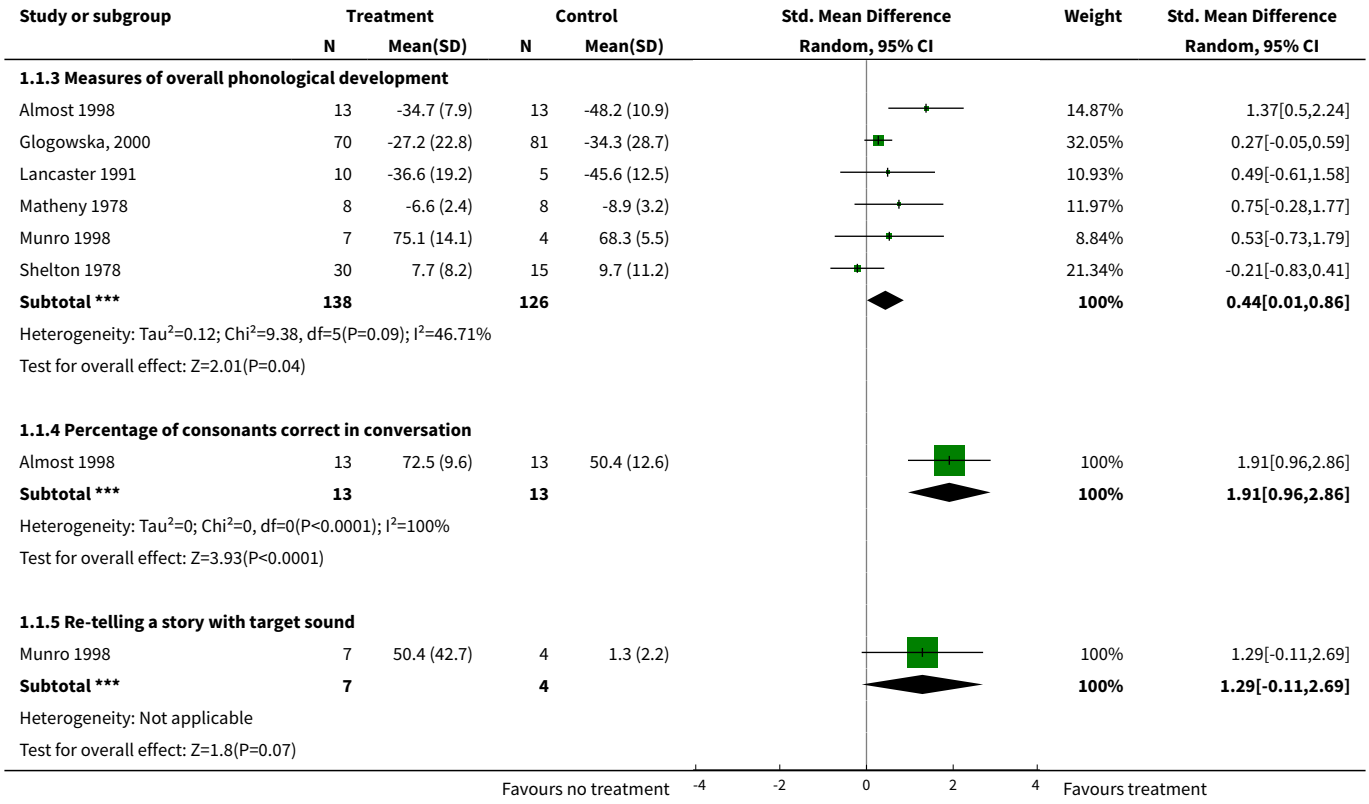
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Measures of overall expressive syntax development	5	271	Std. Mean Difference (IV, Random, 95% CI)	0.70 [-0.14, 1.55]
3.2 Total number of utterances in a language sample	3	99	Std. Mean Difference (IV, Random, 95% CI)	0.68 [-0.45, 1.82]
3.3 Mean length of utterance from language sample	3	95	Std. Mean Difference (IV, Random, 95% CI)	0.74 [-0.33, 1.81]
3.4 Parent report of phrase complexity	3	99	Std. Mean Difference (IV, Random, 95% CI)	1.02 [-0.17, 2.22]
4 Receptive syntax outcomes	2		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
4.1 measures of overall receptive syntax development	2	193	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.64, 0.56]
5 Expressive vocabulary outcomes	5		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
5.1 Number of different target words learnt	2	41	Std. Mean Difference (IV, Random, 95% CI)	0.93 [0.27, 1.58]
5.2 Measures of overall expressive vocabulary development	2	74	Std. Mean Difference (IV, Random, 95% CI)	0.98 [-0.59, 2.56]
5.3 Different words in language sample	3	82	Std. Mean Difference (IV, Random, 95% CI)	1.08 [0.61, 1.55]
5.4 Parent report of vocabulary	5	136	Std. Mean Difference (IV, Random, 95% CI)	0.89 [0.21, 1.56]
6 Receptive vocabulary outcomes	0		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
7 Composite language measures	1		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
7.1 REEL Language quotients	1	55	Std. Mean Difference (IV, Random, 95% CI)	0.22 [-0.32, 0.76]
8 Subgroup analysis (clinician only data)	7		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
8.1 measures of overall expressive phonology development	5	214	Std. Mean Difference (IV, Random, 95% CI)	0.67 [0.19, 1.16]
8.2 measures of overall expressive syntax development	4	214	Std. Mean Difference (IV, Random, 95% CI)	0.28 [-0.19, 0.75]
8.3 measures of overall expressive vocabulary development	1	27	Std. Mean Difference (IV, Random, 95% CI)	0.13 [-0.65, 0.91]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8.4 measures of overall receptive syntax development	2	182	Std. Mean Difference (IV, Random, 95% CI)	0.01 [-0.53, 0.55]
9 Subgroup analysis (trials of longer than eight weeks)	5		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
9.1 measures of overall phonological development	4	203	Std. Mean Difference (IV, Random, 95% CI)	0.74 [0.14, 1.33]
9.2 measures of overall expressive syntax development	3	187	Std. Mean Difference (IV, Random, 95% CI)	0.43 [-0.06, 0.93]
9.3 measures of overall expressive vocabulary development	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9.4 measures of overall receptive syntax development	1	155	Std. Mean Difference (IV, Random, 95% CI)	0.19 [-0.12, 0.51]
10 Subgroup Analysis (excluding data from children with receptive and expressive difficulties)	7		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
10.1 Measures of overall expressive syntax development	4	233	Std. Mean Difference (IV, Random, 95% CI)	1.02 [0.04, 2.01]
10.2 Total number of utterances in language sample	2	61	Std. Mean Difference (IV, Random, 95% CI)	1.20 [0.33, 2.07]
10.3 Mean langth of utterance based on language sample	2	57	Std. Mean Difference (IV, Random, 95% CI)	1.28 [0.66, 1.89]
10.4 Parent report of phrase complexity	2	61	Std. Mean Difference (IV, Random, 95% CI)	1.54 [0.42, 2.65]
10.5 Measures of overall vocabulary development	1	36	Std. Mean Difference (IV, Random, 95% CI)	1.79 [1.01, 2.58]
10.6 Parent report of vocabulary size	4	98	Std. Mean Difference (IV, Random, 95% CI)	1.00 [0.16, 1.84]
11 Sensitivity analysis (excluding studies not reporting attrition)	9		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
11.1 Measures of overall expressive phonology development	5	248	Std. Mean Difference (IV, Random, 95% CI)	0.40 [-0.08, 0.89]
11.2 Measures of overall receptive phonology development	1	45	Std. Mean Difference (IV, Random, 95% CI)	0.53 [-0.10, 1.16]
11.3 Measures of overall expressive syntax development	4	255	Std. Mean Difference (IV, Random, 95% CI)	0.67 [-0.33, 1.66]
11.4 Measures of overall receptive syntax development	2	193	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.64, 0.56]

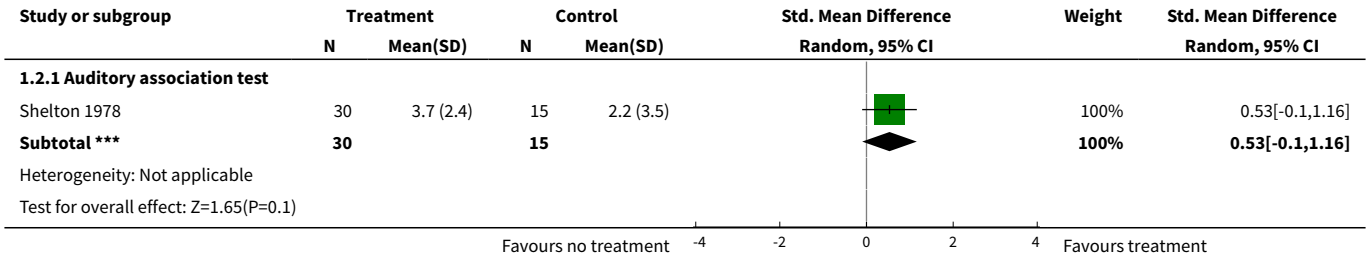
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11.5 Measures of overall expressive vocabulary development	2	74	Std. Mean Difference (IV, Random, 95% CI)	0.98 [-0.59, 2.56]
11.6 Measures of overall receptive vocabulary development	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
11.7 Composite language measures	1	55	Std. Mean Difference (IV, Random, 95% CI)	0.22 [-0.32, 0.76]
12 Sensitivity analysis (excluding studies not reporting blinding)	6		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
12.1 Measures of overall expressive phonology	3	188	Std. Mean Difference (IV, Random, 95% CI)	0.66 [-0.07, 1.40]
12.2 Measures of overall receptive phonology	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12.3 Measures of overall expressive syntax	3	219	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.47, 0.75]
12.4 Measures of overall receptive syntax	2	193	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.64, 0.56]
12.5 Measures of overall expressive vocabulary	1	38	Std. Mean Difference (IV, Random, 95% CI)	0.19 [-0.54, 0.91]
12.6 Measures of overall receptive vocabulary	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12.7 Composite language measures	1	55	Std. Mean Difference (IV, Random, 95% CI)	0.22 [-0.32, 0.76]

Analysis 1.1. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 1 Expressive phonology outcomes.

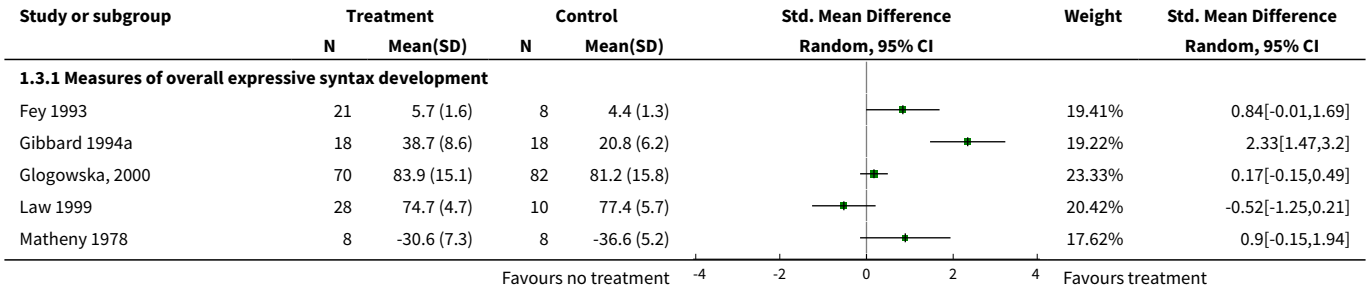




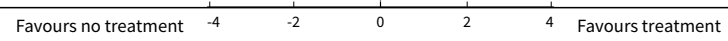
Analysis 1.2. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 2 Receptive phonology outcomes.



Analysis 1.3. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 3 Expressive syntax outcomes.

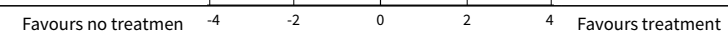


Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
Subtotal ***	**145**		**126**			**100%**	**0.7[-0.14,1.55]**
Heterogeneity: Tau²=0.76; Chi²=28.99, df=4(P<0.0001); I²=86.2%							
Test for overall effect: Z=1.64(P=0.1)							
1.3.2 Total number of utterances in a language sample							
Gibbard 1994a	18	89.5 (58.8)	18	17.4 (16.7)		33.39%	1.63[0.87,2.4]
Girolametto 1996b	12	182.9 (103)	13	103.8 (102)		32.7%	0.75[-0.07,1.56]
Law 1999	28	102.9 (31.4)	10	113.1 (35.4)		33.91%	-0.31[-1.03,0.42]
Subtotal ***	**58**		**41**			**100%**	**0.68[-0.45,1.82]**
Heterogeneity: Tau²=0.85; Chi²=13.03, df=2(P=0); I²=84.66%							
Test for overall effect: Z=1.18(P=0.24)							
1.3.3 Mean length of utterance from language sample							
Gibbard 1994a	18	2.3 (0.7)	18	1.4 (0.4)		33.97%	1.54[0.79,2.3]
Law 1999	28	2.4 (0.6)	10	2.6 (0.8)		34.44%	-0.21[-0.93,0.52]
Robertson 1999	11	1.3 (0.3)	10	1.1 (0.1)		31.59%	0.9[-0,1.81]
Subtotal ***	**57**		**38**			**100%**	**0.74[-0.33,1.81]**
Heterogeneity: Tau²=0.73; Chi²=11.02, df=2(P=0); I²=81.85%							
Test for overall effect: Z=1.35(P=0.18)							
1.3.4 Parent report of phrase complexity							
Gibbard 1994a	18	5 (1.9)	18	1.8 (0.9)		32.91%	2.1[1.27,2.94]
Girolametto 1996b	12	16.7 (13)	13	5.2 (10)		32.84%	0.96[0.13,1.8]
Law 1999	28	23.8 (3.7)	10	23.7 (2.9)		34.25%	0.04[-0.69,0.76]
Subtotal ***	**58**		**41**			**100%**	**1.02[-0.17,2.22]**
Heterogeneity: Tau²=0.95; Chi²=13.55, df=2(P=0); I²=85.24%							
Test for overall effect: Z=1.67(P=0.09)							



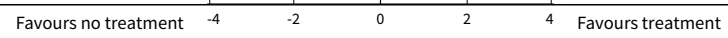
Analysis 1.4. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 4 Receptive syntax outcomes.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.4.1 measures of overall receptive syntax development							
Glogowska, 2000	71	87.3 (15.9)	84	84.3 (15.5)		63.71%	0.19[-0.12,0.51]
Law 1999	28	71.1 (5.3)	10	73.4 (4.6)		36.29%	-0.45[-1.18,0.28]
Subtotal ***	**99**		**94**			**100%**	**-0.04[-0.64,0.56]**
Heterogeneity: Tau²=0.12; Chi²=2.49, df=1(P=0.11); I²=59.87%							
Test for overall effect: Z=0.13(P=0.9)							



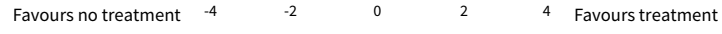
Analysis 1.5. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 5 Expressive vocabulary outcomes.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.5.1 Number of different target words learnt							
Girolametto 1996a	8	3.9 (2.4)	8	1.5 (2)		37.73%	1.03[-0.04,2.09]
Girolametto 1996b	12	5.9 (3.3)	13	3.3 (2.5)		62.27%	0.86[0.04,1.69]
Subtotal ***	**20**		**21**			**100%**	**0.93[0.27,1.58]**
Heterogeneity: Tau^2=0; Chi^2=0.06, df=1(P=0.81); I^2=0%							
Test for overall effect: Z=2.78(P=0.01)							
1.5.2 Measures of overall expressive vocabulary development							
Gibbard 1994a	18	15.7 (8.3)	18	3.2 (4.9)		49.51%	1.79[1.01,2.58]
Law 1999	28	76 (10.5)	10	74 (9.1)		50.49%	0.19[-0.54,0.91]
Subtotal ***	**46**		**28**			**100%**	**0.98[-0.59,2.56]**
Heterogeneity: Tau^2=1.14; Chi^2=8.67, df=1(P=0); I^2=88.47%							
Test for overall effect: Z=1.22(P=0.22)							
1.5.3 Different words in language sample							
Gibbard 1994a	18	14.2 (7.1)	18	8.1 (4.3)		44.98%	1.02[0.32,1.72]
Girolametto 1996b	12	64.5 (46)	13	25.2 (22)		30.54%	1.07[0.22,1.92]
Robertson 1999	11	15.1 (5.2)	10	8.5 (5.3)		24.49%	1.21[0.26,2.15]
Subtotal ***	**41**		**41**			**100%**	**1.08[0.61,1.55]**
Heterogeneity: Tau^2=0; Chi^2=0.1, df=2(P=0.95); I^2=0%							
Test for overall effect: Z=4.51(P<0.0001)							
1.5.4 Parent report of vocabulary							
Gibbard 1994a	18	225.3 (106.1)	18	49.4 (30.3)		20.09%	2.2[1.36,3.05]
Girolametto 1996a	8	79.5 (35)	8	68.9 (49)		18.08%	0.24[-0.75,1.22]
Girolametto 1996b	12	187.7 (181)	13	65.4 (66)		20.37%	0.88[0.05,1.71]
Law 1999	28	23.2 (4.1)	10	21.4 (2.1)		21.87%	0.47[-0.26,1.2]
Robertson 1999	11	76.2 (37.5)	10	51.4 (40.8)		19.59%	0.61[-0.27,1.49]
Subtotal ***	**77**		**59**			**100%**	**0.89[0.21,1.56]**
Heterogeneity: Tau^2=0.4; Chi^2=12.61, df=4(P=0.01); I^2=68.28%							
Test for overall effect: Z=2.58(P=0.01)							



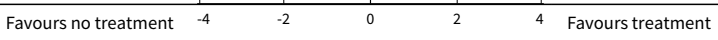
Analysis 1.7. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 7 Composite language measures.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.7.1 REEL Language quotients							
Evans [forthcoming]	23	106.5 (12.3)	32	104 (10.5)		100%	0.22[-0.32,0.76]
Subtotal ***	**23**		**32**			**100%**	**0.22[-0.32,0.76]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.8(P=0.43)							



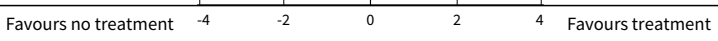
Analysis 1.8. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 8 Subgroup analysis (clinician only data).

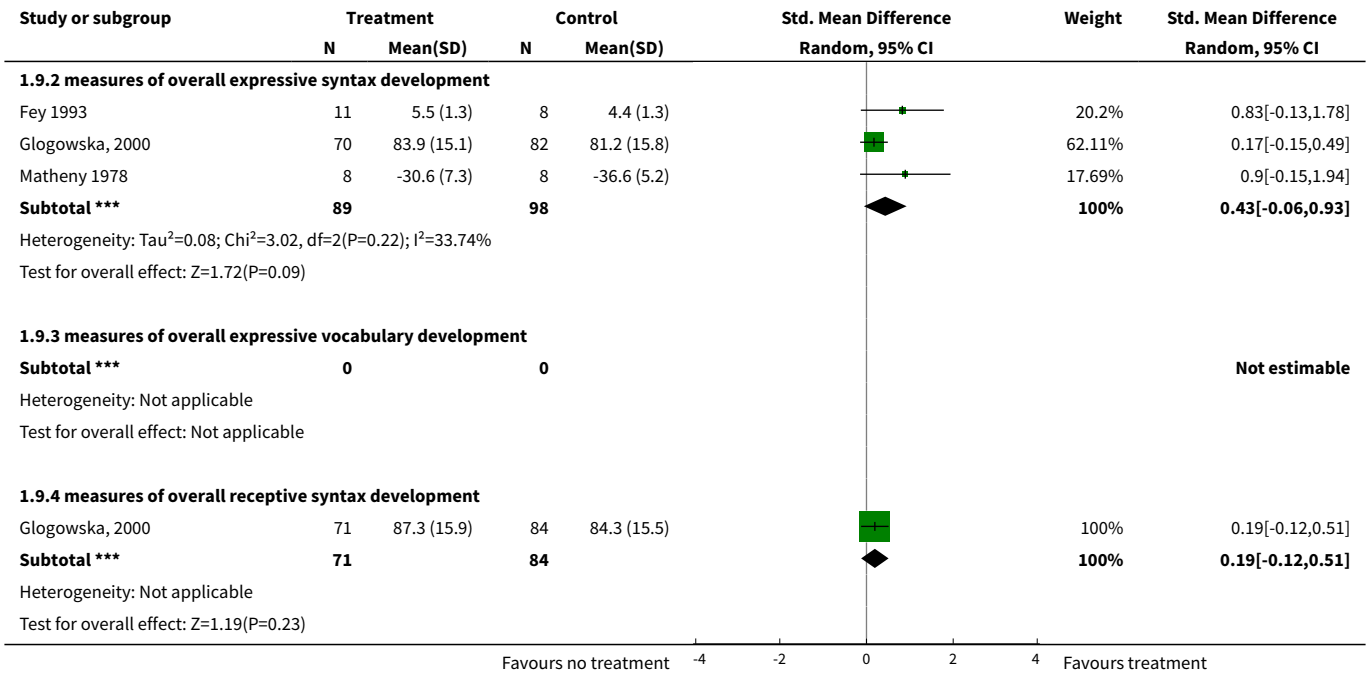
Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.8.1 measures of overall expressive phonology development							
Almost 1998	13	-34.7 (7.9)	13	-48.2 (10.9)		19.6%	1.37[0.5,2.24]
Glogowska, 2000	70	-27.2 (22.8)	81	-34.3 (28.7)		42.93%	0.27[-0.05,0.59]
Lancaster 1991	5	-27.7 (18.2)	5	-45.6 (12.5)		10.13%	1.04[-0.33,2.41]
Matheny 1978	8	-6.6 (2.4)	8	-8.9 (3.2)		15.74%	0.75[-0.28,1.77]
Munro 1998	7	75.1 (14.1)	4	68.3 (5.5)		11.59%	0.53[-0.73,1.79]
Subtotal ***	**103**		**111**			**100%**	**0.67[0.19,1.16]**
Heterogeneity: Tau^2=0.12; Chi^2=6.54, df=4(P=0.16); I^2=38.88%							
Test for overall effect: Z=2.71(P=0.01)							
1.8.2 measures of overall expressive syntax development							
Fey 1993	11	5.5 (1.3)	8	4.4 (1.3)		17%	0.83[-0.13,1.78]
Glogowska, 2000	70	83.9 (15.1)	82	81.2 (15.8)		45.93%	0.17[-0.15,0.49]
Law 1999	17	75.7 (4.3)	10	77.4 (5.7)		22.06%	-0.35[-1.13,0.44]
Matheny 1978	8	-30.6 (7.3)	8	-36.6 (5.2)		15.01%	0.9[-0.15,1.94]
Subtotal ***	**106**		**108**			**100%**	**0.28[-0.19,0.75]**
Heterogeneity: Tau^2=0.1; Chi^2=5.23, df=3(P=0.16); I^2=42.63%							
Test for overall effect: Z=1.16(P=0.25)							
1.8.3 measures of overall expressive vocabulary development							
Law 1999	17	75.5 (11.6)	10	74 (9.1)		100%	0.13[-0.65,0.91]
Subtotal ***	**17**		**10**			**100%**	**0.13[-0.65,0.91]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.33(P=0.74)							
1.8.4 measures of overall receptive syntax development							
Glogowska, 2000	71	87.3 (15.9)	84	84.3 (15.5)		69.21%	0.19[-0.12,0.51]
Law 1999	17	71.3 (5.4)	10	73.4 (4.6)		30.79%	-0.4[-1.19,0.39]
Subtotal ***	**88**		**94**			**100%**	**0.01[-0.53,0.55]**
Heterogeneity: Tau^2=0.08; Chi^2=1.88, df=1(P=0.17); I^2=46.86%							
Test for overall effect: Z=0.03(P=0.97)							



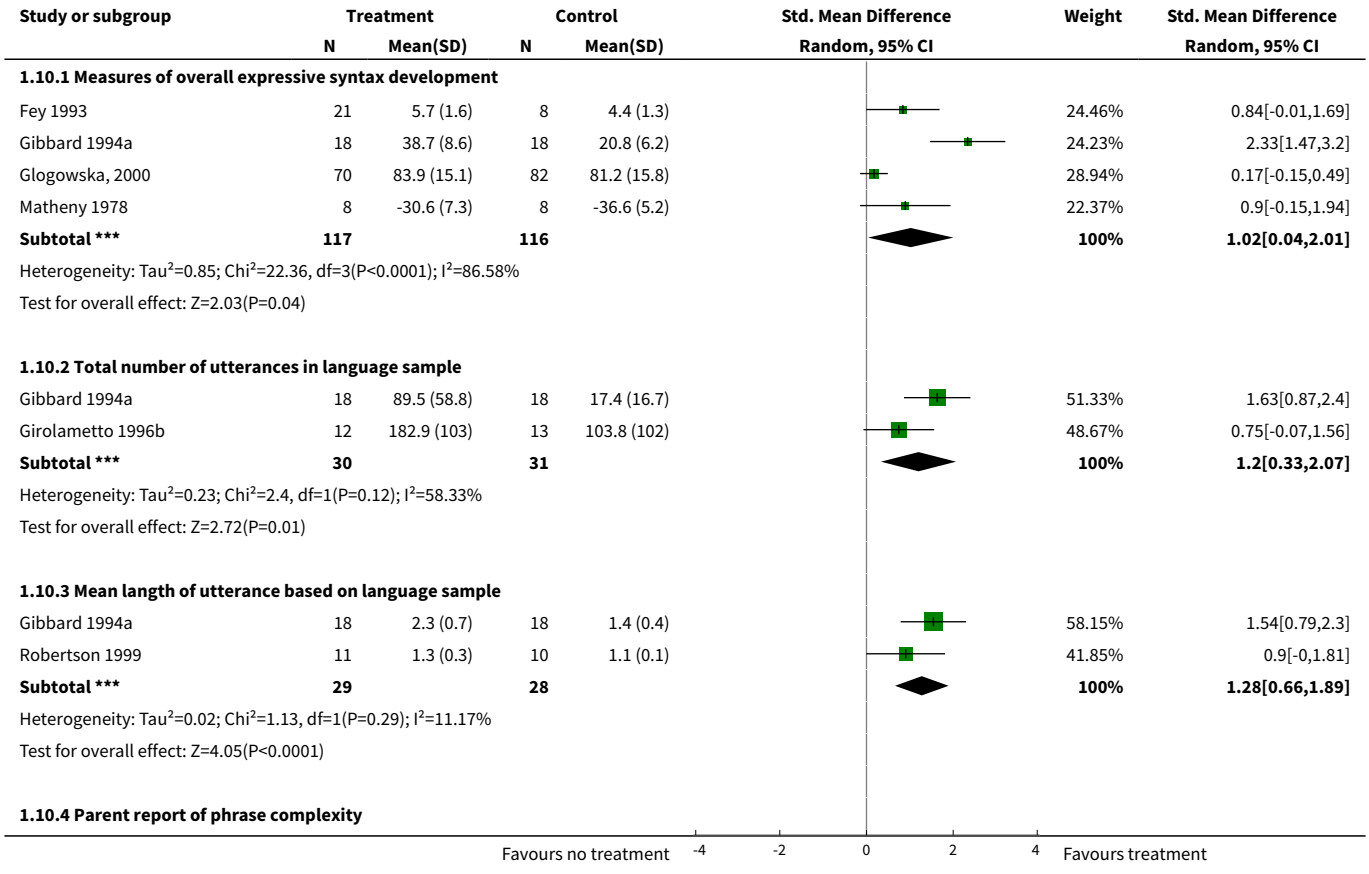
Analysis 1.9. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 9 Subgroup analysis (trials of longer than eight weeks).

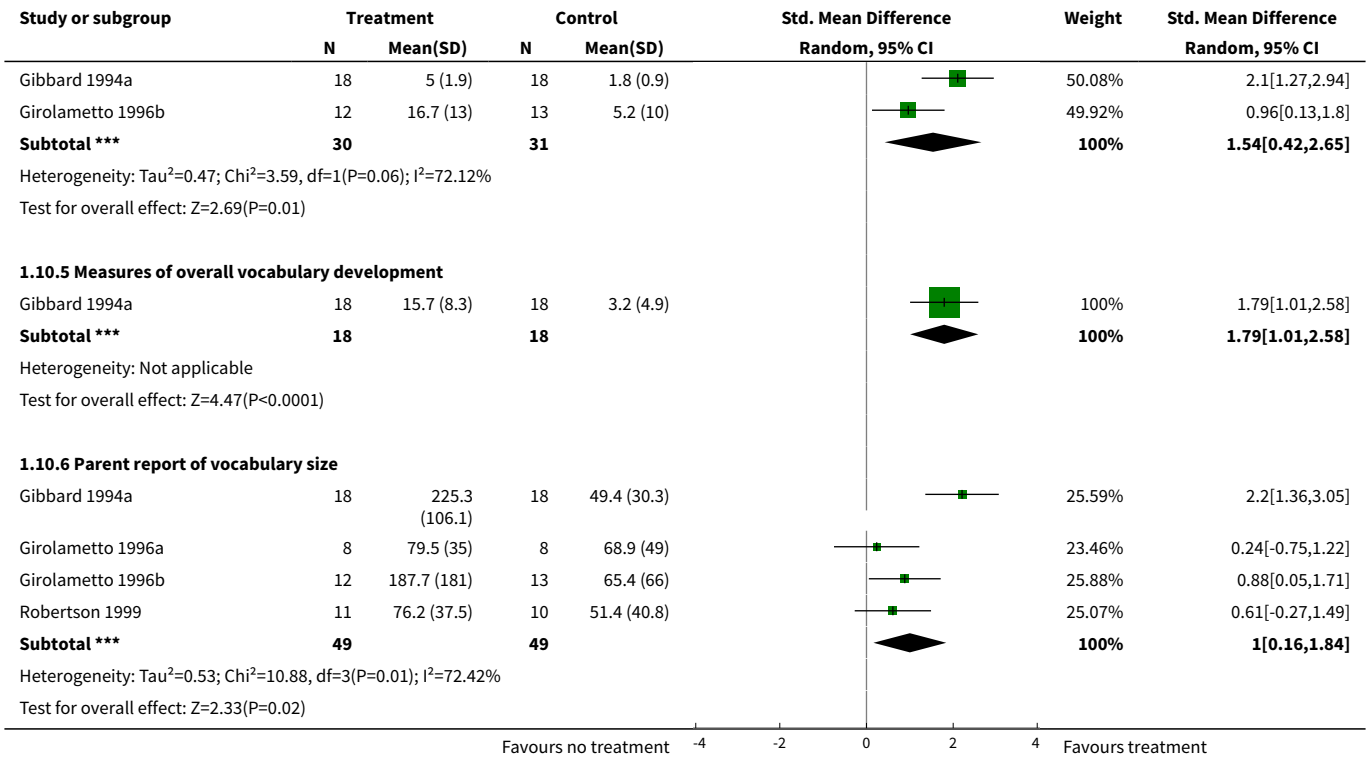
Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.9.1 measures of overall phonological development							
Almost 1998	13	-34.7 (7.9)	13	-48.2 (10.9)		23.94%	1.37[0.5,2.24]
Glogowska, 2000	70	-27.2 (22.8)	81	-34.3 (28.7)		42.36%	0.27[-0.05,0.59]
Lancaster 1991	5	-27.7 (18.2)	5	-45.6 (12.5)		13.69%	1.04[-0.33,2.41]
Matheny 1978	8	-6.6 (2.4)	8	-8.9 (3.2)		20.01%	0.75[-0.28,1.77]
Subtotal ***	**96**		**107**			**100%**	**0.74[0.14,1.33]**
Heterogeneity: Tau^2=0.19; Chi^2=6.53, df=3(P=0.09); I^2=54.09%							
Test for overall effect: Z=2.41(P=0.02)							



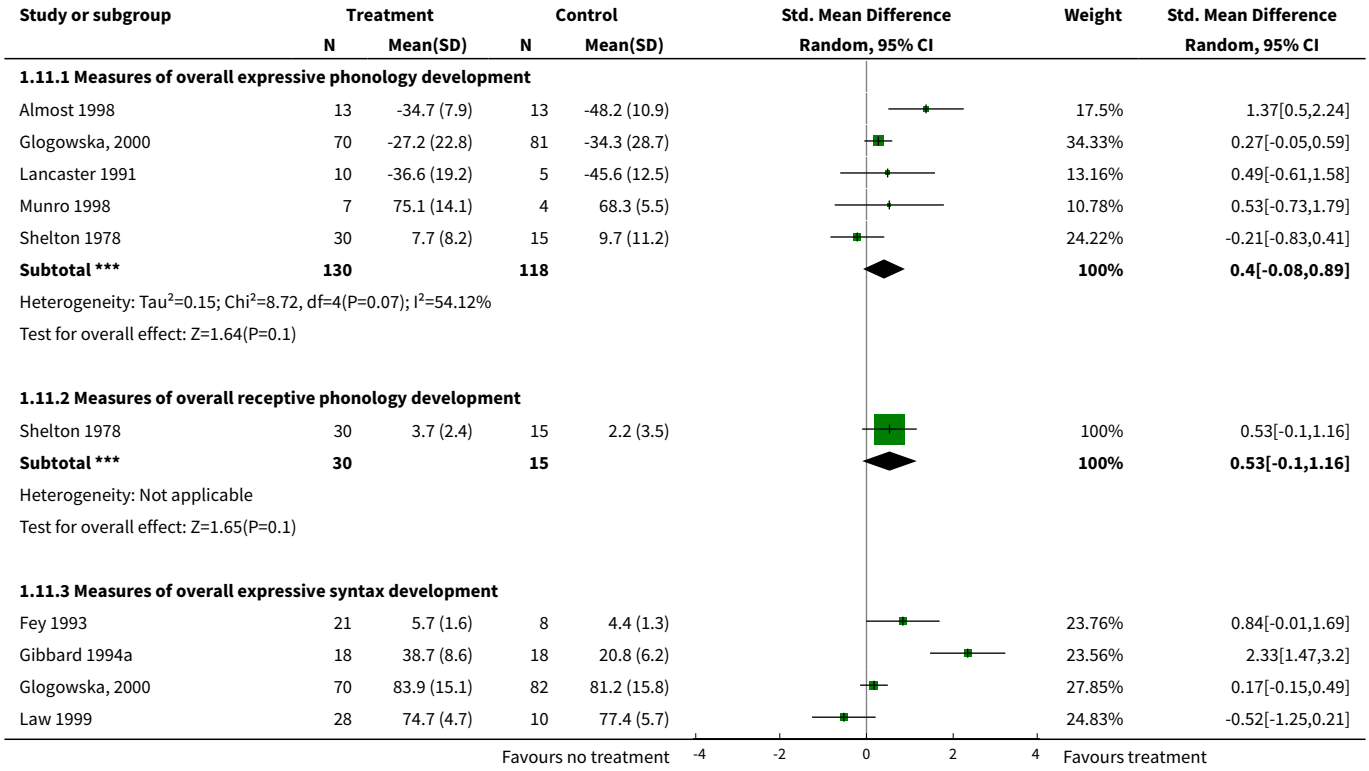


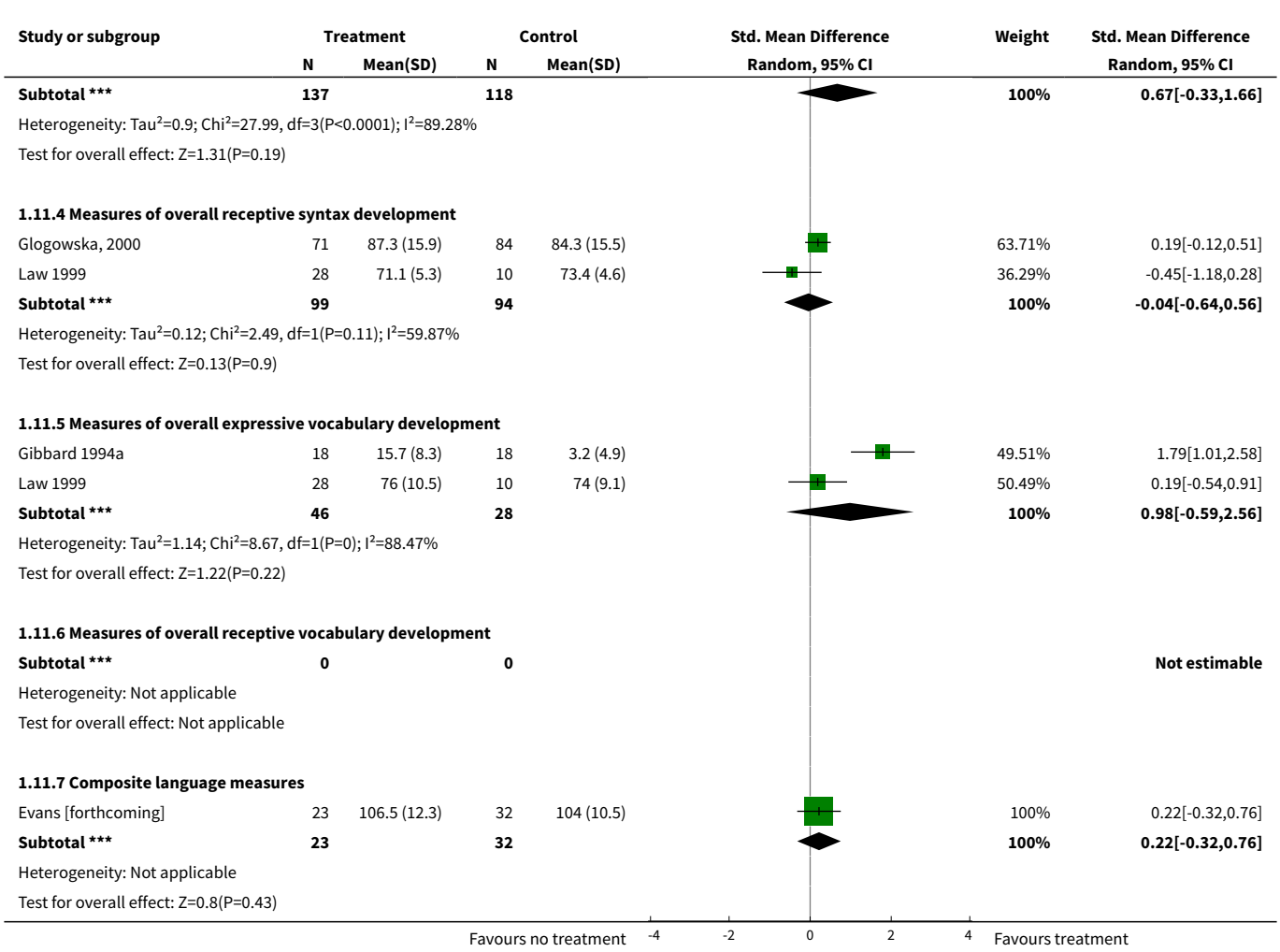
Analysis 1.10. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 10 Subgroup Analysis (excluding data from children with receptive and expressive difficulties).



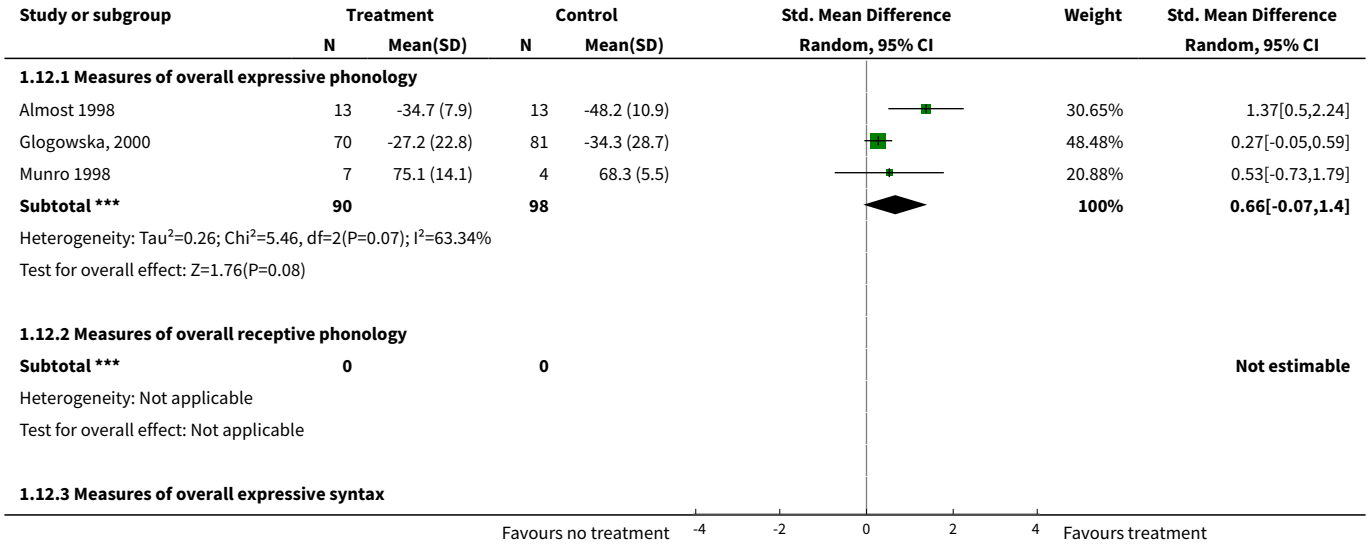


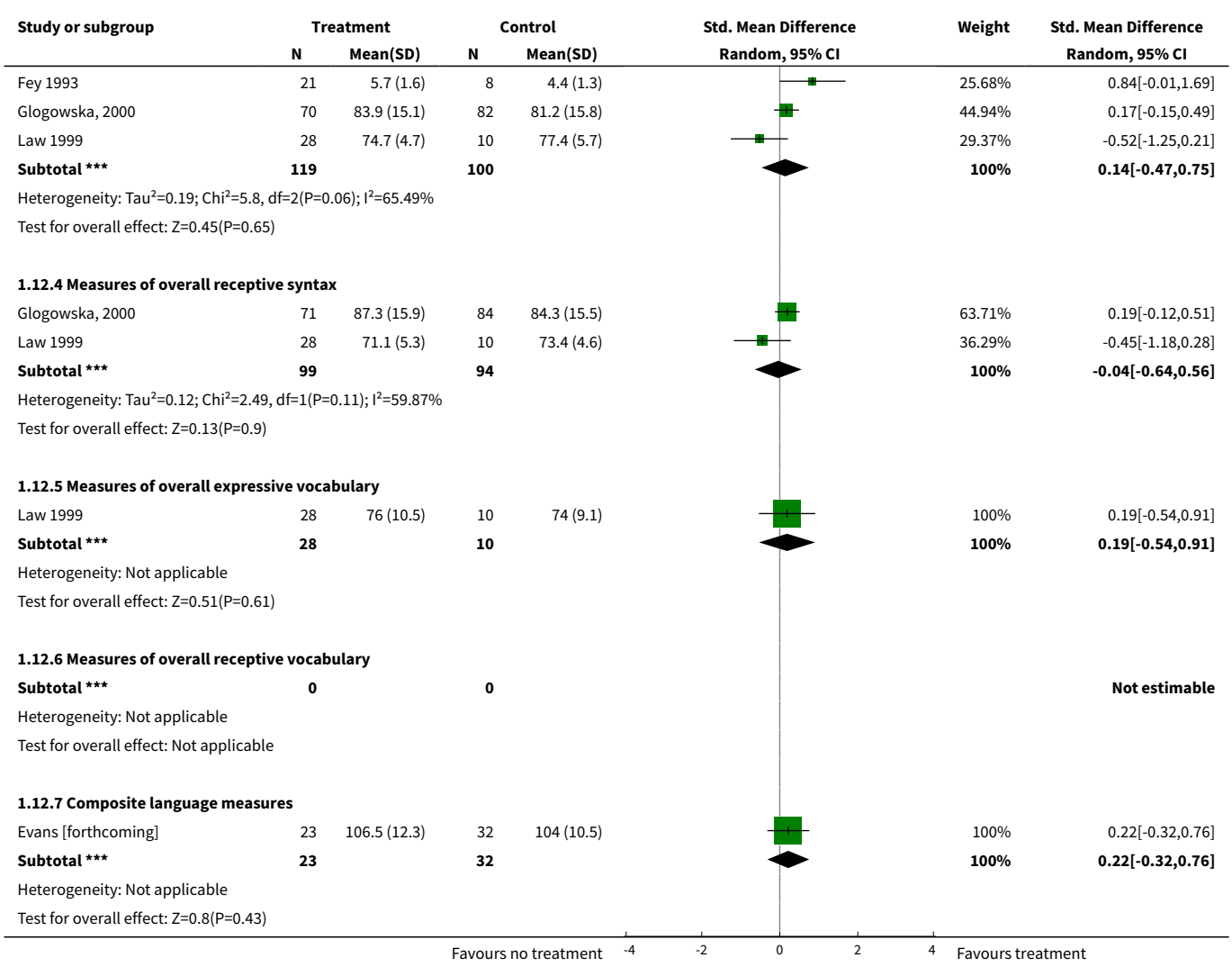
Analysis 1.11. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 11 Sensitivity analysis (excluding studies not reporting attrition).





Analysis 1.12. Comparison 1 Speech and language intervention vesus delayed or no treatment, Outcome 12 Sensitivity analysis (excluding studies not reporting blinding).



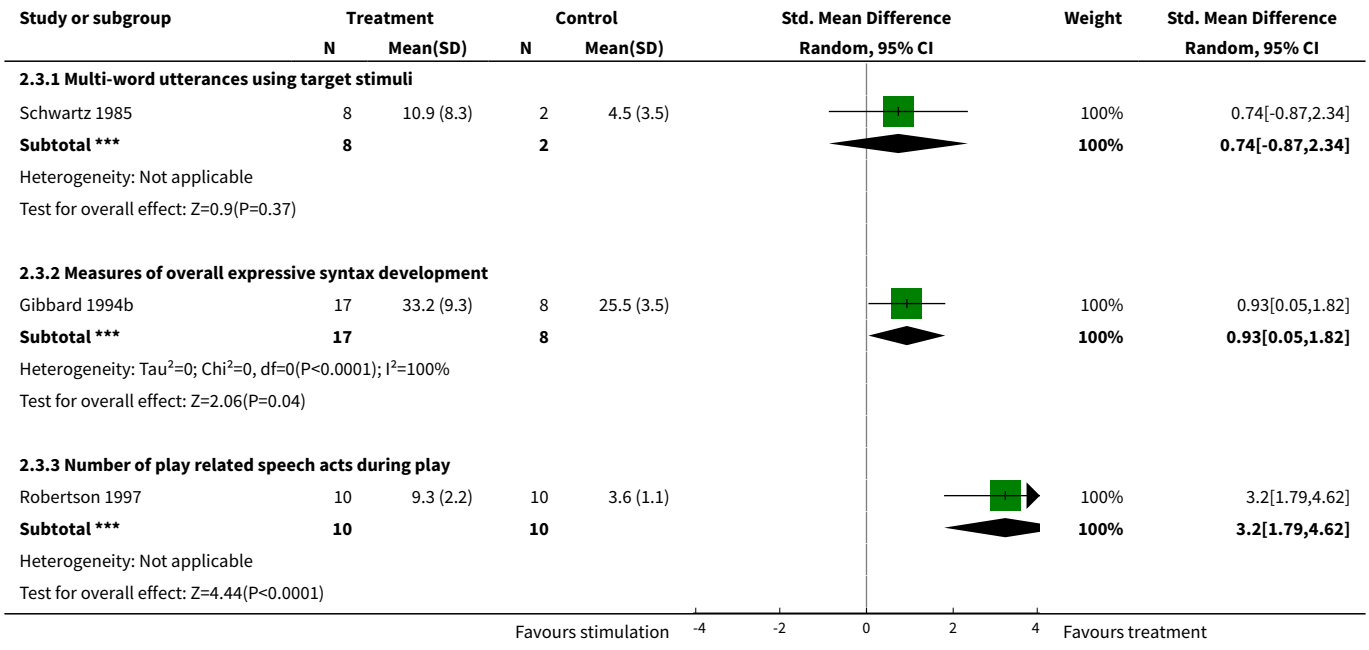


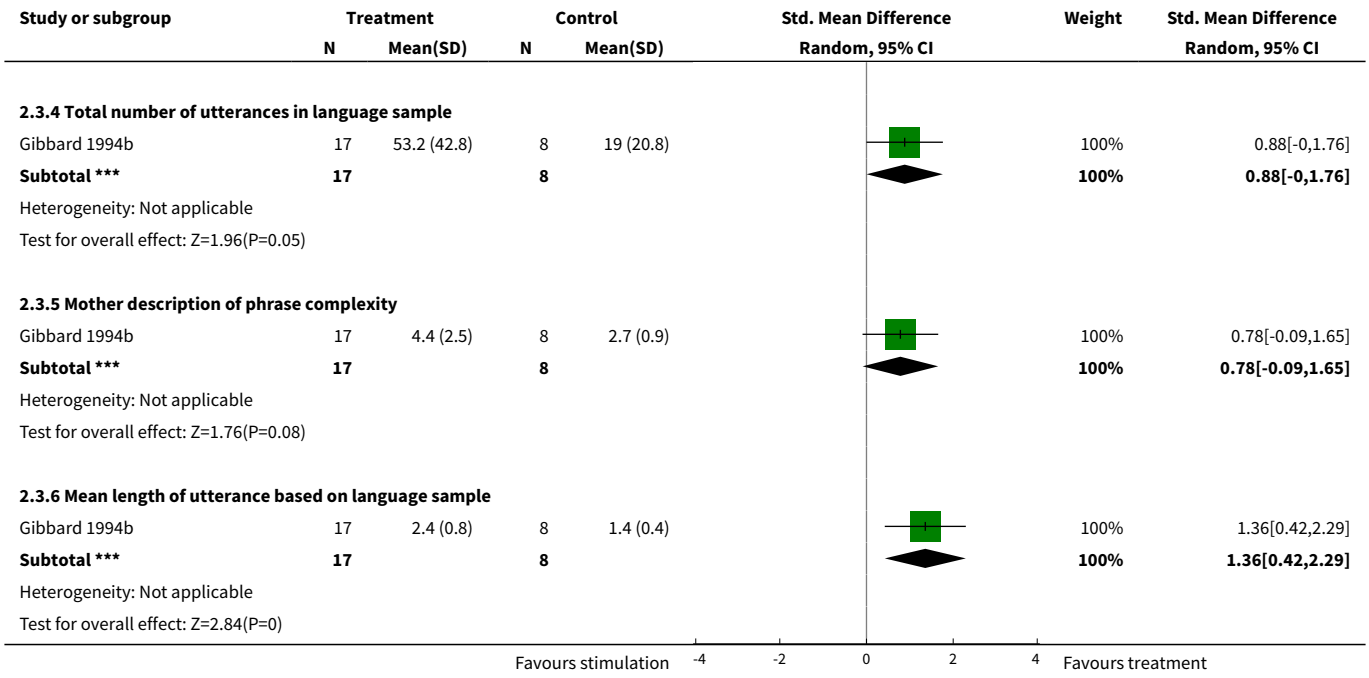
Comparison 2. Speech and language intervention versus general stimulation programmes

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Expressive phonology outcomes	0		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
2 Receptive phonology outcomes	0		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
3 Expressive syntax outcomes	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
3.1 Multi-word utterances using target stimuli	1	10	Std. Mean Difference (IV, Random, 95% CI)	0.74 [-0.87, 2.34]
3.2 Measures of overall expressive syntax development	1	25	Std. Mean Difference (IV, Random, 95% CI)	0.93 [0.05, 1.82]

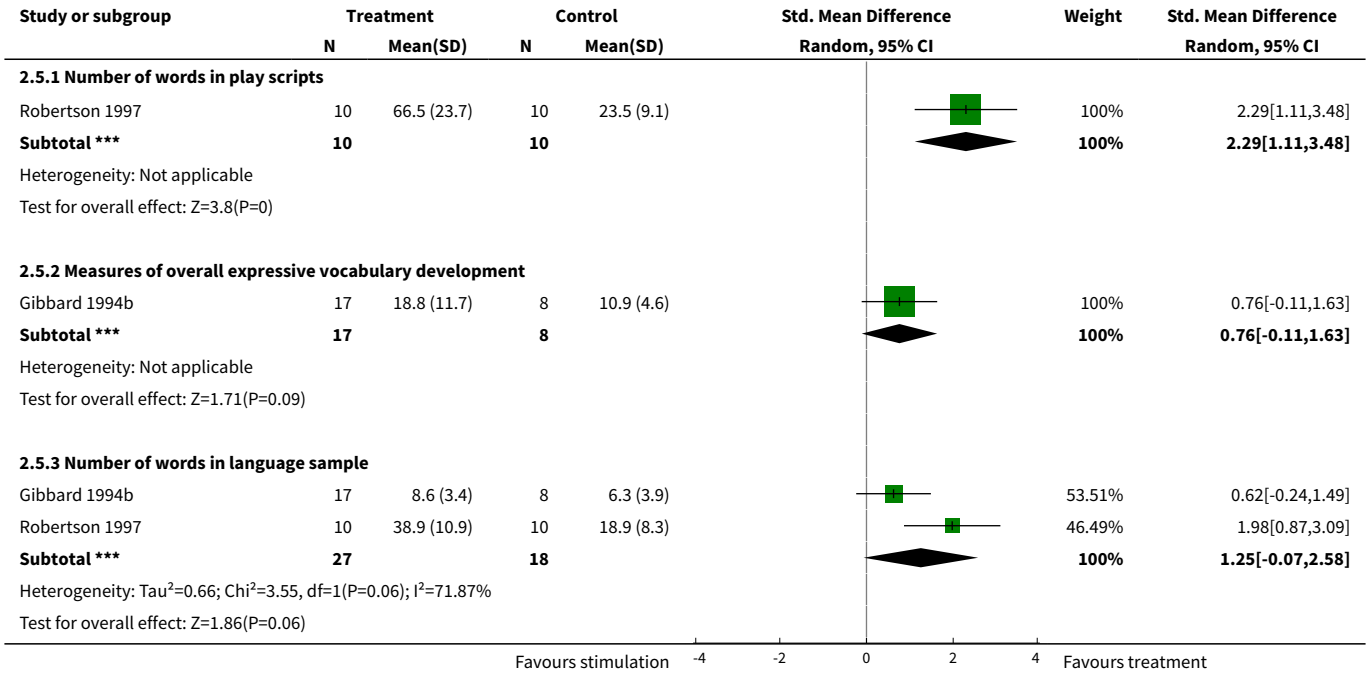
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.3 Number of play related speech acts during play	1	20	Std. Mean Difference (IV, Random, 95% CI)	3.20 [1.79, 4.62]
3.4 Total number of utterances in language sample	1	25	Std. Mean Difference (IV, Random, 95% CI)	0.88 [-0.00, 1.76]
3.5 Mother description of phrase complexity	1	25	Std. Mean Difference (IV, Random, 95% CI)	0.78 [-0.09, 1.65]
3.6 Mean length of utterance based on language sample	1	25	Std. Mean Difference (IV, Random, 95% CI)	1.36 [0.42, 2.29]
4 Receptive syntax outcomes	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Expressive vocabulary outcomes	2		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
5.1 Number of words in play scripts	1	20	Std. Mean Difference (IV, Random, 95% CI)	2.29 [1.11, 3.48]
5.2 Measures of overall expressive vocabulary development	1	25	Std. Mean Difference (IV, Random, 95% CI)	0.76 [-0.11, 1.63]
5.3 Number of words in language sample	2	45	Std. Mean Difference (IV, Random, 95% CI)	1.25 [-0.07, 2.58]
6 Receptive vocabulary outcomes	0	0	Mean Difference (IV, Fixed, 95% CI)	0.0 [0.0, 0.0]

Analysis 2.3. Comparison 2 Speech and language intervention versus general stimulation programmes, Outcome 3 Expressive syntax outcomes.





Analysis 2.5. Comparison 2 Speech and language intervention versus general stimulation programmes, Outcome 5 Expressive vocabulary outcomes.



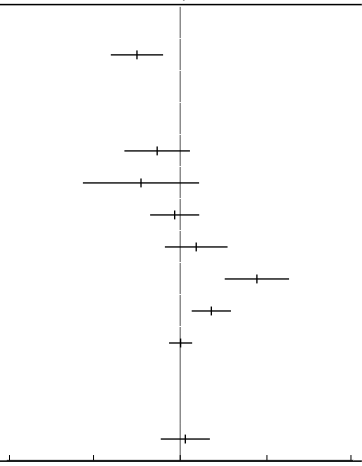
Comparison 3. Speech and language interventions versus traditional speech and language programmes

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Expressive phonology outcomes	7		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 Production of target sound	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 Measures of overall expressive phonology development	7		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.3 Percentage of consonants correct in conversation	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2 Receptive phonology outcomes	1		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Test of Auditory Association	1	30	Std. Mean Difference (IV, Random, 95% CI)	0.0 [-0.72, 0.72]
3 Expressive syntax outcomes	6		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
3.1 Correct utterance of 20 unusual sentences	1	24	Std. Mean Difference (IV, Random, 95% CI)	0.57 [-0.25, 1.39]
3.2 Measures of overall expressive syntax development	5	138	Std. Mean Difference (IV, Random, 95% CI)	-0.13 [-0.47, 0.21]
3.3 Total utterances from a language sample	2	45	Std. Mean Difference (IV, Random, 95% CI)	0.15 [-0.45, 0.74]
3.4 Mean length of utterance from a language sample	3	89	Std. Mean Difference (IV, Random, 95% CI)	0.09 [-0.75, 0.93]
3.5 Parent report of complexity of phrases	2	45	Std. Mean Difference (IV, Random, 95% CI)	0.01 [-0.63, 0.66]
4 Receptive syntax outcomes	3		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
4.1 Measures of overall receptove syntax development	3		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5 Expressive vocabulary outcomes	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
5.1 Overall use of target words in clinic interaction	1	20	Std. Mean Difference (IV, Random, 95% CI)	0.35 [-0.53, 1.24]
5.2 Measures of overall expressive vocabulary development	2	45	Std. Mean Difference (IV, Random, 95% CI)	0.20 [-0.40, 0.79]
5.3 Different words in language sample	1	17	Std. Mean Difference (IV, Random, 95% CI)	-0.50 [-1.48, 0.47]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.4 Parent report of vocabulary size	2	45	Std. Mean Difference (IV, Random, 95% CI)	-0.16 [-0.76, 0.44]
6 Receptive vocabulary outcomes	1		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
6.1 Measures of overall vocabulary understanding	1	44	Std. Mean Difference (IV, Random, 95% CI)	-0.22 [-0.82, 0.38]
7 Composite language outcomes	0		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
8 Subgroup analysis (clinician versus parent)	6		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
8.1 Measures of overall expressive phonology development	3	130	Std. Mean Difference (IV, Random, 95% CI)	0.66 [-0.47, 1.80]
8.2 Measures of overall expressive syntax development	3	66	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.56, 0.48]
8.3 Measures of overall expressive vocabulary development	2	45	Std. Mean Difference (IV, Random, 95% CI)	0.20 [-0.40, 0.79]
8.4 Measures of overall receptive syntax development	1	28	Std. Mean Difference (IV, Random, 95% CI)	-0.11 [-0.87, 0.65]
9 Subgroup analysis (excluding data from children with expressive and receptive difficulties)	2		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
9.1 Measures of overall syntax development	2	38	Std. Mean Difference (IV, Random, 95% CI)	0.27 [-0.37, 0.91]
9.2 Total number of utterances in a language sample	1	17	Std. Mean Difference (IV, Random, 95% CI)	0.43 [-0.54, 1.39]
9.3 Mean length of utterance derived from a language sample	1	17	Std. Mean Difference (IV, Random, 95% CI)	1.17 [0.12, 2.23]
9.4 Parent report of phrase complexity	1	17	Std. Mean Difference (IV, Random, 95% CI)	0.42 [-0.54, 1.39]
9.5 Measures of overall vocabulary development	1	17	Std. Mean Difference (IV, Random, 95% CI)	0.33 [-0.63, 1.29]
9.6 Parental report of vocabulary size	1	17	Std. Mean Difference (IV, Random, 95% CI)	0.13 [-0.82, 1.08]

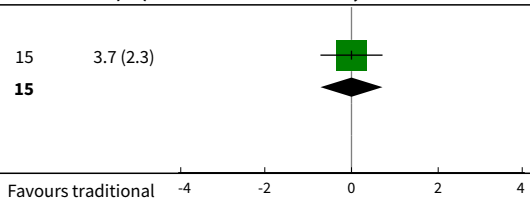
Analysis 3.1. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 1 Expressive phonology outcomes.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
3.1.1 Production of target sound						
Rvachew 2001	24	6.5 (8)	24	15.5 (9.8)		-1[-1.6,-0.4]
3.1.2 Measures of overall expressive phonology development						
Head 1975	14	-42.8 (19.8)	14	-30 (26.5)		-0.53[-1.29,0.22]
Lancaster 1991	5	-45.5 (17.3)	5	-27.7 (18.2)		-0.9[-2.25,0.44]
Rvachew 2001	24	60.5 (11.5)	24	62.4 (16.7)		-0.13[-0.69,0.44]
Shelton 1978	15	9.1 (8.8)	15	6 (7.5)		0.37[-0.35,1.09]
Sommers 1962	20	94 (29.1)	20	50.3 (18.1)		1.77[1.03,2.51]
Sommers 1964	40	-116.7 (27.1)	40	-137.3 (29.6)		0.72[0.26,1.17]
Sommers 1966	108	62.3 (24.1)	108	62.1 (22.6)		0.01[-0.26,0.28]
3.1.3 Percentage of consonants correct in conversation						
Rvachew 2001	24	64 (11.1)	24	62.6 (12)		0.12[-0.45,0.68]



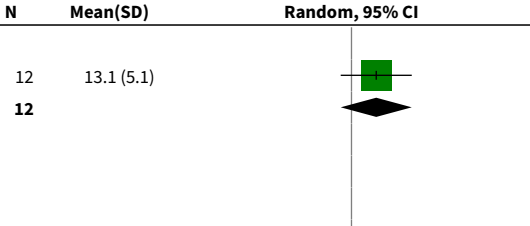
Analysis 3.2. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 2 Receptive phonology outcomes.

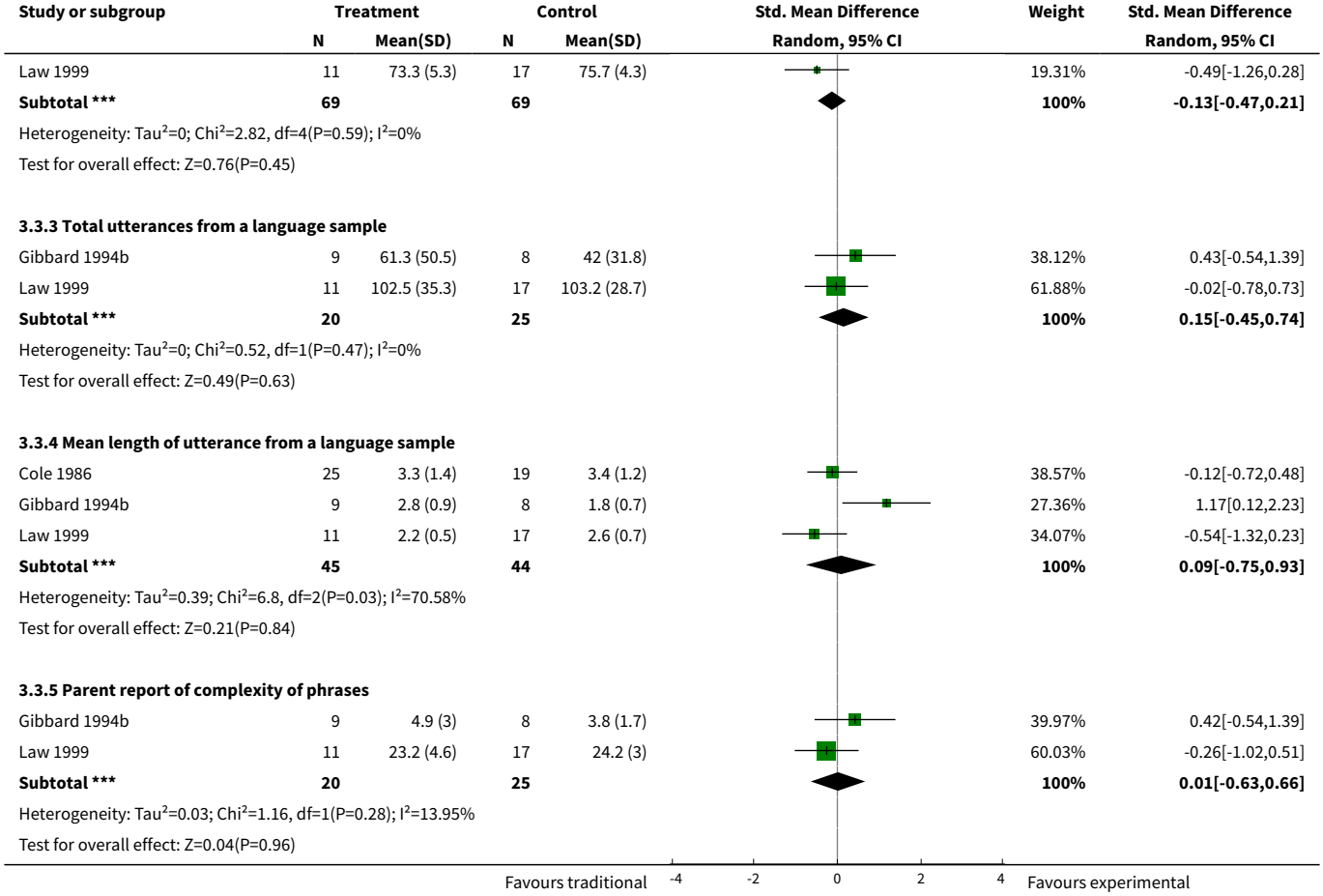
Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
3.2.1 Test of Auditory Association							
Shelton 1978	15	3.7 (2.4)	15	3.7 (2.3)		100%	0[-0.72,0.72]
Subtotal ***	**15**		**15**			**100%**	**0[-0.72,0.72]**
Heterogeneity: Not applicable							
Test for overall effect: Not applicable							



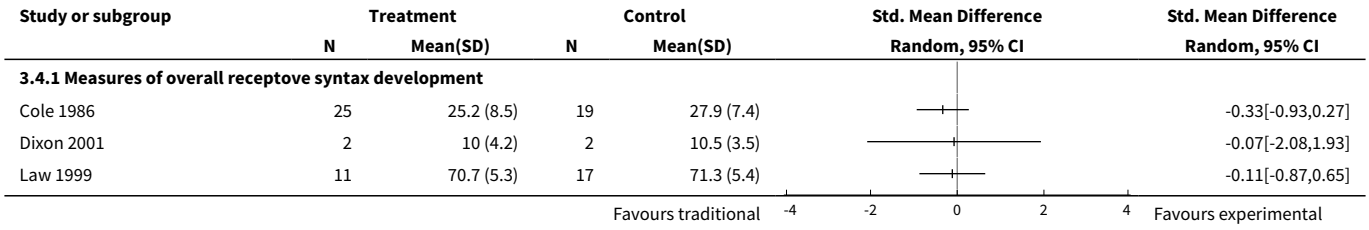
Analysis 3.3. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 3 Expressive syntax outcomes.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
3.3.1 Correct utterance of 20 unusual sentences							
Courtwright 1979	12	15.8 (4.1)	12	13.1 (5.1)		100%	0.57[-0.25,1.39]
Subtotal ***	**12**		**12**			**100%**	**0.57[-0.25,1.39]**
Heterogeneity: Not applicable							
Test for overall effect: Z=1.37(P=0.17)							
3.3.2 Measures of overall expressive syntax development							
Cole 1986	25	22.6 (10.1)	19	25.9 (9.6)		31.79%	-0.33[-0.93,0.27]
Fey 1993	10	5.9 (1.8)	11	5.5 (1.3)		15.53%	0.23[-0.63,1.08]
Gibbard 1994b	9	34.6 (8.2)	8	31.5 (10.4)		12.45%	0.32[-0.64,1.28]
Head 1975	14	27.2 (4.8)	14	27.4 (7.5)		20.91%	-0.03[-0.77,0.71]

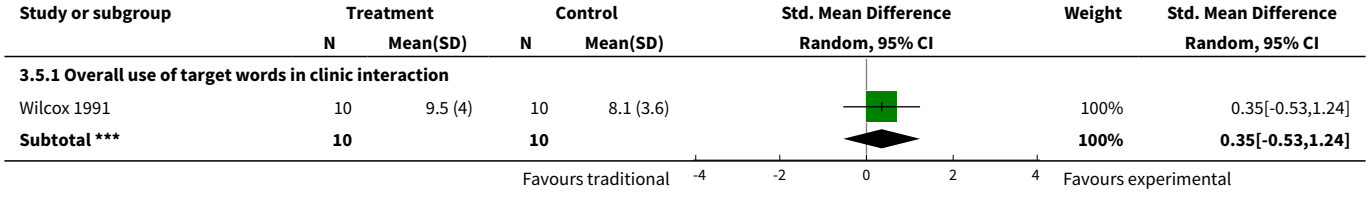


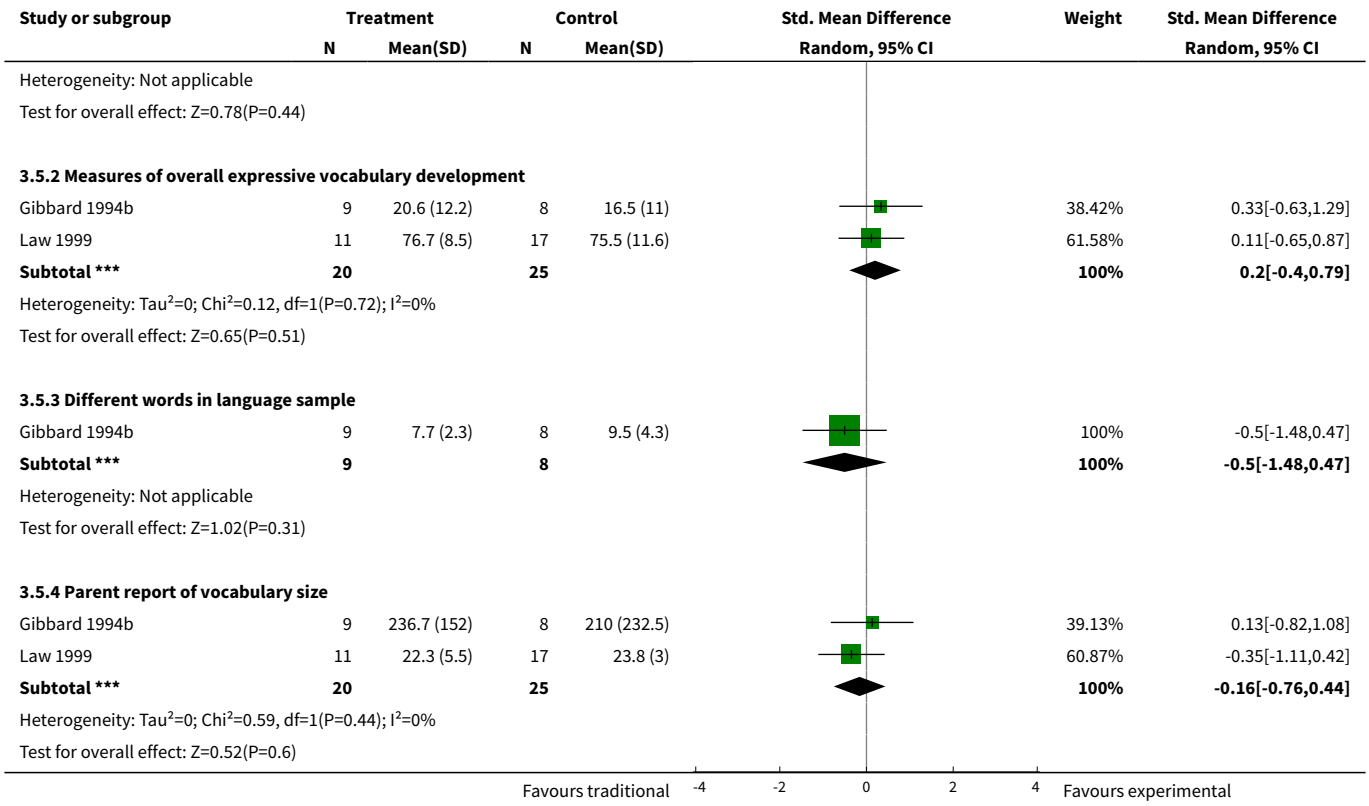


Analysis 3.4. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 4 Receptive syntax outcomes.

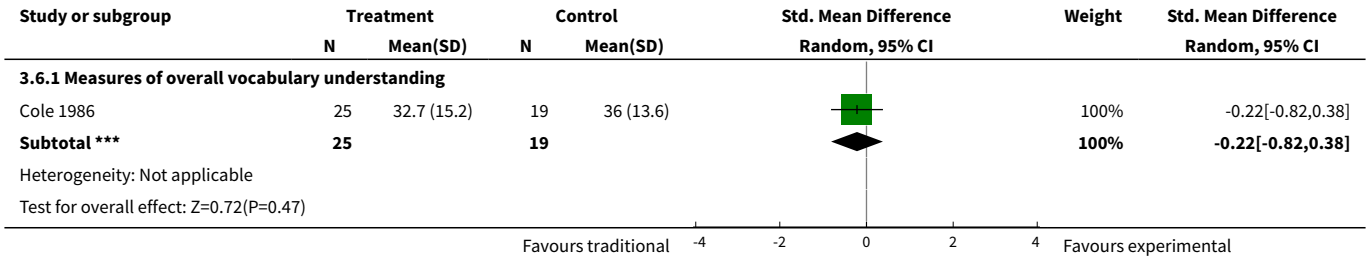


Analysis 3.5. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 5 Expressive vocabulary outcomes.

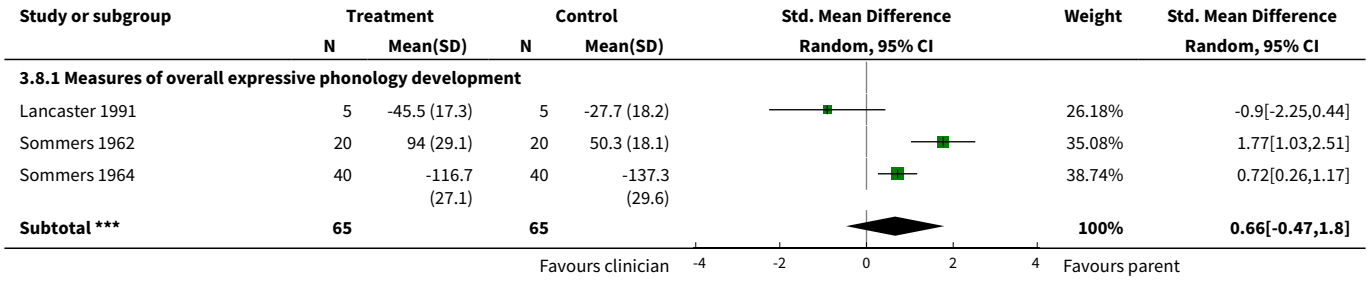


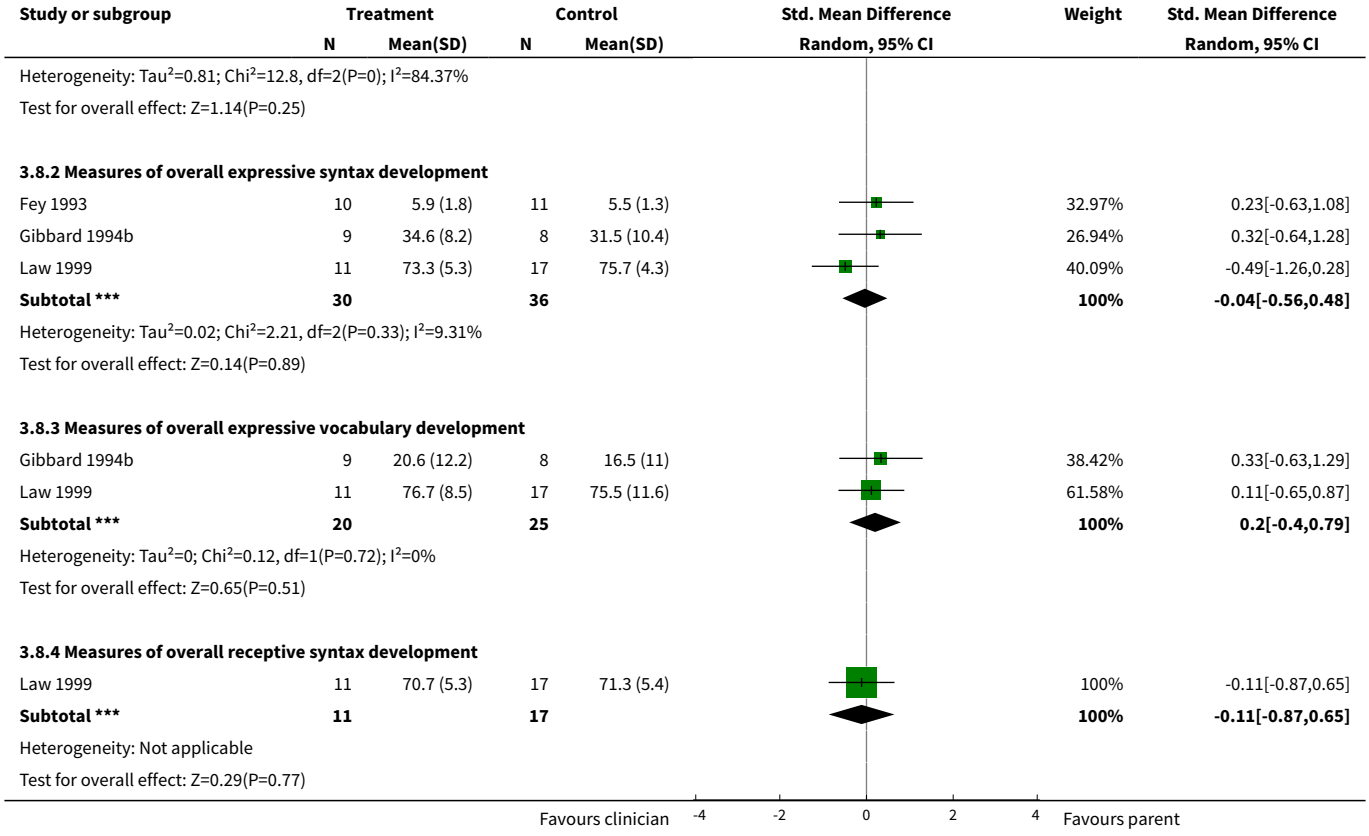


Analysis 3.6. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 6 Receptive vocabulary outcomes.

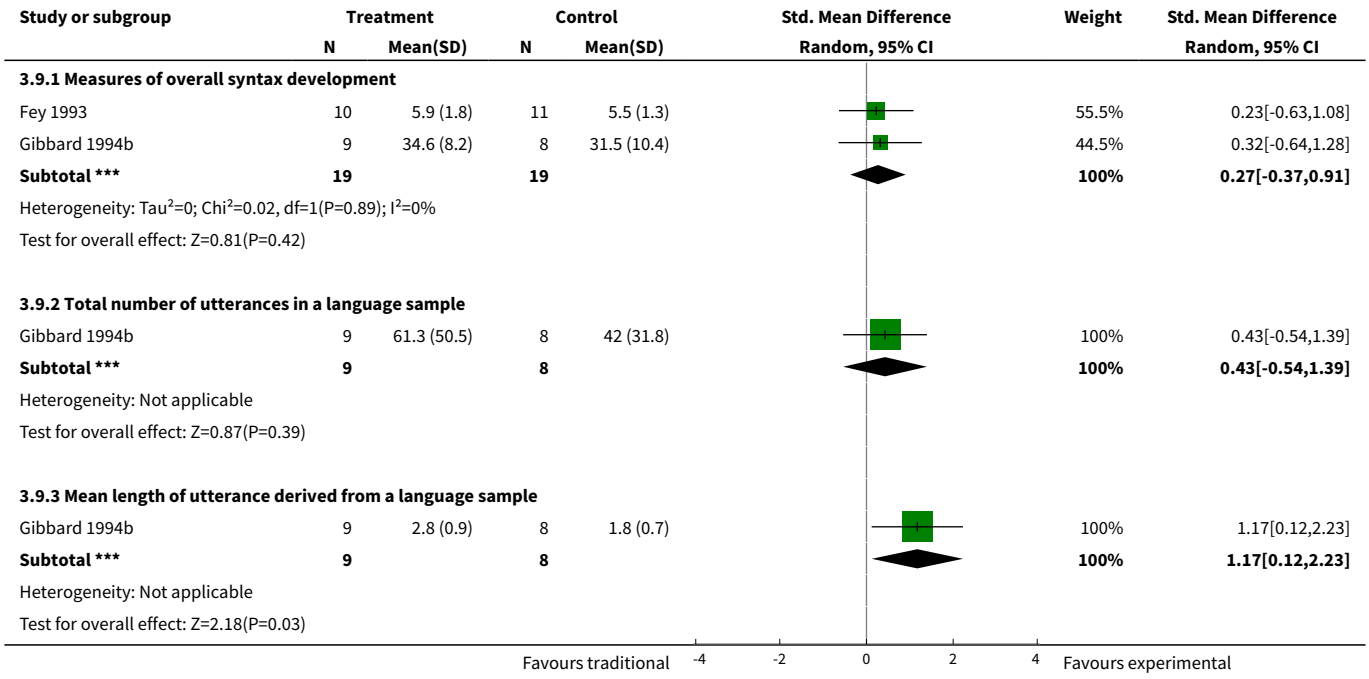


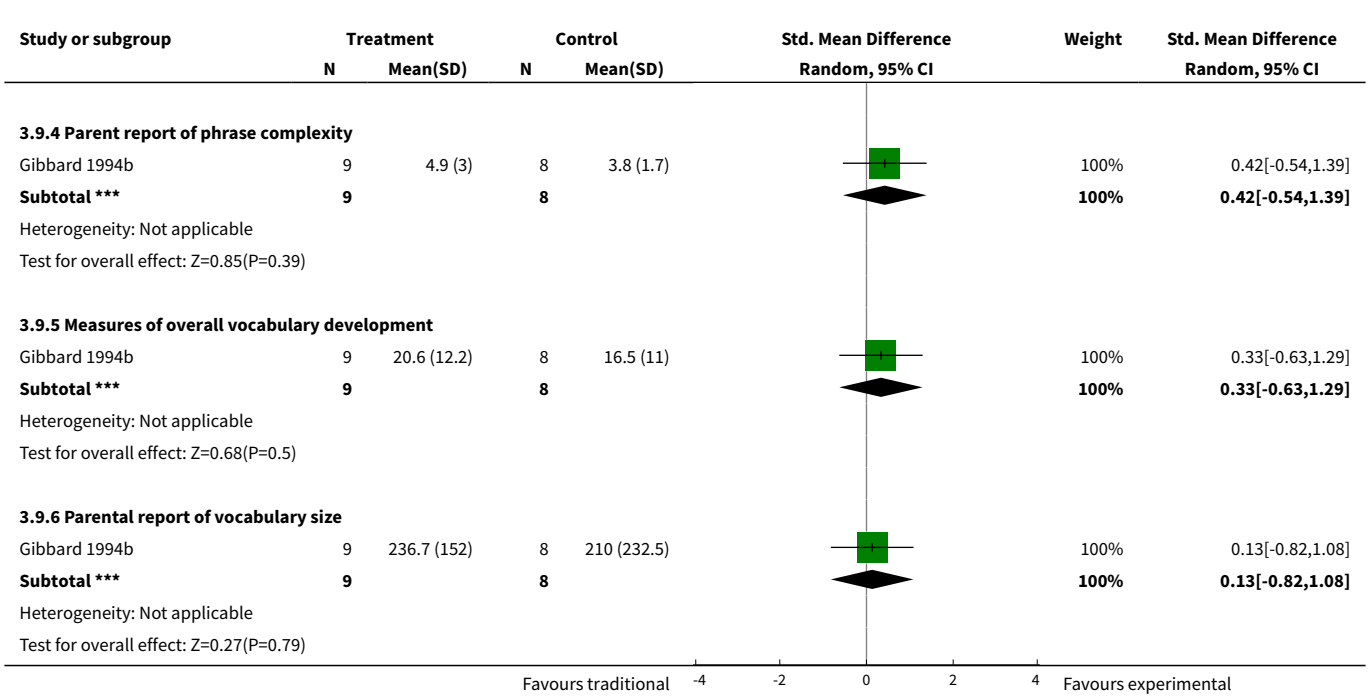
Analysis 3.8. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 8 Subgroup analysis (clinician versus parent).





Analysis 3.9. Comparison 3 Speech and language interventions versus traditional speech and language programmes, Outcome 9 Subgroup analysis (excluding data from children with expressive and receptive difficulties).





ADDITIONAL TABLES

Table 1. Methodological Quality (A-L)

Study	Randomisation	Blinding of Assessors	Similarities at Baseline	Explanation of Withdrawals	Discounting in analysis of Missing Values	Degree of Attrition	Intention to Treat Analysis	Power	Description of Eligibility Criteria
Almost (1998)	A	A	A	A	A (last known scores used)	C (.15)	A (I to T)	A	A
Barratt (1992)	B	B	B	A	C	A (.07)	B	A	A
Cole (1986)	B	B	A	B	B	B	B	B	A
Courtwright (1979)	B	A	B	B	B	B	B	B	B
Dixon (2001)	B	B	B	A (none)	A (none)	A (none)	B	B	A
Evans (Forthcoming)	B	A	B	A	C	C (.10)	B	B	A
Fey (1993)	B	A	C (mothers education)	A	C	A (.03)	B	B	A
Fey (1994)	B	C	A	A	A (none)	A (none)	B	B	A
Fey (1997)	B	A	A	A	C	A (.06)	B	B	A
Fudala (1972)	B	B	A	B	B	B	B	B	B
Gibbard (1994a)	B	B	A	A (none)	A (none)	A (none)	B	B	A
Gibbard (1994b)	B	B	A	A (none)	A (none)	A (none)	B	B	A
Girolametto (1996a)	B	A	C (behaviour)	A (none)	A (none)	A (none)	B	B	A
Girolametto (1996b)	B	A	A	A (none)	A (none)	A (none)	B	B	A
Girolametto (1997)	B	A	A	A (none)	A (none)	A (none)	B	B	A
Glogowska (2000)	A	A	A	A	C	A (.03)	A (I to T)	C	A

Table 1. Methodological Quality (A-L) *(Continued)*

Head (1975)	B	B	B	A	C	C (.11)	B	B	C
Lancaster (1991)	B	B	B	A	A (included in end analysis)	A (none)	A (I to T)	B	A
Law (1999)	A	A	C (esteem, behaviour)	A	C	C (.12)	B	C	A
Key:	A: randomisation methods explained	A: assessors blind at pre and post test	A: baseline characteristics reported	A: withdrawals accounted for	A: missing values accounted for in analysis	A: attrition <.10	A: intention to treat analysis	A: power calculation and sufficient participants recruited	A: characteristics provided in main areas of language
	B: randomisation methods not explained	B: blinding not reported	B: baseine characteristics not reported	B: withdrawals not reported	B: no missing values shown	B: attrition not reported	B: intention to treat analysis not used	B: power claculation not reported	B: characteristics reported in area of investigation
	C: randomisation methods not adequate	C: blinding at pre-test only	C: baseline characteristics reported to be different	C: withdrawals not accounted for	C: missing values discounted from analysis	C: attrition >.10		C: power calculation completed but insufficient participants recruited	C: characteristics unclear

Table 1. Methodological Quality (A-L) *(Continued)*

Table 2. Methodological Quality (M-Z)

Study	Randomisation	Blinding of Assessor	Baseline	Withdrawals	Missing Values	Attrition	Analysis	Power	Eligibility
Matheny (1978)	B	B	A	B	B	B	B	B	A
Mulac (1977)	B	A	B	B	B	B	B	B	B
Munro (1999)	B	A	B	A	C	C (.15)	B	B	A
Reid (1996)	B	B	C (medians)	A (subgroup)	A (subgroup)	A (subgroup)	B	B	A
Robertson (1997)	B	C	A	B	B	B	B	B	A
Robertson (1999)	B	B	A	A	C	C (.13)	B	B	A
Ruscello (1993)	B	B	A	B	B	B	B	B	A

Table 2. Methodological Quality (M-Z) *(Continued)*

Rvachew (1994)	B	A	A	B	C	C (.13)	B	B	A
Rvachew (2001)	B	A	A	A	B	B	B	B	A
Schwartz (1985)	B	C	B	B	B	B	B	B	A
Shelton (1978)	B	B	A	A	C	A (.08)	B	B	A
Sommers (1962)	B	B	A	B	B	B	B	B	B
Sommers (1964)	B	B	B	B	B	B	B	B	B
Sommers (1966)	B	A	B	C	C	C (.10)	B	B	B
Sutton (1999)	B	B	B	B	B	B	B	B	A
Tufts (1959)	B	A	A	B	B	B	B	B	B
Wilcox (1991)	B	B	A	B	B	B	B	B	A
Key	A: methods of randomisation explained	A: assessors blind to group allocation at pre and post test	A: baseline characteristics reported	A: withdrawals accounted for	A: missing values taken into account in analysis	A: <.10 attrition	A: intention to treat analysis used	A: power calculation completed and sufficient participants recruited	A: characteristics in main linguistic areas
	B: methods fo randomisation not explained	B: blinding not reported	B: baseline characteristics not reported	B: withdrawals not reported	B: no missing values shown	B: attrition not reported	B: intention to treat analysis not reported	B: power clacula-tion not reported	B: characteristics in main area of study
	C: methods of randomisation inadequate	C: assessors blind at pretest only	C: baseline characteristics reported to be different	C: withdrawals not accounted for	C: missing values discounted in analysis	C: >.10 attrition		C: power calculation completed but insufficient participants recruited	C: characteristics unclear

WHAT'S NEW

Date	Event	Description
21 May 2015	Amended	This review is being updated and replaced by a new protocol. Please see section on 'published notes' for more information
14 April 2010	Amended	Zoe Garrett's affiliation updated. Please see published notes for details.

HISTORY

Protocol first published: Issue 1, 2003
Review first published: Issue 3, 2003

Date	Event	Description
17 February 2010	Amended	Contact details updated.
11 November 2008	Amended	Converted to new review format.
9 May 2003	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

All authors have contributed to the data collection, analysis and writing of this review.

DECLARATIONS OF INTEREST

James Law is an author on one of the included studies and one of the excluded studies in this review, and has published a non-Cochrane review in this area.

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- The Nuffield Foundation, UK.

NOTES

Zoe Garrett undertook this review whilst working at City University, and not whilst working for the National Institute for Clinical Excellence (NICE).

This review is being updated and replaced by a new protocol. It will be withdrawn from the Library when the new review is published.

INDEX TERMS

Medical Subject Headings (MeSH)

*Language Therapy; *Speech Therapy; Aphasia [therapy]; Dysarthria [therapy]; Language Development Disorders [*therapy]; Randomized Controlled Trials as Topic; Speech Disorders [*therapy]

MeSH check words

Adolescent; Child; Humans