Speech and Language Therapy Interventions for Children with Primary Speech and Language Delay or Disorder

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Title

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

Reviewers

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Dates

Date edited: 20/07/2004

Date of last substantive update: 09/05/2003

Date of last minor update: / /

Date next stage expected: / /

Protocol first published: Issue 1, 2003

Review first published: Issue 3, 2003

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Internal sources of support

None

External sources of support

Contribution of reviewers

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

Acknowledgements

Potential conflict 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.

What's new

Dates

Protocol first published:	Issue 1, 2003
Review first published:	Issue 3, 2003
Date of last substantive update:	09/05/2003
Date of last minor update:	/ /
Date review re-formatted:	/ /
Date new studies sought but none found:	/ /
Date new studies found but not yet included/excluded:	/ /
Date new studies found and included or excluded:	/ /
Date reviewers' conclusions section amended:	/ /
Date comment/criticism added:	/ /
Date response to comment/criticism added:	/ /

Synopsis

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.

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 strategy

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 & 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).

Reviewers' 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.

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.

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 strategy 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.

Methods of the review

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 01; Table 02).

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 01; Table 02).

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).

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), targeting 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).

Methodological quality of 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 01; Table 02). 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).

Results

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 siginifical 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.

Reviewers' 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).

Characteristics of included studies

Study ID	Methods	Participants	Interventions	Outcomes	Notes	Allocation concealment
Almost 1998	Randomised Controlled Trial	30 participants age range 2;09 - 5;01 21 males and 5 females SES details not mentioned	Clinician administered phonology therapy 80 minutes a week over 4 months 13 participants received immediate treatment 13 participants received delayed treatment	Goldman Fristoe % consonants correct in conversation Outcomes not used: APPR, MLU	At baseline children had to score severe on APPR	A
Barratt 1992	Randomised Controlled Trial	42 participants age range 3;01-3;07 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	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.	Reynell Expressive and Receptive scales	Children had to score less than 1SD below mean on expressive and/or receptive subtests	B
Cole 1986	Randomised ControlledTrial	44 participants age range 3;02 - 5;09 34 males and 10 females participated Information on SES characteristics not provided	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	MLU Preschool language scale: overall scores Basic language concepts test PPVT Outcomes excluded: DSS, Basic language concepts test, northwestern syntax test	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)	B

directive approach
25 participants received an interactive approach

Courtwright 1979	Randomised Controlled Trial	36 participants age range 3;11-6;11 24 males and 12 females SES details not given	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	Utterances correct on 20 unusual sentences	At baseline children scored below 10%tile on DSS. Unusual sentence structure taught noun-means to-verb-ing	B
Dixon 2001	Randomised study Authors do not describe it as a randomised controlled trial	8 participants age range 9;00 - 15.01 children described as being from two towns with potentially different SES groups. Gender details not provided	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	Analytic Reading Inventory	Children had to score 2SD below mean on CELF receptive test Only subjects receiving traditional only and experimental only used in analysis	B
Evans [forthcoming]	Randomised Controlled Trial	60 participants aged 0;08 Children from middle class area Gender mix not stated	Parent administered general language intervention with training from clinician: WILSTAAR intervention 24 participants assigned to WILSTAAR condition 36 participants assigned to no treatment condition	REEL Language Quotients	At baseline children had to have REEL scores 1SD below mean	B

Fey 1993	Randomised Controlled Trial	30 participants aged 3;08 - 5;10 21 male and 9 female SES details not provided	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	DSS composite Outcomes not used: DSS subtests	At baseline children had to score below the 10%tile in expressive language	B
Fey 1994 Phonology measures for Fey 1993	Randomised Controlled Trial	26 participants aged 3;08 - 5;10 17 males and 9 females SES details not provided	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	Indirect outcomes not used in main meta-analysis Percentage of consonants correct derived from the APPR assessment	Indirect outcomes looking at the impact of expressive interventions on phonology	B
Fey 1997 Follow up of Fey 1993	Randomised Controlled Trial	28 participants aged 3;08 - 5;10 Details of gender and SES as Fey 1993	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	Follow-up study not used in main meta-analysis DSS composite DSS verbs DSS sentence points	At baseline children had to score below the 10%tile in expressive syntax	B

Fudala 1972	Randomised Controlled Trial	92 participants aged between first and fifth grade Stated that all socio-economic and ethnic populations represented Gender details not provided	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	Arizona articulation proficiency scale	Child had mild phonological impairment B
Gibbard 1994a	Study 1 Randomised Controlled Trial	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	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	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	Children had less than 30 words and be at a one word stage of development based on mother report B
Gibbard 1994b	Study 2 Randomised Controlled Trial	25 participants aged between 2.03 - 3; 03 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	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	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)	Children has less that 30 words and be at the one word stage of development B

			8 children received clinician therapy 9 children received parent therapy 8 children received the parent control therapy			
Girolametto 1996a	Randomised ControlledTrial	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	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	Parent report of vocabulary size Number of target words in probe exercise Outcomes excluded: probe control words, parent report of symbolic gestures, behaviour scales	Children were below the 5%tile on CDI vocabulary measure	B
Girolametto 1996b	Randomised Controlled Trial	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	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	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	Children were below the 5%tile on vocabulary as determined by the CDI	B
Girolametto 1997	Randomised Controlled Trial	25 participants aged between	Parental administered	Indirect phonology outcomes	This study reports the	B

	Phonology outcomes for Girolametto (b)	1;11 - 2;11 SES details as Girolametto 1996b all participants middle class Provides gender details: 22 males and 3 females took part	expressive vocabulary intervention based on HANEN principles and adapted for focused stimulation 12 received parent intervention 13 received delayed intervention	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	indirect effects of an expressive treatment on phonology	
Glogowska, 2000	Randomised ControlledTrial	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	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	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	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	A
Head 1975	Randomised ControlledTrial	28 participants aged between 6;00 - 12;00 No details given concerning gender or SES	Clinician administered language intervention as part of a summer camp for children with severe speech and language difficulties. 14 children received	Northwest Syntax Test: expressive Goldman Fristoe Test of Articulation Outcomes excluded: Basic Concept Inventory	Severity levels or difficulties of children not specified	B

			recreation games 14 children received percpetual motor activities	Oral Commission Detroit Test Part 7, Peabody Picture Vocabulary Test Northwest test of receptive syntax		
Lancaster 1991	Randomised Controlled Trial	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	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	Composite Deviancy Score	Children needed to have a standard score of below 80 on the EAT	B
Law 1999	Randomised Controlled Trial	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.	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	BPVS PLS: expressive and receptive Parent Report: vocabulary, and phrase complexity Language sample: total communication acts, MLU Outcomes excluded: Reynell	Child were below 1.5SD on comprehension measures	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	Irregular nouns and verbs CDI Behaviour Child and Self: Family Grid Language sample: initiation, responsiveness, discourse maintainers, echos, nouns, verbs, parent behaviours		
Matheny 1978	Randomised ControlledTrial	24 participants aged between 5;05 - 6;10 All participants were described as white, no details of gender are given	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	PAT (phonology) PCLT (syntax)	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	B
Mulac 1977	Randomised Controlled Trial	9 participants aged 4;04 - 6;03 6 males and 3 females participated, no details of SES are given	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	Extra clinic measures of 'is' interrogative measures	Focus on the generalisation of 'is' interrogative Children only had to fail this component in order to be included in the study.	B

			3 children received Monterey language programme 3 children received Monterey language programme and additional exercises to facilitate generalisation			
Munro 1998	Randomised Controlled Trial (not all participants could be randomised)	13 participants aged 3;11-5;05 6 boys and 5 girls participated, no details of SES were provided	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	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	Not all children had significant phonological delays. The average mean SS was <70 but the range was broad 48-101	B
Reid 1996	Randomised Controlled Trial (sub-group analysis)	30 participants aged 3;06-5;06 No details are provided of gender or SES	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	EAT Occurance of Phonological Process: subtest from Metaphon resources	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	B
Robertson 1997	Randomised Controlled Trial (Study 1)	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	Play intervention for expressive narrative language. 20 minutes of therapy a week provided over 3 weeks 10 SLI children played with	Language Sample: Number of words in script, number of different words, number of play related themes Outcome excluded: number of linguistic markers	Children had severe recpetive difficulties as well as expressive difficulties (2SD below mean)	B

		control group: 15.4 years In SLI group 13 participants were male and 7 were female	each other in pairs 10 SLI children were paired with a normal peer			
Robertson 1999	Randomised Controlled Trial	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	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	Language Sample: MLU, total number of words Parent report of vocabulary (CDI) Outcomes excluded: Stress and behaviour measures, % of intelligible utterances	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	B
Ruscello 1993	Randomised study (author does not say it is a randomised controlled study)	12 participants aged between 4;01-5;08 8 males and 4 females participated in the study no SES characteristics are given	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	30 item naming sample including words, phrases, and sentences Khan Lewis Phonological Assessment	Children had to score below the 15%tile on Khan Lewis phonological analysis.	B
Rvachew 1994	Randomised Controlled Trial	27 participants aged 3;06 - 5;06 21 males and 6 females participated, no SES	Clinician administered phonological therapy with additional auditory discrimination task. Therapy	Auditory word discrimination test Object naming speech sample Outcomes excluded: /sh/	The criteria stated that children had to be non-stimulable to /sh/ however all but two children	B

		characteristics are provided	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	centroid	also had moderate or severe phonological delay as shown by CAPP	
Rvachew 2001	Randomised Controlled Trial	48 participants aged mean 4;02 Gender and SES characteristics are not provided	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	Probes for each target sound PPKP: phonological profile Percentage of consonants correct in conversation	Children had moderate to severe phonological delay majority fell below the first percentile (39 participants), all fell below 9%tile.	B

			sounds Intervention delivered for 30 minutes a week for 12 weeks.		
Schwartz 1985	Randomised Controlled Trial	10 participants aged 2;08 - 3;04 All participants were male, no SES characteristics were provided	Clinician administered expressive syntax intervention. Therapy administered over 3 weeks 8 received experimental intervention 2 served as control group receiving intervention without target utterances	Multiword utterances used with the target stimuli	Children had a receptive difficulty approximately 6-9 months behind CA, and an expressive difficulty approx 12-16 months behind CA	B
Shelton 1978	Randomised Controlled Trial	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	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	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	Child had to score below their age range on Templin Darley	B
Sommers 1962	Randomised Controlled Trial	80 participants but data from 40 participants considered 'slow learners' was not used.	Clinician administered speech therapy with parental training in half of the	McDonald Deep Test of Articulation	As well as trained and untrained parents also compares group and	B

		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	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		individual therapy The severity of these children is unclear but most improved the equivalent of 2-3 phonemes.	
Sommers 1964	Randomised ControlledTrial	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	Clinician administered speech therapy with additional intervention from trained parents for half the participants Therapy administered for 200 minutes a week for 4 weeks	McDonald Deep Test of Articulation	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	B
Sommers 1966	Randomised Controlled Trial	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	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	McDonald Deep Test of Articulation	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	B

			group or individual treatment			
Sutton 1999	Randomised Controlled Trial	22 participants aged 0;07 No SES characteristics or gender details are provided	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	REEL language quotients	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	B
Tufts 1959	Randomised Controlled Trial	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	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	Ranks as given by a panel of judges	Children with mild and severe difficulties as rated by the panel of judges were excluded from the study	B
Wilcox 1991	Randomised Controlled Trial	20 participants age range 1;08 - 3;11 Gender details and SES characteristics are not provided	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	Overall use of target words in clinic sessions. Outcomes excluded: seperate productive and additional use of target words measured in clinic Home measures	Children had to score 1.5SD below mean on both expressive and receptive scales of the sequenced inventory of communication development	B

10 participants received
classroom based group
intervention

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

Study ID	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
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

Study ID	Trial name	Participants	Interventions	Outcomes	Starting date	Contact info	Notes
Boyle, Ongoing	Evaluation of Speech and Language Therapy	Approximately 250 children with persisting expressive and/or receptive difficulties	Group or Individual therapy delivered by a therapist or a clinician compared to children receiving community delivered speech and language therapy	No data available	ns	Prof James Boyle Department of Psychology, University of Strathclyde, Graham Hills Building, 40 George Street, G1 1QE	
Broomfield, FC	Evaluation of the clinical effectiveness of speech and language therapy for children with a primary speech/ language disability	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	Routine clinic therapy as it was normally offered. Clinician interventions in group or individual situations	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	01.02.1999	Ms Jan Broomfield Tees and North East Yorkshire NHS Trust, 157 Southfield Road, Middleborough, Teeside, TS1 3HF.	
O'Hare, Ongoing	The effects of adaptive training in auditory temporal processing on specific language impairment: a randomised controlled trial of 'FastForWord' on Scottish children	Children aged 6-8 with specific language impairment	FastForWord: Software programme	No data available	01.08.00	Dr AE O'Hare Lothian University Hospitals NHS Trust, Community Child Health Services, 10 Chalmers Crescent, Edinburgh, Mid-Lothian, EH9 1TS	

References to studies

Included studies

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}

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Table of comparisons

01 Speech and language intervention vesus delayed or no treatment

    01 Expressive phonology outcomes

        01 Production of target sound

        02 Variability in production of target sound

        03 Measures of overall phonological development

        04 Percentage of consonants correct in conversation

        05 Re-telling a story with target sound

    02 Receptive phonology outcomes

        01 Auditory association test

    03 Expressive syntax outcomes

        01 Measures of overall expressive syntax development

        02 Total number of utterances in a language sample

        03 Mean length of utterance from language sample

        04 Parent report of phrase complexity

    04 Receptive syntax outcomes

        01 measures of overall receptive syntax development

    05 Expressive vocabulary outcomes

        01 Number of different target words learnt

        02 Measures of overall expressive vocabulary development

        03 Different words in language sample

        04 Parent report of vocabulary

    06 Receptive vocabulary outcomes

    07 Composite language measures

        01 REEL Language quotients

    08 Subgroup analysis (clinician only data)

        01 measures of overall expressive phonology development

        02 measures of overall expressive syntax development

        03 measures of overall expressive vocabulary development

        04 measures of overall receptive syntax development

    09 Subgroup analysis (trials of longer than eight weeks)

        01 measures of overall phonological development

        02 measures of overall expressive syntax development

        03 measures of overall expressive vocabulary development

        04 measures of overall receptive syntax development

    10 Subgroup Analysis (excluding data from children with receptive and expressive difficulties)

        01 Measures of overall expressive syntax development

        02 Total number of utterances in language sample

        03 Mean langth of utterance based on language sample

        04 Parent report of phrase complexity

        05 Measures of overall vocabulary development

        06 Parent report of vocabulary size

    11 Sensitivity analysis (excluding studies not reporting attrition)

        01 Measures of overall expressive phonology development

       02 Measures of overall receptive phonology development

       03 Measures of overall expressive syntax development

       04 Measures of overall receptive syntax development

       05 Measures of overall expressive vocabulary development

       06 Measures of overall receptive vocabulary development

       07 Composite language measures

    12 Sensitivity analysis (excluding studies not reporting blinding)

       01 Measures of overall expressive phonology

       02 Measures of overall receptive phonology

       03 Measures of overall expressive syntax

       04 Measures of overall receptive syntax

       05 Measures of overall expressive vocabulary

       06 Measures of overall receptive vocabulary

       07 Composite language measures

02 Speech and language intervention versus general stimulation programmes

    01 Expressive phonology outcomes

    02 Receptive phonology outcomes

    03 Expressive syntax outcomes

       01 Multi-word utterances using target stimuli

       02 Measures of overall expressive syntax development

       03 Number of play related speech acts during play

       04 Total number of utterances in language sample

       05 Mother description of phrase complexity

       06 Mean length of utterance based on language sample

    04 Receptive syntax outcomes

    05 Expressive vocabulary outcomes

       01 Number of words in play scripts

       02 Measures of overall expressive vocabulary development

       03 Number of words in language sample

    06 Receptive vocabulary outcomes

03 Speech and language interventions versus traditional speech and language programmes

    01 Expressive phonology outcomes

       01 Production of target sound

       02 Measures of overall expressive phonology development

       03 Percentage of consonants correct in conversation

    02 Receptive phonology outcomes

       01 Test of Auditory Association

    03 Expressive syntax outcomes

       01 Correct utterance of 20 unusual sentences

       02 Measures of overall expressive syntax development

       03 Total utterances from a language sample

       04 Mean length of utterance from a language sample

       05 Parent report of complexity of phrases

    04 Receptive syntax outcomes

        01 Measures of overall receptove syntax development

05 Expressive vocabulary outcomes

        01 Overall use of target words in clinic interaction

        02 Measures of overall expressive vocabulary development

        03 Different words in language sample

        04 Parent report of vocabulary size

06 Receptive vocabulary outcomes

        01 Measures of overall vocabulary understanding

07 Composite language outcomes

08 Subgroup analysis (clinician versus parent)

        01 Measures of overall expressive phonology development

        02 Measures of overall expressive syntax development

        03 Measures of overall expressive vocabulary development

        04 Measures of overall receptive syntax development

09 Subgroup analysis (excluding data from children with expressive and receptive difficulties)

        01 Measures of overall syntax development

        02 Total number of utterances in a language sample

        03 Mean length of utterance derived from a language sample

        04 Parent report of phrase complexity

        05 Measures of overall vocabulary development

        06 Parental report of vocabulary size

Additional tables

01 Methodological Quality (A-L)

Study	Randomi sation	Blinding of Assessor s	Similarit ies at Baseline	Explanat ion of Withdra wals	Discount ing in analysis of Missing Values	Degree of Attrition	Intention to Teat Analysis	Power	Descripti on of Eligibilit y 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
Courtwri ght (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 (Forthco ming)	B	A	B	A	C	C (.10)	B	B	A
Fey (1993)	B	A	C (mothers educatio n)	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
Girolam etto (1996a)	B	A	C (behavio ur)	A (none)	A (none)	A (none)	B	B	A
Girolam etto (1996b)	B	A	A	A (none)	A (none)	A (none)	B	B	A
Girolam etto (1997)	B	A	A	A (none)	A (none)	A (none)	B	B	A
Glogows ka (2000)	A	A	A	A	C	A (.03)	A (I to T)	C	A
Head (1975)	B	B	B	A	C	C (.11)	B	B	C
Lancaste r (1991)	B	B	B	A	A (included in end analysis)	A (none)	A (I to T)	B	A
Law (1999)	A	A	C (esteem,	A	C	C (.12)	B	C	A

			behaviour)							
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 calculation 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

Additional tables

02 Methodological Quality (M-Z)

Study	Random isation	Blinding of Assessor	Baseline	Withdra wals	Missing Values	Attrition	Analysis	Power	Eligibilit y
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 (subgrou p)	A (subgrou p)	A (subgrou p)	B	B	A
Robertso n (1997)	B	C	A	B	B	B	B	B	A
Robertso n (1999)	B	B	A	A	C	C (.13)	B	B	A
Ruscello (1993)	B	B	A	B	B	B	B	B	A
Rvachew (1994)	B	A	A	B	C	C (.13)	B	B	A
Rvachew (2001)	B	A	A	A	B	B	B	B	A
Schwart z (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 claculation not reported	B: characteristics in main area of study
	C: methods of	C: assessors blind at	C: baseline character	C: withdrawals not	C: missing values	C: >.10 attrition		C: power calculation	C: character istics

	randomisation inadequate	pre-test only	istics reported to be different	accounted for	discounted in analysis			completed but insufficient participants recruited	unclear

Notes

Unpublished CRG notes

Exported from Review Manager 4.2.3

Published notes

Amended sections

Other references

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

Total number of included studies: 36

Comparison or outcome	Studies	Participants	Statistical method	Effect size
01 Speech and language intervention vesus delayed or no treatment				
01 Expressive phonology outcomes			SMD (random), 95% CI	Subtotals only
02 Receptive phonology outcomes			SMD (random), 95% CI	Subtotals only
03 Expressive syntax outcomes			SMD (random), 95% CI	Subtotals only
04 Receptive syntax outcomes			SMD (random), 95% CI	Subtotals only
05 Expressive vocabulary outcomes			SMD (random), 95% CI	Subtotals only
06 Receptive vocabulary outcomes			SMD (random), 95% CI	Subtotals only
07 Composite language measures			SMD (random), 95% CI	Subtotals only
08 Subgroup analysis (clinician only data)			SMD (random), 95% CI	Subtotals only
09 Subgroup analysis (trials of longer than eight weeks)			SMD (random), 95% CI	Subtotals only
10 Subgroup Analysis (excluding data from children with receptive and expressive difficulties)			SMD (random), 95% CI	Subtotals only
11 Sensitivity analysis (excluding studies not reporting attrition)			SMD (random), 95% CI	Subtotals only
12 Sensitivity analysis (excluding studies not reporting blinding)			SMD (random), 95% CI	Subtotals only
02 Speech and language intervention versus general stimulation programmes				
01 Expressive phonology outcomes			SMD (random), 95% CI	Subtotals only
02 Receptive phonology outcomes			SMD (random), 95% CI	Subtotals only
03 Expressive syntax outcomes			SMD (random), 95% CI	Subtotals only
04 Receptive syntax outcomes	0	0	WMD (fixed), 95% CI	Not estimable
05 Expressive vocabulary outcomes			SMD (random), 95% CI	Subtotals only
06 Receptive vocabulary outcomes	0	0	WMD (fixed), 95% CI	Not estimable
03 Speech and language interventions versus traditional speech and language programmes				
01 Expressive phonology outcomes			SMD (random), 95% CI	No total
02 Receptive phonology outcomes			SMD (random), 95% CI	Subtotals only
03 Expressive syntax outcomes			SMD (random), 95% CI	Subtotals only
04 Receptive syntax outcomes			SMD (random), 95% CI	No total
05 Expressive vocabulary outcomes			SMD (random), 95% CI	Subtotals only
06 Receptive vocabulary outcomes			SMD (random), 95% CI	Subtotals only
07 Composite language outcomes			SMD (random), 95% CI	Subtotals only
08 Subgroup analysis (clinician versus parent)			SMD (random), 95% CI	Subtotals only
09 Subgroup analysis (excluding data from children with expressive			SMD (random), 95% CI	Subtotals only

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Total number of included studies: 36

Comparison or outcome	Studies	Participants	Statistical method	Effect size

and receptive difficulties)

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 01 Expressive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Production of target sound							
Munro 1998	7	10.14(9.26)	4	1.88(2.46)		100.00	0.98 [-0.35, 2.31]
Subtotal (95% CI)	7		4			100.00	0.98 [-0.35, 2.31]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.45 (P = 0.15)							
02 Variability in production of target sound							
Munro 1998	7	11.57(9.74)	4	3.13(5.13)		100.00	0.91 [-0.41, 2.23]
Subtotal (95% CI)	7		4			100.00	0.91 [-0.41, 2.23]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.35 (P = 0.18)							
03 Measures of overall phonological development							
Matheny 1978	8	-6.62(2.39)	8	-8.87(3.23)		13.74	0.75 [-0.28, 1.77]
Shelton 1978	30	7.71(8.18)	15	9.70(11.20)		20.52	-0.21 [-0.83, 0.41]
Lancaster 1991	10	-36.59(19.17)	5	-45.60(12.51)		12.82	0.49 [-0.61, 1.58]
Almost 1998	13	-34.70(7.90)	13	-48.20(10.90)		16.10	1.37 [0.50, 2.24]
Munro 1998	7	75.14(14.14)	4	68.25(5.45)		10.85	0.53 [-0.73, 1.79]
Glogowska, 2000	70	-27.20(22.76)	81	-34.35(28.66)		25.98	0.27 [-0.05, 0.59]
Subtotal (95% CI)	138		126			100.00	0.44 [0.01, 0.86]
Test for heterogeneity: Chi² = 9.38, df = 5 (P = 0.09), I² = 46.7%							
Test for overall effect: Z = 2.01 (P = 0.04)							
04 Percentage of consonants correct in conversation							
Almost 1998	13	72.50(9.60)	13	50.40(12.60)		100.00	1.91 [0.96, 2.86]
Subtotal (95% CI)	13		13			100.00	1.91 [0.96, 2.86]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 3.93 (P < 0.0001)							
05 Re-telling a story with target sound							
Munro 1998	7	50.43(42.67)	4	1.25(2.17)		100.00	1.29 [-0.11, 2.69]
Subtotal (95% CI)	7		4			100.00	1.29 [-0.11, 2.69]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.80 (P = 0.07)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 02 Receptive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Auditory association test							
Shelton 1978	30	3.70(2.35)	15	2.20(3.50)		100.00	0.53 [-0.10, 1.16]
Subtotal (95% CI)	30		15			100.00	0.53 [-0.10, 1.16]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.65 (P = 0.10)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 03 Expressive syntax outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall expressive syntax development							
Matheny 1978	8	-30.62(7.27)	8	-36.62(5.24)		17.11	0.90 [-0.15, 1.94]
Fey 1993	21	5.66(1.58)	8	4.36(1.27)		19.23	0.84 [-0.01, 1.69]
Gibbard 1994a	18	38.70(8.60)	18	20.80(6.20)		19.00	2.33 [1.47, 3.20]
Law 1999	28	74.74(4.71)	10	77.40(5.74)		20.46	-0.52 [-1.25, 0.21]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		24.21	0.17 [-0.15, 0.49]
Subtotal (95% CI)	145		126			100.00	0.70 [-0.14, 1.55]
Test for heterogeneity: Chi² = 28.99, df = 4 (P < 0.00001), I² = 86.2%							
Test for overall effect: Z = 1.64 (P = 0.10)							
02 Total number of utterances in a language sample							
Gibbard 1994a	18	89.50(58.80)	18	17.40(16.70)		33.40	1.63 [0.87, 2.40]
Girolametto 1996b	12	182.90(103.00)	13	103.80(102.00)		32.49	0.75 [-0.07, 1.56]
Law 1999	28	102.94(31.42)	10	113.10(35.37)		34.11	-0.31 [-1.03, 0.42]
Subtotal (95% CI)	58		41			100.00	0.68 [-0.45, 1.82]
Test for heterogeneity: Chi² = 13.03, df = 2 (P = 0.001), I² = 84.7%							
Test for overall effect: Z = 1.18 (P = 0.24)							
03 Mean length of utterance from language sample							
Gibbard 1994a	18	2.30(0.70)	18	1.40(0.40)		34.09	1.54 [0.79, 2.30]
Law 1999	28	2.42(0.62)	10	2.56(0.78)		34.64	-0.21 [-0.93, 0.52]
Robertson 1999	11	1.32(0.32)	10	1.09(0.11)		31.27	0.90 [0.00, 1.81]
Subtotal (95% CI)	57		38			100.00	0.74 [-0.33, 1.81]
Test for heterogeneity: Chi² = 11.02, df = 2 (P = 0.004), I² = 81.9%							
Test for overall effect: Z = 1.35 (P = 0.18)							
04 Parent report of phrase complexity							
Gibbard 1994a	18	5.00(1.90)	18	1.80(0.90)		32.70	2.10 [1.27, 2.94]
Girolametto 1996b	12	16.70(13.00)	13	5.20(10.00)		32.61	0.96 [0.13, 1.80]
Law 1999	28	23.80(3.72)	10	23.67(2.87)		34.70	0.04 [-0.69, 0.76]
Subtotal (95% CI)	58		41			100.00	1.02 [-0.17, 2.22]
Test for heterogeneity: Chi² = 13.55, df = 2 (P = 0.001), I² = 85.2%							
Test for overall effect: Z = 1.67 (P = 0.09)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 04 Receptive syntax outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 measures of overall receptive syntax development							
Law 1999	28	71.05(5.32)	10	73.40(4.55)		36.29	-0.45 [-1.18, 0.28]
Glogowska, 2000	71	87.30(15.89)	84	84.26(15.49)		63.71	0.19 [-0.12, 0.51]
Subtotal (95% CI)	99		94			100.00	-0.04 [-0.64, 0.56]

Test for heterogeneity: Chi² = 2.49, df = 1 (P = 0.11), I² = 59.9%
Test for overall effect: Z = 0.13 (P = 0.90)

-4   -2   0   2   4
Favours no treatmen   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 05 Expressive vocabulary outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Number of different target words learnt							
Girolametto 1996a	8	3.90(2.40)	8	1.50(2.00)		42.99	1.03 [-0.04, 2.09]
Girolametto 1996b	12	5.90(3.30)	13	3.30(2.50)		57.01	0.86 [0.04, 1.69]
Subtotal (95% CI)	20		21			100.00	0.93 [0.27, 1.58]

Test for heterogeneity: Chi² = 0.06, df = 1 (P = 0.81), I² = 0%
Test for overall effect: Z = 2.78 (P = 0.005)

02 Measures of overall expressive vocabulary development							
Gibbard 1994a	18	15.70(8.30)	18	3.20(4.90)		48.08	1.79 [1.01, 2.58]
Law 1999	28	75.95(10.54)	10	74.00(9.06)		51.92	0.19 [-0.54, 0.91]
Subtotal (95% CI)	46		28			100.00	0.98 [-0.59, 2.56]

Test for heterogeneity: Chi² = 8.67, df = 1 (P = 0.003), I² = 88.5%
Test for overall effect: Z = 1.22 (P = 0.22)

03 Different words in language sample							
Gibbard 1994a	18	14.20(7.10)	18	8.10(4.30)		38.82	1.02 [0.32, 1.72]
Girolametto 1996b	12	64.50(46.00)	13	25.20(22.00)		32.41	1.07 [0.22, 1.92]
Robertson 1999	11	15.10(5.20)	10	8.50(5.30)		28.76	1.21 [0.26, 2.15]
Subtotal (95% CI)	41		41			100.00	1.08 [0.61, 1.55]

Test for heterogeneity: Chi² = 0.10, df = 2 (P = 0.95), I² = 0%
Test for overall effect: Z = 4.51 (P < 0.00001)

04 Parent report of vocabulary							
Gibbard 1994a	18	225.30(106.10)	18	49.40(30.30)		20.07	2.20 [1.36, 3.05]
Girolametto 1996a	8	79.50(35.00)	8	68.90(49.00)		17.01	0.24 [-0.75, 1.22]
Girolametto 1996b	12	187.70(181.00)	13	65.40(66.00)		20.53	0.88 [0.05, 1.71]
Law 1999	28	23.22(4.12)	10	21.44(2.07)		23.11	0.47 [-0.26, 1.20]
Robertson 1999	11	76.20(37.50)	10	51.40(40.80)		19.28	0.61 [-0.27, 1.49]
Subtotal (95% CI)	77		59			100.00	0.89 [0.21, 1.56]

Test for heterogeneity: Chi² = 12.61, df = 4 (P = 0.01), I² = 68.3%
Test for overall effect: Z = 2.58 (P = 0.010)

-4   -2   0   2   4
Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 06 Receptive vocabulary outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI

-4   -2   0   2   4
Favours treatment   Favours no treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 07 Composite language measures

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 REEL Language quotients							
Evans [forthcoming]	23	106.50(12.30)	32	104.00(10.50)		100.00	0.22 [-0.32, 0.76]
Subtotal (95% CI)	23		32			100.00	0.22 [-0.32, 0.76]

Test for heterogeneity: not applicable
Test for overall effect: Z = 0.80 (P = 0.43)

-4   -2   0   2   4
Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 08 Subgroup analysis (clinician only data)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 measures of overall expressive phonology development							
Matheny 1978	8	-6.62(2.39)	8	-8.87(3.23)		12.65	0.75 [-0.28, 1.77]
Lancaster 1991	5	-27.70(18.18)	5	-45.60(12.51)		7.57	1.04 [-0.33, 2.41]
Almost 1998	13	-34.70(7.90)	13	-48.20(10.90)		16.62	1.37 [0.50, 2.24]
Munro 1998	7	75.14(14.14)	4	68.25(5.45)		8.82	0.53 [-0.73, 1.79]
Glogowska, 2000	70	-27.20(22.76)	81	-34.35(28.66)		54.34	0.27 [-0.05, 0.59]
Subtotal (95% CI)	103		111			100.00	0.67 [0.19, 1.16]
Test for heterogeneity: Chi² = 6.54, df = 4 (P = 0.16), I² = 38.9%							
Test for overall effect: Z = 2.71 (P = 0.007)							
02 measures of overall expressive syntax development							
Matheny 1978	8	-30.62(7.27)	8	-36.62(5.24)		12.22	0.90 [-0.15, 1.94]
Fey 1993	11	5.48(1.31)	8	4.36(1.27)		14.12	0.83 [-0.13, 1.78]
Law 1999	17	75.65(4.33)	10	77.40(5.74)		19.33	-0.35 [-1.13, 0.44]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		54.33	0.17 [-0.15, 0.49]
Subtotal (95% CI)	106		108			100.00	0.28 [-0.19, 0.75]
Test for heterogeneity: Chi² = 5.23, df = 3 (P = 0.16), I² = 42.6%							
Test for overall effect: Z = 1.16 (P = 0.25)							
03 measures of overall expressive vocabulary development							
Law 1999	17	75.47(11.63)	10	74.00(9.06)		100.00	0.13 [-0.65, 0.91]
Subtotal (95% CI)	17		10			100.00	0.13 [-0.65, 0.91]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.33 (P = 0.74)							
04 measures of overall receptive syntax development							
Law 1999	17	71.29(5.36)	10	73.40(4.55)		26.03	-0.40 [-1.19, 0.39]
Glogowska, 2000	71	87.30(15.89)	84	84.26(15.49)		73.97	0.19 [-0.12, 0.51]
Subtotal (95% CI)	88		94			100.00	0.01 [-0.53, 0.55]
Test for heterogeneity: Chi² = 1.88, df = 1 (P = 0.17), I² = 46.9%							
Test for overall effect: Z = 0.04 (P = 0.97)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 09 Subgroup analysis (trials of longer than eight weeks)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 measures of overall phonological development							
Matheny 1978	8	-6.62(2.39)	8	-8.87(3.23)		13.33	0.75 [-0.28, 1.77]
Lancaster 1991	5	-27.70(18.18)	5	-45.60(12.51)		7.92	1.04 [-0.33, 2.41]
Almost 1998	13	-34.70(7.90)	13	-48.20(10.90)		17.62	1.37 [0.50, 2.24]
Glogowska, 2000	70	-27.20(22.76)	81	-34.35(28.66)		61.13	0.27 [-0.05, 0.59]
Subtotal (95% CI)	96		107			100.00	0.74 [0.14, 1.33]
Test for heterogeneity: Chi² = 6.53, df = 3 (P = 0.09), I² = 54.1%							
Test for overall effect: Z = 2.41 (P = 0.02)							
02 measures of overall expressive syntax development							
Matheny 1978	8	-30.62(7.27)	8	-36.62(5.24)		14.47	0.90 [-0.15, 1.94]
Fey 1993	11	5.48(1.31)	8	4.36(1.27)		16.77	0.83 [-0.13, 1.78]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		68.76	0.17 [-0.15, 0.49]
Subtotal (95% CI)	89		98			100.00	0.43 [-0.06, 0.93]
Test for heterogeneity: Chi² = 3.02, df = 2 (P = 0.22), I² = 33.7%							
Test for overall effect: Z = 1.72 (P = 0.09)							
03 measures of overall expressive vocabulary development							
Subtotal (95% CI)	0		0				Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable							
04 measures of overall receptive syntax development							
Glogowska, 2000	71	87.30(15.89)	84	84.26(15.49)		100.00	0.19 [-0.12, 0.51]
Subtotal (95% CI)	71		84			100.00	0.19 [-0.12, 0.51]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.19 (P = 0.23)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 10 Subgroup Analysis (excluding data from children with receptive and expressive difficulties)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall expressive syntax development							
Matheny 1978	8	-30.62(7.27)	8	-36.62(5.24)		20.97	0.90 [-0.15, 1.94]
Fey 1993	21	5.66(1.58)	8	4.36(1.27)		23.97	0.84 [-0.01, 1.69]
Gibbard 1994a	18	38.70(8.60)	18	20.80(6.20)		23.64	2.33 [1.47, 3.20]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		31.41	0.17 [-0.15, 0.49]
Subtotal (95% CI)	117		116			100.00	1.02 [0.04, 2.01]
Test for heterogeneity: Chi² = 22.36, df = 3 (P < 0.0001), I² = 86.6%							
Test for overall effect: Z = 2.03 (P = 0.04)							
02 Total number of utterances in language sample							
Gibbard 1994a	18	89.50(58.80)	18	17.40(16.70)		50.80	1.63 [0.87, 2.40]
Girolametto 1996b	12	182.90(103.00)	13	103.80(102.00)		49.20	0.75 [-0.07, 1.56]
Subtotal (95% CI)	30		31			100.00	1.20 [0.33, 2.07]
Test for heterogeneity: Chi² = 2.40, df = 1 (P = 0.12), I² = 58.3%							
Test for overall effect: Z = 2.72 (P = 0.007)							
03 Mean length of utterance based on language sample							
Gibbard 1994a	18	2.30(0.70)	18	1.40(0.40)		52.48	1.54 [0.79, 2.30]
Robertson 1999	11	1.32(0.32)	10	1.09(0.11)		47.52	0.90 [0.00, 1.81]
Subtotal (95% CI)	29		28			100.00	1.28 [0.66, 1.89]
Test for heterogeneity: Chi² = 1.13, df = 1 (P = 0.29), I² = 11.2%							
Test for overall effect: Z = 4.05 (P < 0.0001)							
04 Parent report of phrase complexity							
Gibbard 1994a	18	5.00(1.90)	18	1.80(0.90)		50.08	2.10 [1.27, 2.94]
Girolametto 1996b	12	16.70(13.00)	13	5.20(10.00)		49.92	0.96 [0.13, 1.80]
Subtotal (95% CI)	30		31			100.00	1.54 [0.42, 2.65]
Test for heterogeneity: Chi² = 3.59, df = 1 (P = 0.06), I² = 72.1%							
Test for overall effect: Z = 2.69 (P = 0.007)							
05 Measures of overall vocabulary development							
Gibbard 1994a	18	15.70(8.30)	18	3.20(4.90)		100.00	1.79 [1.01, 2.58]
Subtotal (95% CI)	18		18			100.00	1.79 [1.01, 2.58]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 4.47 (P < 0.00001)							
06 Parent report of vocabulary size							
Gibbard 1994a	18	225.30(106.10)	18	49.40(30.30)		25.63	2.20 [1.36, 3.05]
Girolametto 1996a	8	79.50(35.00)	8	68.90(49.00)		23.36	0.24 [-0.75, 1.22]
Girolametto 1996b	12	187.70(181.00)	13	65.40(66.00)		25.94	0.88 [0.05, 1.71]
Robertson 1999	11	76.20(37.50)	10	51.40(40.80)		25.07	0.61 [-0.27, 1.49]
Subtotal (95% CI)	49		49			100.00	1.00 [0.16, 1.84]
Test for heterogeneity: Chi² = 10.88, df = 3 (P = 0.01), I² = 72.4%							
Test for overall effect: Z = 2.33 (P = 0.02)							

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        -4        -2        0        2        4
   Favours no treatment     Favours treatment
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Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 11 Sensitivity analysis (excluding studies not reporting attrition)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall expressive phonology development							
Shelton 1978	30	7.71(8.18)	15	9.70(11.20)		23.80	-0.21 [-0.83, 0.41]
Lancaster 1991	10	-36.59(19.17)	5	-45.60(12.51)		14.81	0.49 [-0.61, 1.58]
Almost 1998	13	-34.70(7.90)	13	-48.20(10.90)		18.63	1.37 [0.50, 2.24]
Munro 1998	7	75.14(14.14)	4	68.25(5.45)		12.52	0.53 [-0.73, 1.79]
Glogowska, 2000	70	-27.20(22.76)	81	-34.35(28.66)		30.23	0.27 [-0.05, 0.59]
Subtotal (95% CI)	130		118			100.00	0.40 [-0.08, 0.89]
Test for heterogeneity: Chi² = 8.72, df = 4 (P = 0.07), I² = 54.1%							
Test for overall effect: Z = 1.64 (P = 0.10)							
02 Measures of overall receptive phonology development							
Shelton 1978	30	3.70(2.35)	15	2.20(3.50)		100.00	0.53 [-0.10, 1.16]
Subtotal (95% CI)	30		15			100.00	0.53 [-0.10, 1.16]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.65 (P = 0.10)							
03 Measures of overall expressive syntax development							
Fey 1993	21	5.66(1.58)	8	4.36(1.27)		21.33	0.84 [-0.01, 1.69]
Gibbard 1994a	18	38.70(8.60)	18	20.80(6.20)		20.88	2.33 [1.47, 3.20]
Law 1999	28	74.74(4.71)	10	77.40(5.74)		23.93	-0.52 [-1.25, 0.21]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		33.86	0.17 [-0.15, 0.49]
Subtotal (95% CI)	137		118			100.00	0.67 [-0.33, 1.66]
Test for heterogeneity: Chi² = 27.99, df = 3 (P < 0.00001), I² = 89.3%							
Test for overall effect: Z = 1.31 (P = 0.19)							
04 Measures of overall receptive syntax development							
Law 1999	28	71.05(5.32)	10	73.40(4.55)		41.43	-0.45 [-1.18, 0.28]
Glogowska, 2000	71	87.30(15.89)	84	84.26(15.49)		58.57	0.19 [-0.12, 0.51]
Subtotal (95% CI)	99		94			100.00	-0.04 [-0.64, 0.56]
Test for heterogeneity: Chi² = 2.49, df = 1 (P = 0.11), I² = 59.9%							
Test for overall effect: Z = 0.13 (P = 0.90)							
05 Measures of overall expressive vocabulary development							
Gibbard 1994a	18	15.70(8.30)	18	3.20(4.90)		48.41	1.79 [1.01, 2.58]
Law 1999	28	75.95(10.54)	10	74.00(9.06)		51.59	0.19 [-0.54, 0.91]
Subtotal (95% CI)	46		28			100.00	0.98 [-0.59, 2.56]
Test for heterogeneity: Chi² = 8.67, df = 1 (P = 0.003), I² = 88.5%							
Test for overall effect: Z = 1.22 (P = 0.22)							
06 Measures of overall receptive vocabulary development							
Subtotal (95% CI)	0		0				Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable							
07 Composite language measures							
Evans [forthcoming]	23	106.50(12.30)	32	104.00(10.50)		100.00	0.22 [-0.32, 0.76]
Subtotal (95% CI)	23		32			100.00	0.22 [-0.32, 0.76]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.80 (P = 0.43)							

-4   -2   0   2   4

Favours no treatment   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 01 Speech and language intervention vesus delayed or no treatment
Outcome: 12 Sensitivity analysis (excluding studies not reporting blinding)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall expressive phonology							
Almost 1998	13	-34.70(7.90)	13	-48.20(10.90)		21.82	1.37 [0.50, 2.24]
Munro 1998	7	75.14(14.14)	4	68.25(5.45)		11.77	0.53 [-0.73, 1.79]
Glogowska, 2000	70	-27.20(22.76)	81	-34.35(28.66)		66.41	0.27 [-0.05, 0.59]
Subtotal (95% CI)	90		98			100.00	0.66 [-0.07, 1.40]

Test for heterogeneity: Chi² = 5.46, df = 2 (P = 0.07), I² = 63.3%
Test for overall effect: Z = 1.76 (P = 0.08)

02 Measures of overall receptive phonology							
Subtotal (95% CI)	0		0				Not estimable

Test for heterogeneity: not applicable
Test for overall effect: not applicable

03 Measures of overall expressive syntax							
Fey 1993	21	5.66(1.58)	8	4.36(1.27)		19.33	0.84 [-0.01, 1.69]
Law 1999	28	74.74(4.71)	10	77.40(5.74)		23.96	-0.52 [-1.25, 0.21]
Glogowska, 2000	70	83.87(15.13)	82	81.18(15.79)		56.71	0.17 [-0.15, 0.49]
Subtotal (95% CI)	119		100			100.00	0.14 [-0.47, 0.75]

Test for heterogeneity: Chi² = 5.80, df = 2 (P = 0.06), I² = 65.5%
Test for overall effect: Z = 0.45 (P = 0.65)

04 Measures of overall receptive syntax							
Law 1999	28	71.05(5.32)	10	73.40(4.55)		29.69	-0.45 [-1.18, 0.28]
Glogowska, 2000	71	87.30(15.89)	84	84.26(15.49)		70.31	0.19 [-0.12, 0.51]
Subtotal (95% CI)	99		94			100.00	-0.04 [-0.64, 0.56]

Test for heterogeneity: Chi² = 2.49, df = 1 (P = 0.11), I² = 59.9%
Test for overall effect: Z = 0.13 (P = 0.90)

05 Measures of overall expressive vocabulary							
Law 1999	28	75.95(10.54)	10	74.00(9.06)		100.00	0.19 [-0.54, 0.91]
Subtotal (95% CI)	28		10			100.00	0.19 [-0.54, 0.91]

Test for heterogeneity: not applicable
Test for overall effect: Z = 0.51 (P = 0.61)

06 Measures of overall receptive vocabulary							
Subtotal (95% CI)	0		0				Not estimable

Test for heterogeneity: not applicable
Test for overall effect: not applicable

07 Composite language measures							
Evans [forthcoming]	23	106.50(12.30)	32	104.00(10.50)		100.00	0.22 [-0.32, 0.76]
Subtotal (95% CI)	23		32			100.00	0.22 [-0.32, 0.76]

Test for heterogeneity: not applicable
Test for overall effect: Z = 0.80 (P = 0.43)

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          -4    -2     0     2     4
      Favours no treatment   Favours treatment
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Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 02 Speech and language intervention versus general stimulation programmes
Outcome: 01 Expressive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI

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        -10    -5     0     5     10
      Favours Stimulation   Favours treatment
```

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 02 Speech and language intervention versus general stimulation programmes
Outcome: 02 Receptive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI

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        -10    -5     0     5     10
      Favours Stimulation   Favours treatment
```

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Multi-word utterances using target stimuli							
Schwartz 1985	8	10.90(8.30)	2	4.50(3.50)		100.00	0.74 [−0.87, 2.34]
Subtotal (95% CI)	8		2			100.00	0.74 [−0.87, 2.34]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.90 (P = 0.37)							
02 Measures of overall expressive syntax development							
Gibbard 1994b	17	33.19(9.29)	8	25.50(3.50)		100.00	0.93 [0.05, 1.82]
Subtotal (95% CI)	17		8			100.00	0.93 [0.05, 1.82]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 2.06 (P = 0.04)							
03 Number of play related speech acts during play							
Robertson 1997	10	9.30(2.16)	10	3.60(1.07)		100.00	3.20 [1.79, 4.62]
Subtotal (95% CI)	10		10			100.00	3.20 [1.79, 4.62]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 4.44 (P < 0.00001)							
04 Total number of utterances in language sample							
Gibbard 1994b	17	53.17(42.80)	8	19.00(20.80)		100.00	0.88 [0.00, 1.76]
Subtotal (95% CI)	17		8			100.00	0.88 [0.00, 1.76]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.96 (P = 0.05)							
05 Mother description of phrase complexity							
Gibbard 1994b	17	4.42(2.48)	8	2.70(0.90)		100.00	0.78 [−0.09, 1.65]
Subtotal (95% CI)	17		8			100.00	0.78 [−0.09, 1.65]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.76 (P = 0.08)							
06 Mean length of utterance based on language sample							
Gibbard 1994b	17	2.41(0.79)	8	1.44(0.38)		100.00	1.36 [0.42, 2.29]
Subtotal (95% CI)	17		8			100.00	1.36 [0.42, 2.29]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 2.84 (P = 0.004)							

-4   -2   0   2   4

Favours stimulation   Favours treatment

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	WMD (fixed) 95% CI	Weight %	WMD (fixed) 95% CI
Total (95% CI)	0		0				Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable							

-10   -5   0   5   10

Favours stimulation   Favours treatment

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Number of words in play scripts							
Robertson 1997	10	66.50(23.70)	10	23.50(9.10)		100.00	2.29 [1.11, 3.48]
Subtotal (95% CI)	10		10			100.00	2.29 [1.11, 3.48]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 3.80 (P = 0.0001)							
02 Measures of overall expressive vocabulary development							
Gibbard 1994b	17	18.80(11.66)	8	10.90(4.60)		100.00	0.76 [−0.11, 1.63]
Subtotal (95% CI)	17		8			100.00	0.76 [−0.11, 1.63]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.71 (P = 0.09)							
03 Number of words in language sample							
Gibbard 1994b	17	8.59(3.38)	8	6.30(3.90)		54.80	0.62 [−0.24, 1.49]
Robertson 1997	10	38.90(10.90)	10	18.90(8.30)		45.20	1.98 [0.87, 3.09]
Subtotal (95% CI)	27		18			100.00	1.25 [−0.07, 2.58]
Test for heterogeneity: Chi² = 3.55, df = 1 (P = 0.06), I² = 71.9%							
Test for overall effect: Z = 1.86 (P = 0.06)							

-4   -2   0   2   4

Favours stimulation   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 02 Speech and language intervention versus general stimulation programmes
Outcome: 06 Receptive vocabulary outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	WMD (fixed) 95% CI	Weight %	WMD (fixed) 95% CI
Total (95% CI)	0		0				Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable							

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Favours stimulation   Favours treatment

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
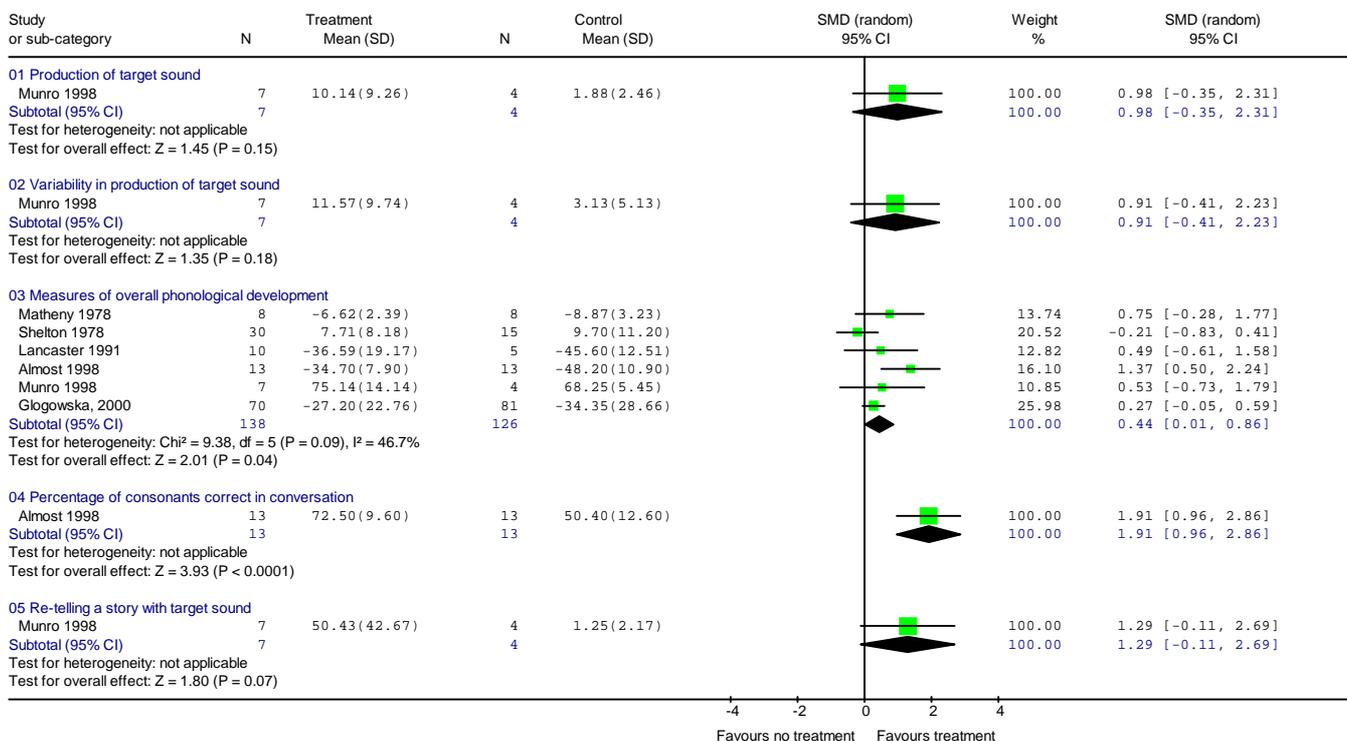Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 01 Expressive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Production of target sound							
Rvachew 2001	24	6.46(8.03)	24	15.54(9.78)		100.00	-1.00 [-1.60, -0.40]
02 Measures of overall expressive phonology development							
Sommers 1962	20	94.04(29.12)	20	50.32(18.06)		13.74	1.77 [1.03, 2.51]
Sommers 1964	40	-116.73(27.11)	40	-137.28(29.56)		16.64	0.72 [0.26, 1.17]
Sommers 1966	108	62.30(24.07)	108	62.10(22.59)		18.12	0.01 [-0.26, 0.28]
Head 1975	14	-42.80(19.75)	14	-30.00(26.49)		13.60	-0.53 [-1.29, 0.22]
Shelton 1978	15	9.10(8.80)	15	6.00(7.50)		13.94	0.37 [-0.35, 1.09]
Lancaster 1991	5	-45.48(17.30)	5	-27.70(18.18)		8.44	-0.90 [-2.25, 0.44]
Rvachew 2001	24	60.48(11.48)	24	62.35(16.74)		15.54	-0.13 [-0.69, 0.44]
03 Percentage of consonants correct in conversation							
Rvachew 2001	24	64.00(11.10)	24	62.62(12.00)		100.00	0.12 [-0.45, 0.68]

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Favours traditional   Favours experimental
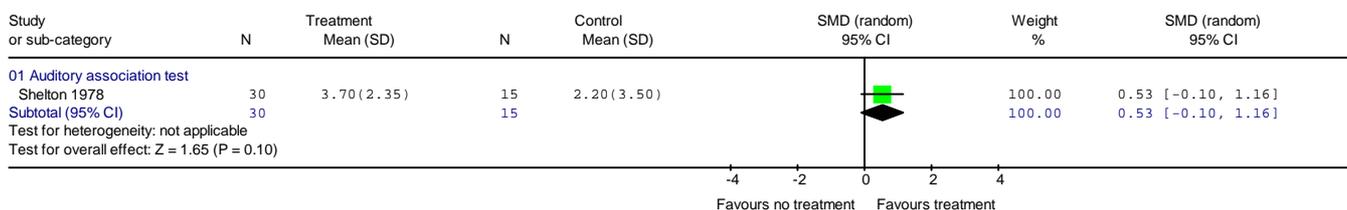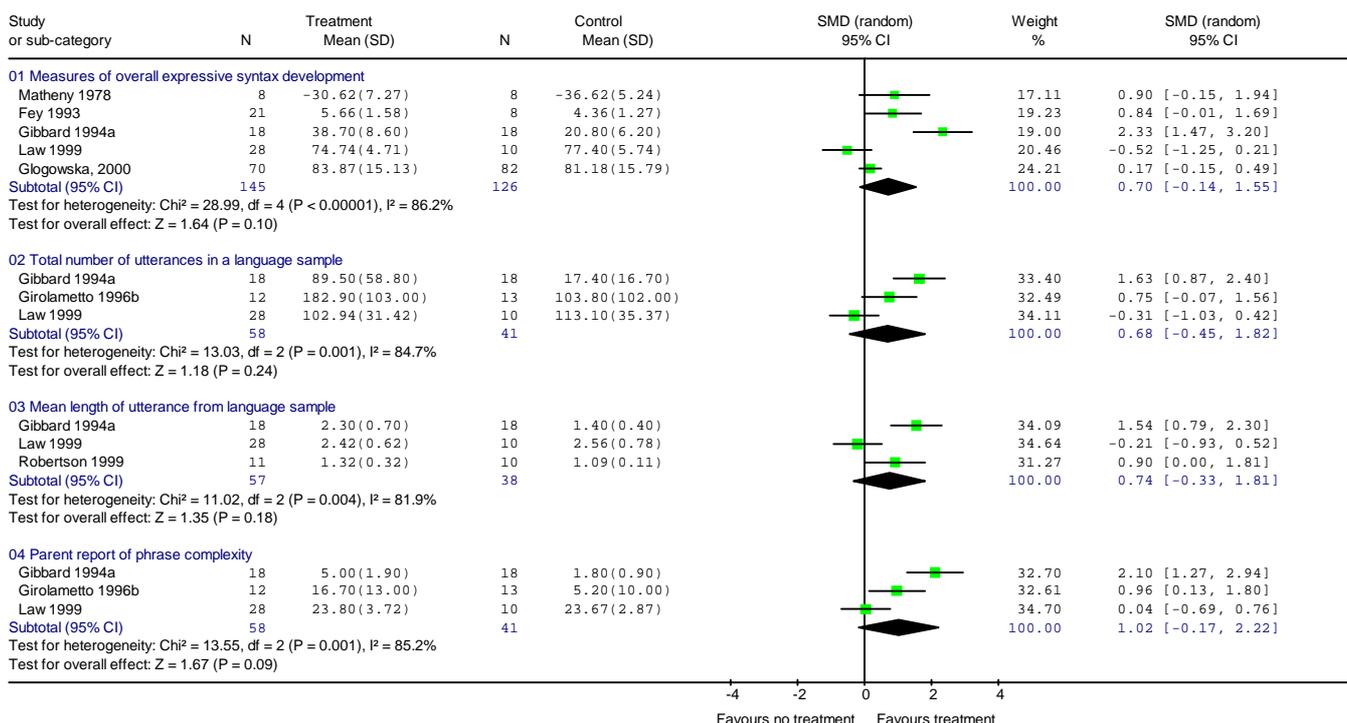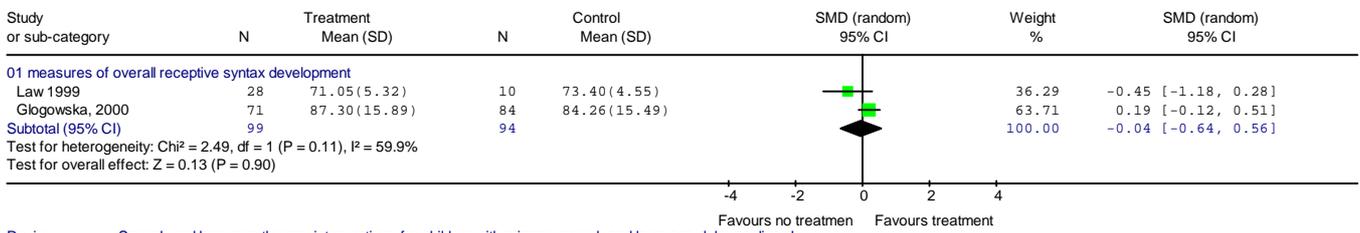
Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 02 Receptive phonology outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Test of Auditory Association							
Shelton 1978	15	3.70(2.40)	15	3.70(2.30)		100.00	0.00 [-0.72, 0.72]
Subtotal (95% CI)	15		15			100.00	0.00 [-0.72, 0.72]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.00 (P = 1.00)							

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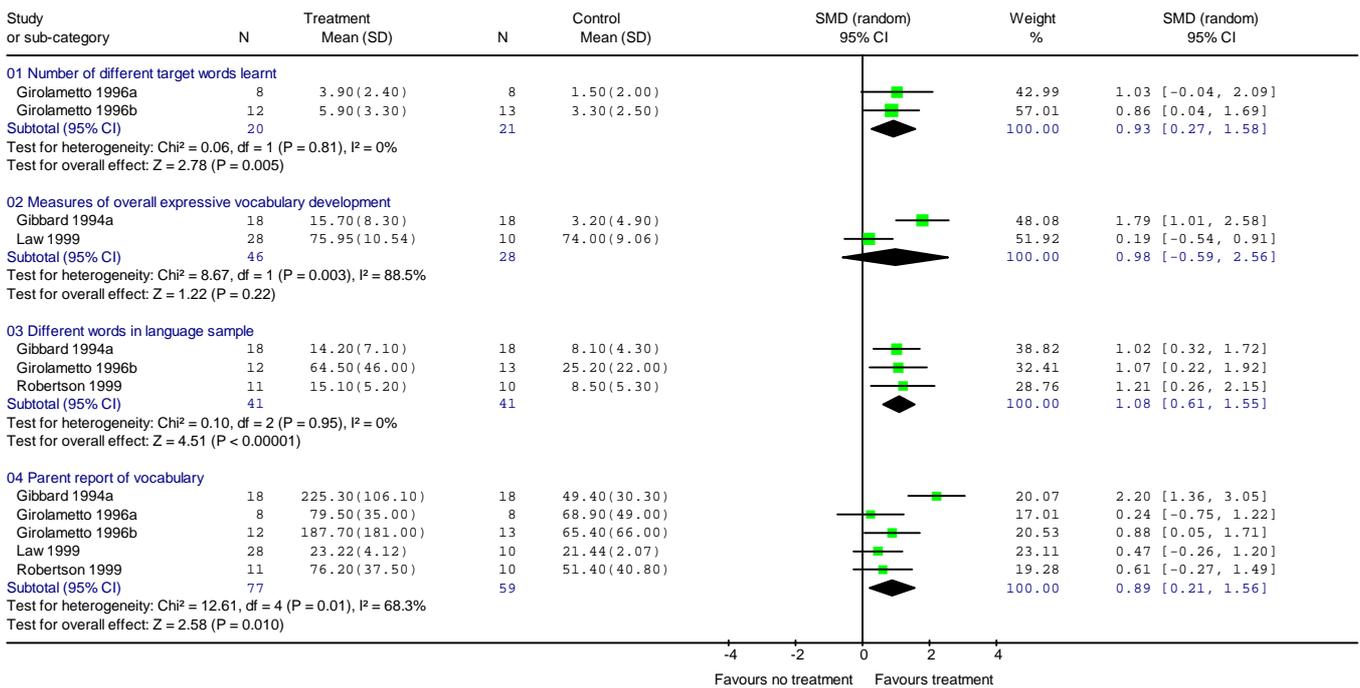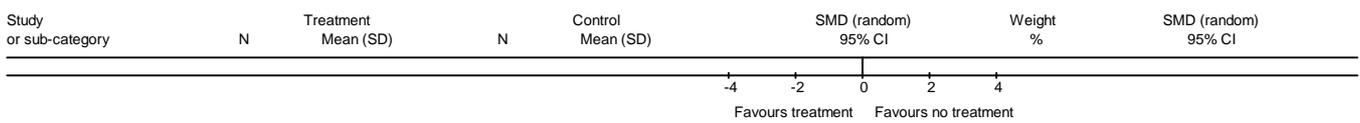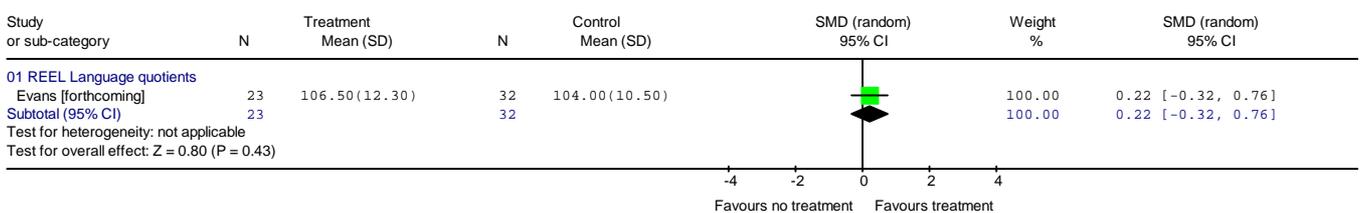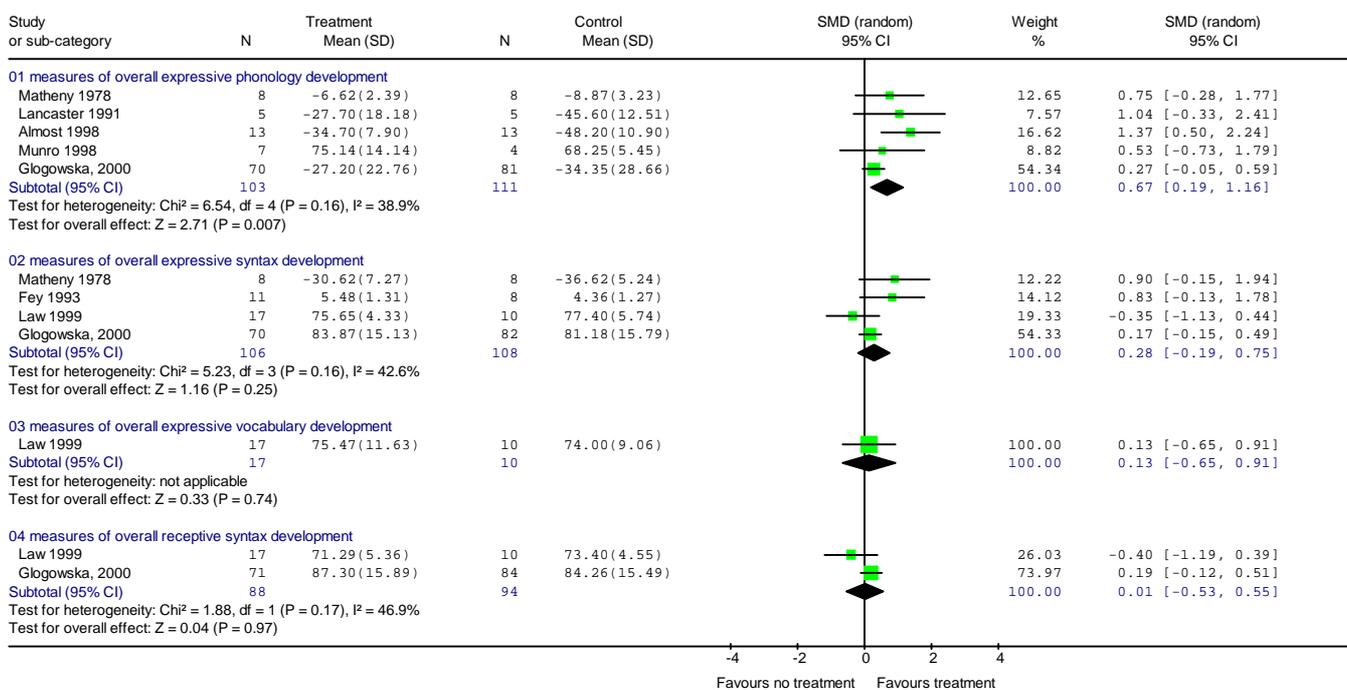Favours traditional   Favours experimental

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 03 Expressive syntax outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Correct utterance of 20 unusual sentences							
Courtwright 1979	12	15.83(4.13)	12	13.08(5.12)		100.00	0.57 [-0.25, 1.39]
Subtotal (95% CI)	12		12			100.00	0.57 [-0.25, 1.39]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.37 (P = 0.17)							
02 Measures of overall expressive syntax development							
Head 1975	14	27.20(4.81)	14	27.40(7.47)		21.05	-0.03 [-0.77, 0.71]
Cole 1986	25	22.58(10.10)	19	25.90(9.57)		29.56	-0.33 [-0.93, 0.27]
Fey 1993	10	5.85(1.83)	11	5.48(1.31)		16.30	0.23 [-0.63, 1.08]
Gibbard 1994b	9	34.60(8.20)	8	31.50(10.40)		13.40	0.32 [-0.64, 1.28]
Law 1999	11	73.27(5.27)	17	75.65(4.33)		19.68	-0.49 [-1.26, 0.28]
Subtotal (95% CI)	69		69			100.00	-0.13 [-0.47, 0.21]
Test for heterogeneity: Chi² = 2.82, df = 4 (P = 0.59), I² = 0%							
Test for overall effect: Z = 0.76 (P = 0.45)							
03 Total utterances from a language sample							
Gibbard 1994b	9	61.30(50.50)	8	42.00(31.80)		39.55	0.43 [-0.54, 1.39]
Law 1999	11	102.46(35.31)	17	103.24(28.73)		60.45	-0.02 [-0.78, 0.73]
Subtotal (95% CI)	20		25			100.00	0.15 [-0.45, 0.74]
Test for heterogeneity: Chi² = 0.52, df = 1 (P = 0.47), I² = 0%							
Test for overall effect: Z = 0.49 (P = 0.63)							
04 Mean length of utterance from a language sample							
Cole 1986	25	3.26(1.36)	19	3.42(1.21)		49.15	-0.12 [-0.72, 0.48]
Gibbard 1994b	9	2.82(0.90)	8	1.84(0.65)		18.65	1.17 [0.12, 2.23]
Law 1999	11	2.20(0.50)	17	2.55(0.69)		32.20	-0.54 [-1.32, 0.23]
Subtotal (95% CI)	45		44			100.00	0.09 [-0.75, 0.93]
Test for heterogeneity: Chi² = 6.80, df = 2 (P = 0.03), I² = 70.6%							
Test for overall effect: Z = 0.21 (P = 0.84)							
05 Parent report of complexity of phrases							
Gibbard 1994b	9	4.90(3.00)	8	3.80(1.70)		39.75	0.42 [-0.54, 1.39]
Law 1999	11	23.20(4.64)	17	24.18(3.01)		60.25	-0.26 [-1.02, 0.51]
Subtotal (95% CI)	20		25			100.00	0.01 [-0.63, 0.66]
Test for heterogeneity: Chi² = 1.16, df = 1 (P = 0.28), I² = 14.0%							
Test for overall effect: Z = 0.04 (P = 0.96)							

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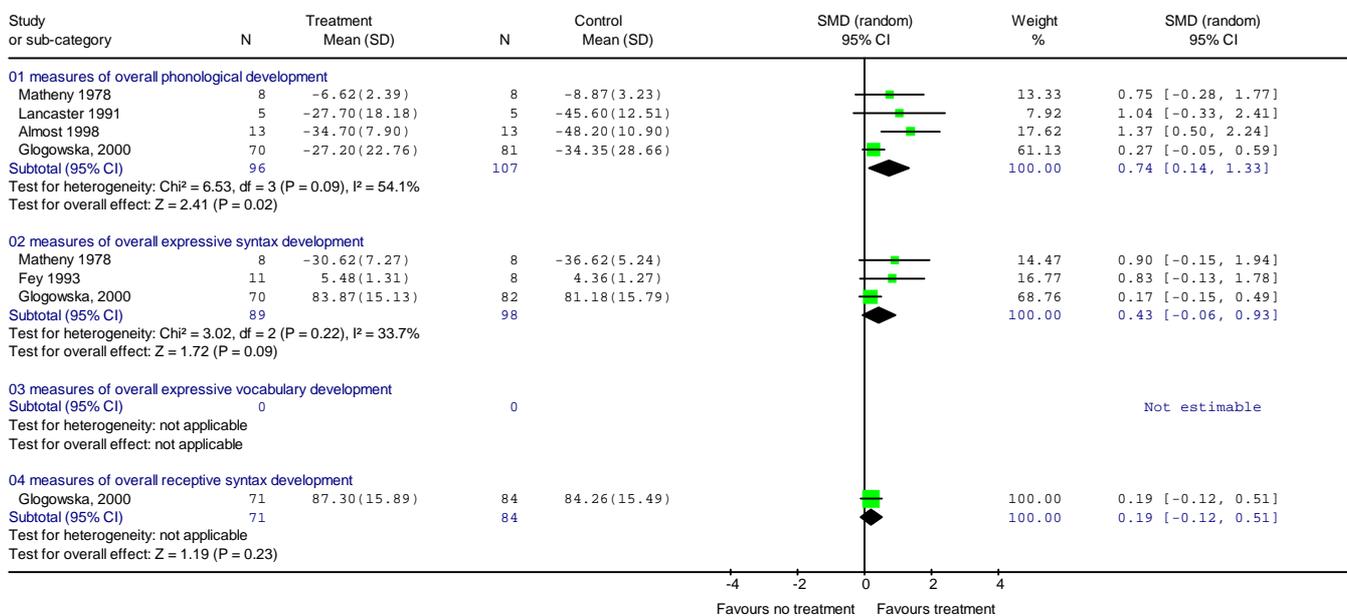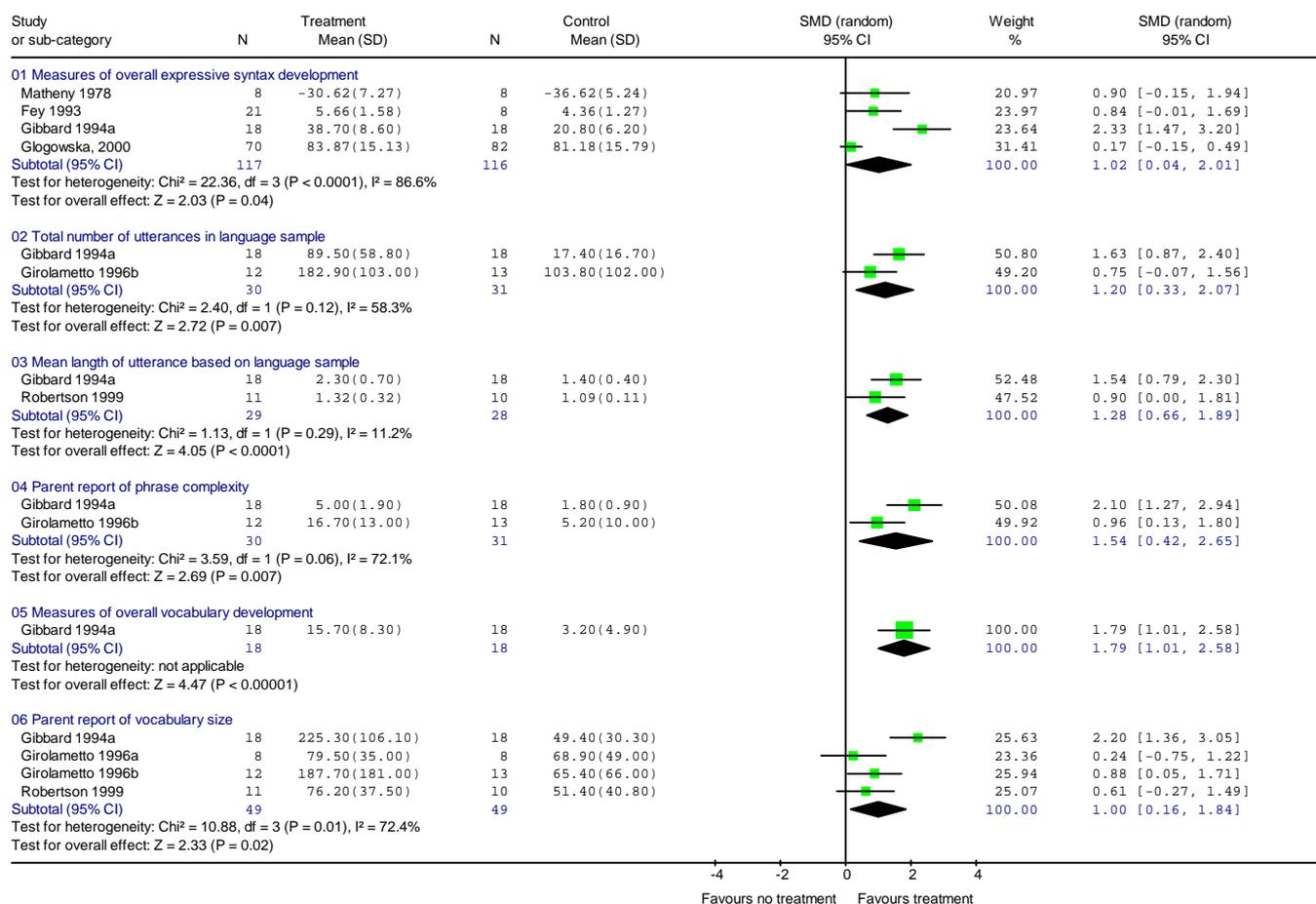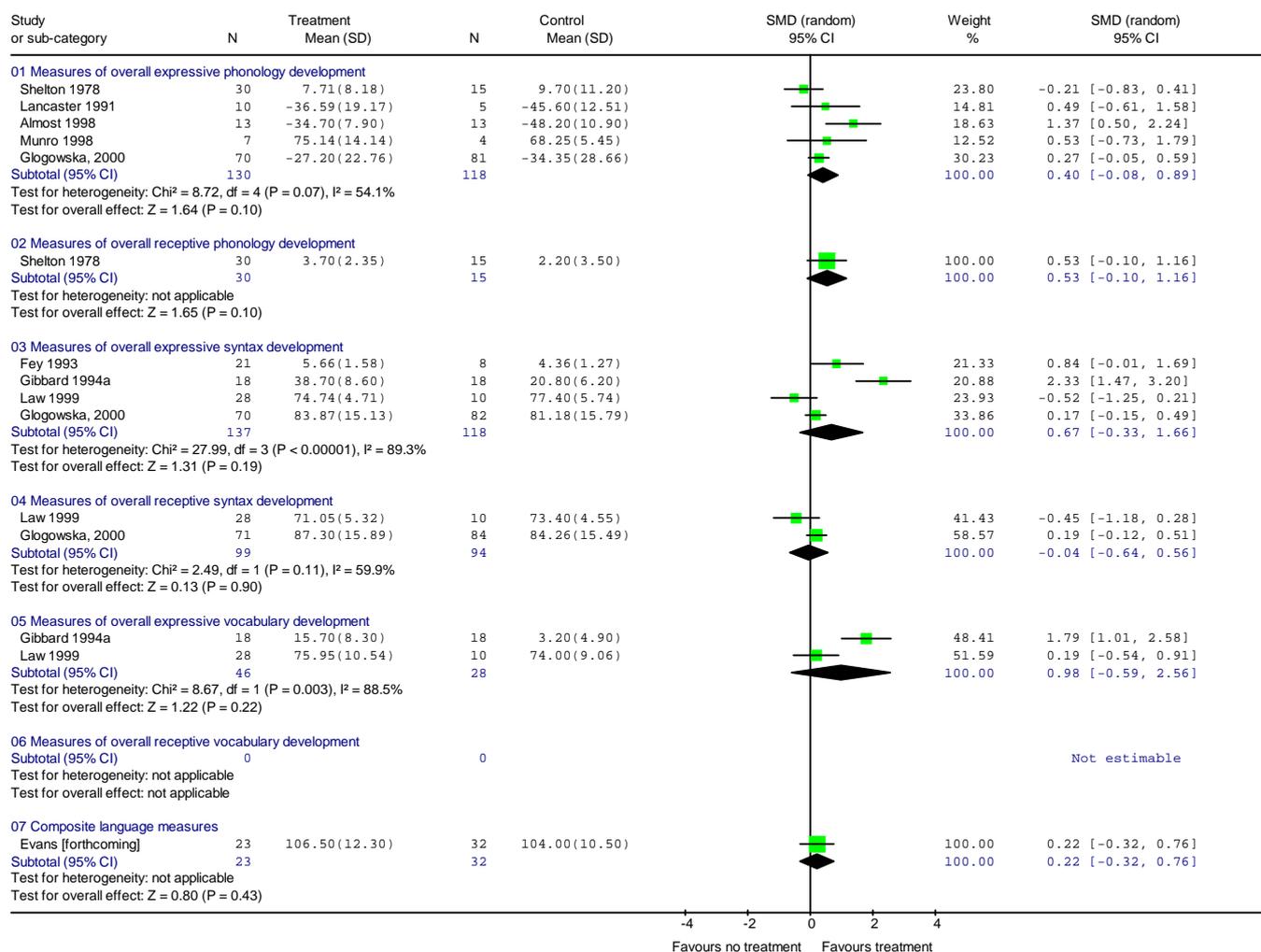Favours traditional   Favours experimental

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 04 Receptive syntax outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall receptove syntax development							
Cole 1986	25	25.17(8.45)	19	27.90(7.44)		58.25	-0.33 [-0.93, 0.27]
Law 1999	11	70.67(5.25)	17	71.29(5.36)		36.51	-0.11 [-0.87, 0.65]
Dixon 2001	2	10.00(4.24)	2	10.50(3.54)		5.24	-0.07 [-2.08, 1.93]

-4   -2   0   2   4
Favours traditional   Favours experimental
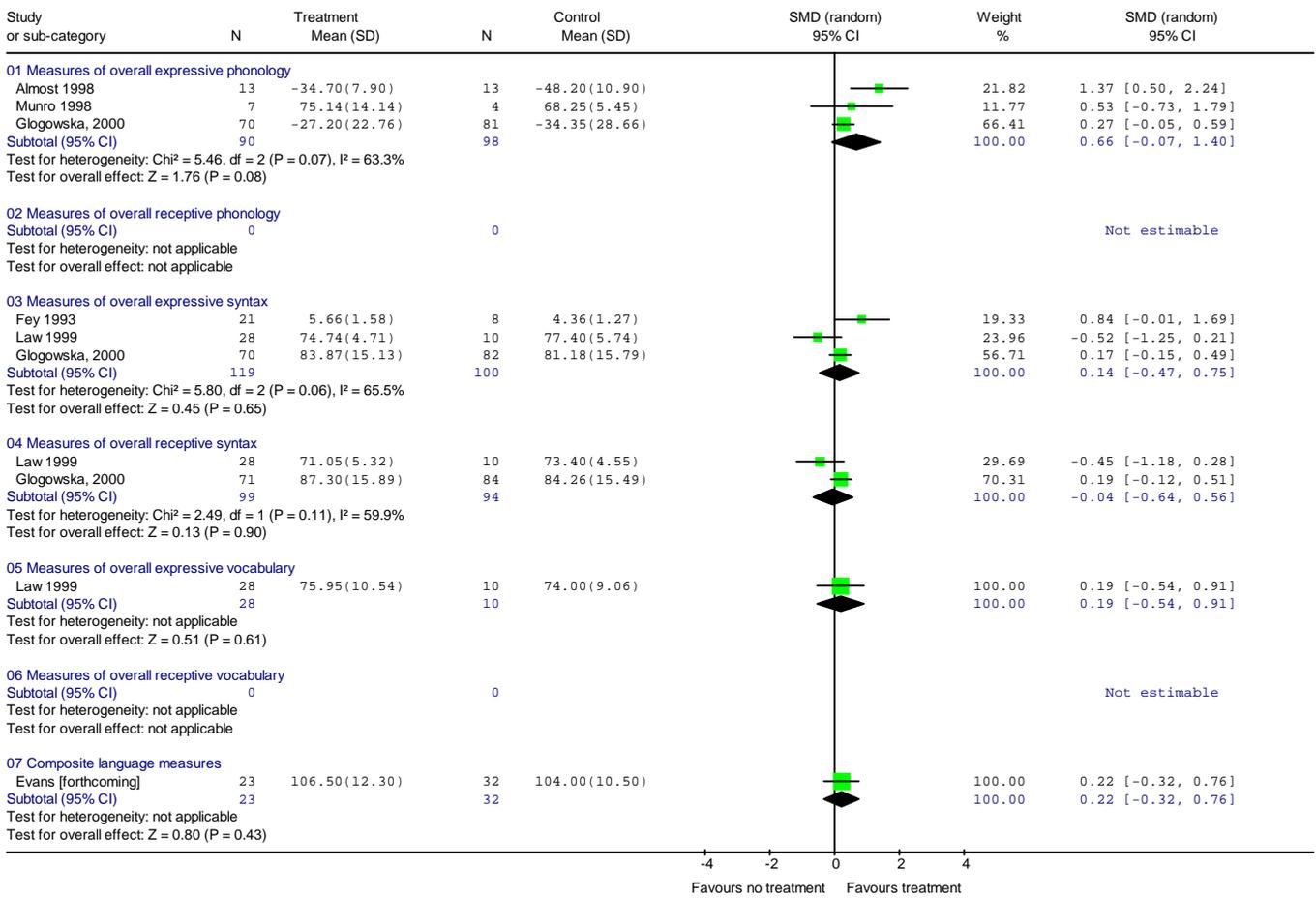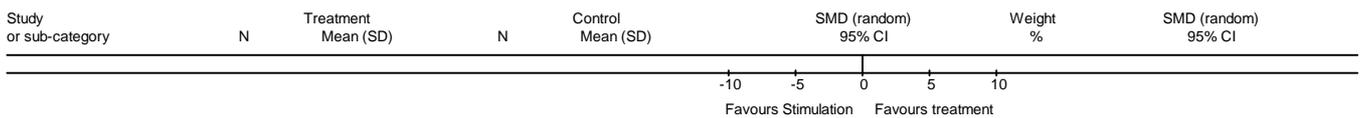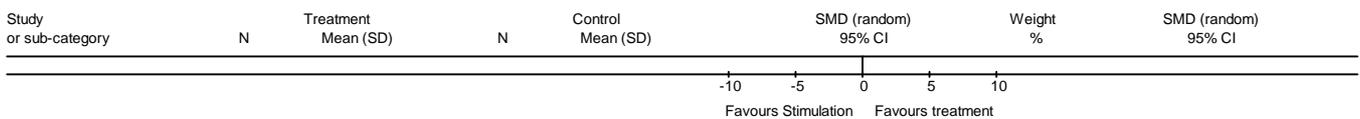
Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 05 Expressive vocabulary outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Overall use of target words in clinic interaction							
Wilcox 1991	10	9.50(4.03)	10	8.10(3.60)		100.00	0.35 [-0.53, 1.24]
Subtotal (95% CI)	10		10			100.00	0.35 [-0.53, 1.24]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.78 (P = 0.44)							
02 Measures of overall expressive vocabulary development							
Gibbard 1994b	9	20.60(12.20)	8	16.50(11.00)		38.42	0.33 [-0.63, 1.29]
Law 1999	11	76.70(8.51)	17	75.47(11.63)		61.58	0.11 [-0.65, 0.87]
Subtotal (95% CI)	20		25			100.00	0.20 [-0.40, 0.79]
Test for heterogeneity: Chi² = 0.12, df = 1 (P = 0.72), I² = 0%							
Test for overall effect: Z = 0.65 (P = 0.51)							
03 Different words in language sample							
Gibbard 1994b	9	7.70(2.30)	8	9.50(4.30)		100.00	-0.50 [-1.48, 0.47]
Subtotal (95% CI)	9		8			100.00	-0.50 [-1.48, 0.47]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 1.02 (P = 0.31)							
04 Parent report of vocabulary size							
Gibbard 1994b	9	236.70(152.00)	8	210.00(232.50)		39.13	0.13 [-0.82, 1.08]
Law 1999	11	22.30(5.46)	17	23.77(2.99)		60.87	-0.35 [-1.11, 0.42]
Subtotal (95% CI)	20		25			100.00	-0.16 [-0.76, 0.44]
Test for heterogeneity: Chi² = 0.59, df = 1 (P = 0.44), I² = 0%							
Test for overall effect: Z = 0.52 (P = 0.60)							

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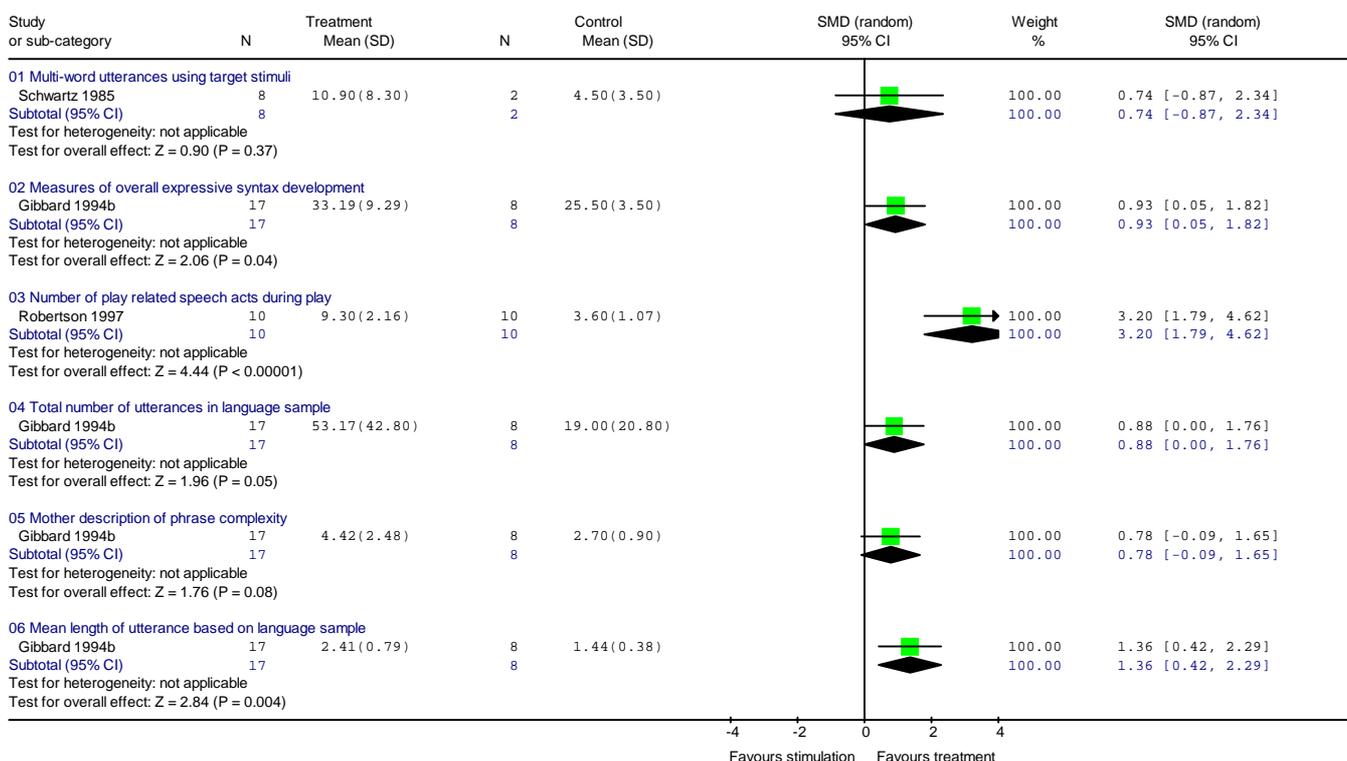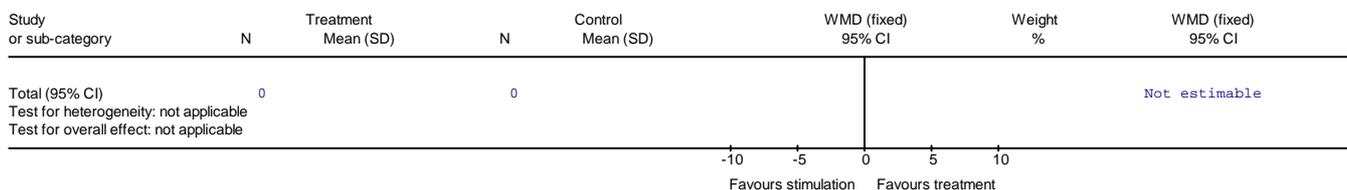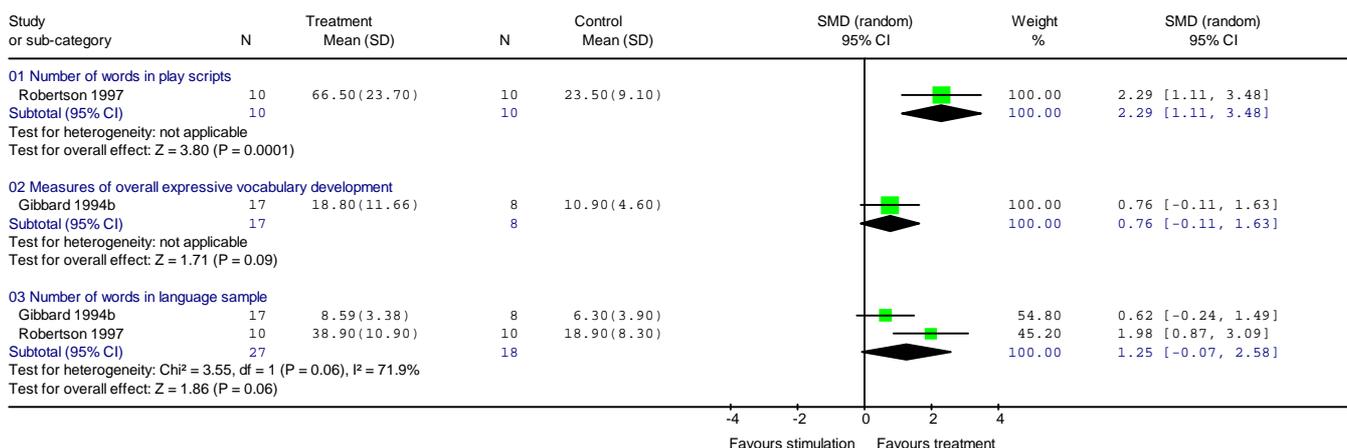Favours traditional   Favours experimental

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 06 Receptive vocabulary outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall vocabulary understanding							
Cole 1986	25	32.71(15.20)	19	35.95(13.60)		100.00	-0.22 [-0.82, 0.38]
Subtotal (95% CI)	25		19			100.00	-0.22 [-0.82, 0.38]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.72 (P = 0.47)							

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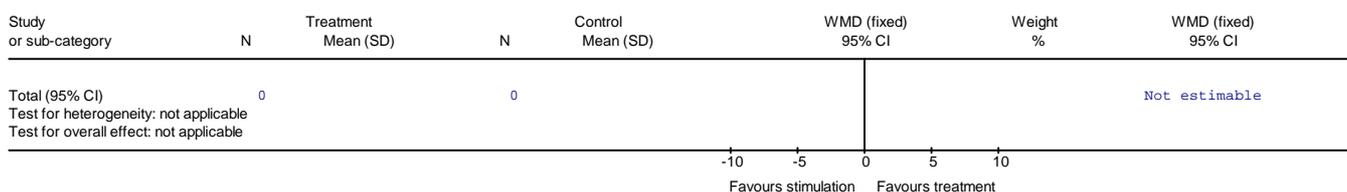Favours traditional   Favours experimental

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 07 Composite language outcomes

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI

-4   -2   0   2   4
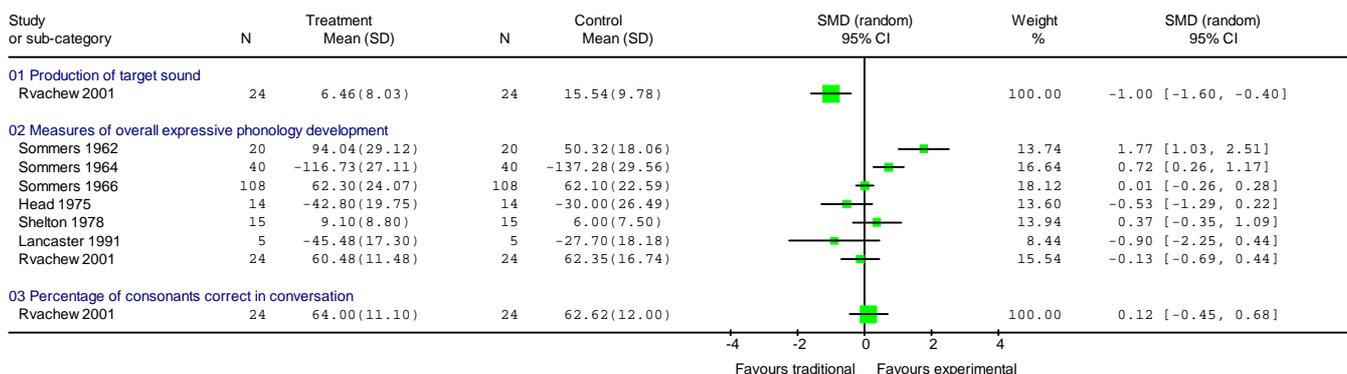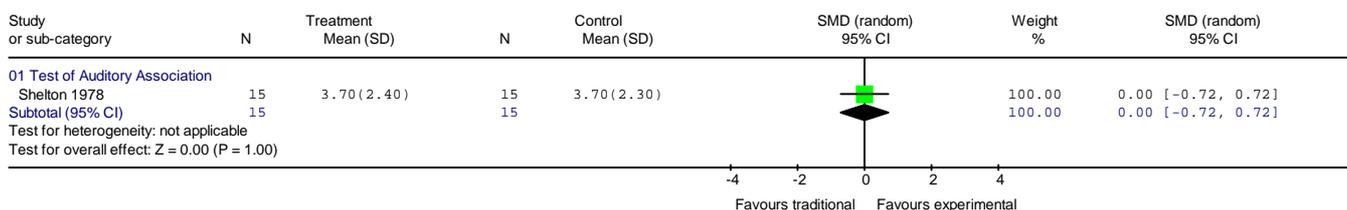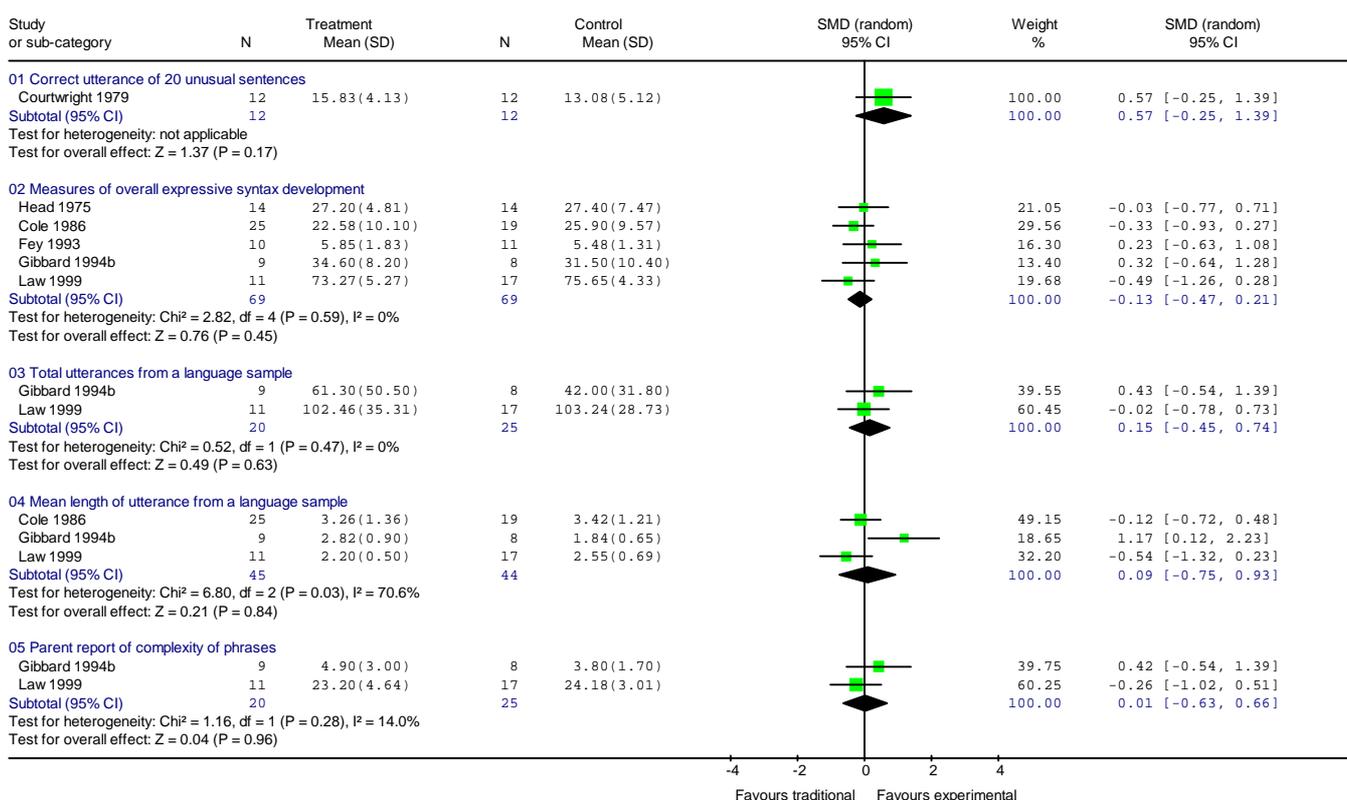Favours traditional   Favours experimental

Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 08 Subgroup analysis (clinician versus parent)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall expressive phonology development							
Sommers 1962	20	94.04(29.12)	20	50.32(18.06)		35.38	1.77 [1.03, 2.51]
Sommers 1964	40	-116.73(27.11)	40	-137.28(29.56)		43.19	0.72 [0.26, 1.17]
Lancaster 1991	5	-45.48(17.30)	5	-27.70(18.18)		21.43	-0.90 [-2.25, 0.44]
Subtotal (95% CI)	65		65			100.00	0.66 [-0.47, 1.80]
Test for heterogeneity: Chi² = 12.80, df = 2 (P = 0.002), I² = 84.4%							
Test for overall effect: Z = 1.14 (P = 0.25)							
02 Measures of overall expressive syntax development							
Fey 1993	10	5.85(1.83)	11	5.48(1.31)		33.40	0.23 [-0.63, 1.08]
Gibbard 1994b	9	34.60(8.20)	8	31.50(10.40)		30.73	0.32 [-0.64, 1.28]
Law 1999	11	73.27(5.27)	17	75.65(4.33)		35.87	-0.49 [-1.26, 0.28]
Subtotal (95% CI)	30		36			100.00	-0.04 [-0.56, 0.48]
Test for heterogeneity: Chi² = 2.21, df = 2 (P = 0.33), I² = 9.3%							
Test for overall effect: Z = 0.14 (P = 0.89)							
03 Measures of overall expressive vocabulary development							
Gibbard 1994b	9	20.60(12.20)	8	16.50(11.00)		45.89	0.33 [-0.63, 1.29]
Law 1999	11	76.70(8.51)	17	75.47(11.63)		54.11	0.11 [-0.65, 0.87]
Subtotal (95% CI)	20		25			100.00	0.20 [-0.40, 0.79]
Test for heterogeneity: Chi² = 0.12, df = 1 (P = 0.72), I² = 0%							
Test for overall effect: Z = 0.65 (P = 0.51)							
04 Measures of overall receptive syntax development							
Law 1999	11	70.67(5.25)	17	71.29(5.36)		100.00	-0.11 [-0.87, 0.65]
Subtotal (95% CI)	11		17			100.00	-0.11 [-0.87, 0.65]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.29 (P = 0.77)							

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        Favours clinician   Favours parent
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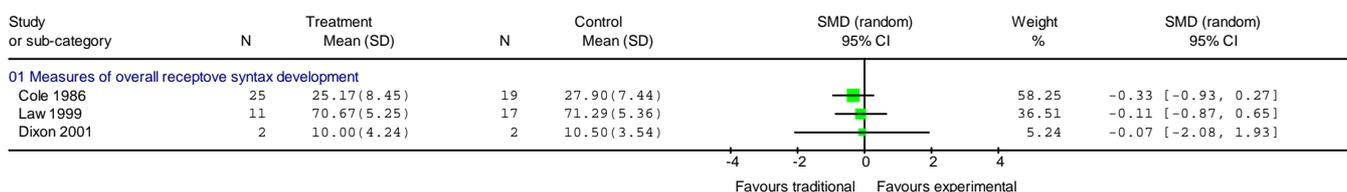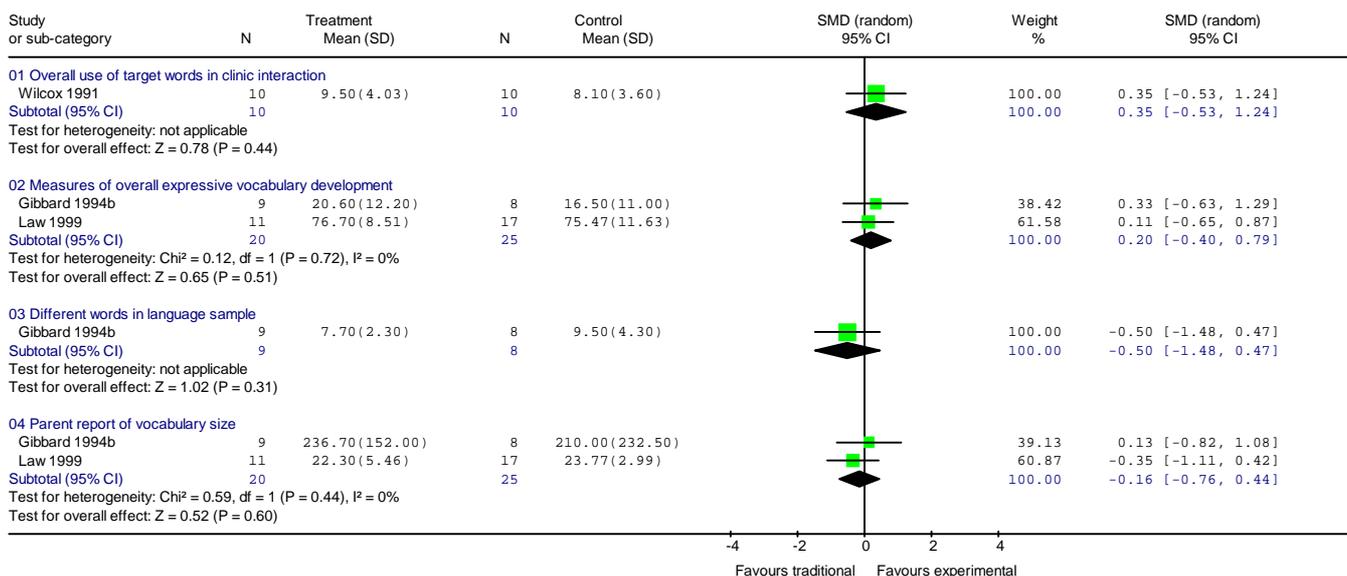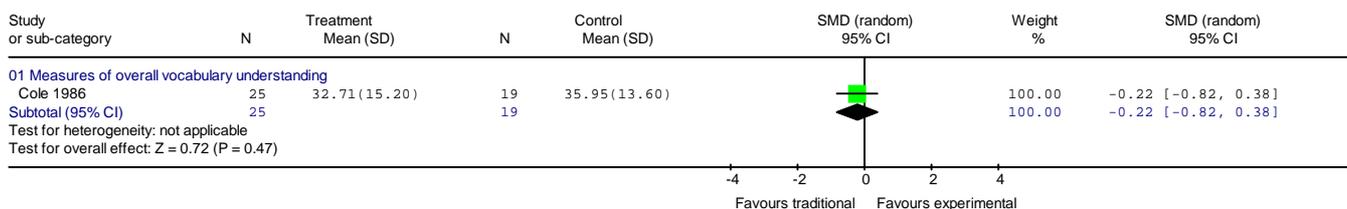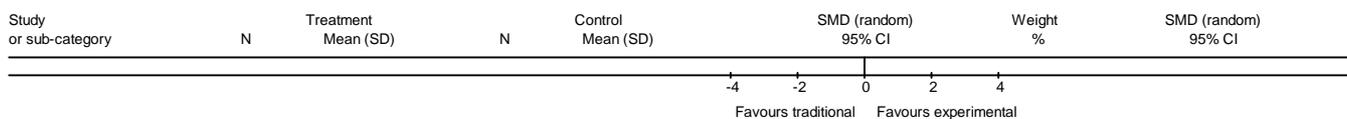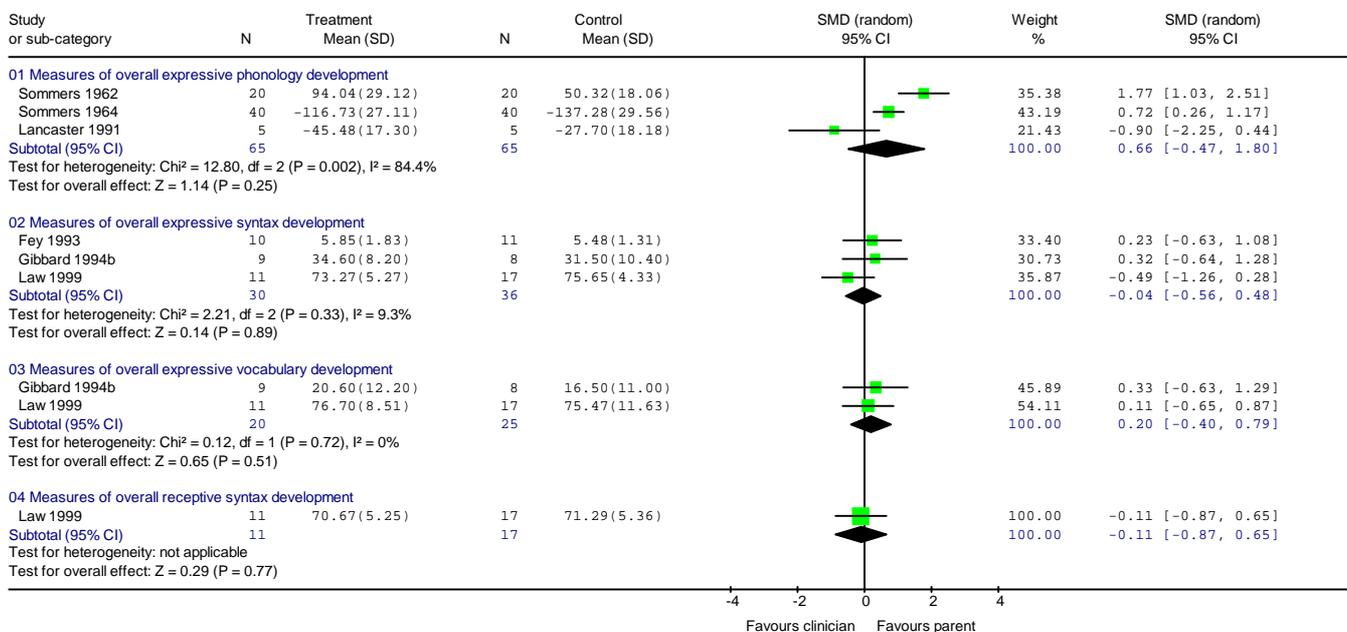
Review: Speech and language therapy interventions for children with primary speech and language delay or disorder
Comparison: 03 Speech and language interventions versus traditional speech and language programmes
Outcome: 09 Subgroup analysis (excluding data from children with expressive and receptive difficulties)

Study or sub-category	N	Treatment Mean (SD)	N	Control Mean (SD)	SMD (random) 95% CI	Weight %	SMD (random) 95% CI
01 Measures of overall syntax development							
Fey 1993	10	5.85(1.83)	11	5.48(1.31)		55.50	0.23 [-0.63, 1.08]
Gibbard 1994b	9	34.60(8.20)	8	31.50(10.40)		44.50	0.32 [-0.64, 1.28]
Subtotal (95% CI)	19		19			100.00	0.27 [-0.37, 0.91]
Test for heterogeneity: Chi² = 0.02, df = 1 (P = 0.89), I² = 0%							
Test for overall effect: Z = 0.81 (P = 0.42)							
02 Total number of utterances in a language sample							
Gibbard 1994b	9	61.30(50.50)	8	42.00(31.80)		100.00	0.43 [-0.54, 1.39]
Subtotal (95% CI)	9		8			100.00	0.43 [-0.54, 1.39]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.87 (P = 0.39)							
03 Mean length of utterance derived from a language sample							
Gibbard 1994b	9	2.82(0.90)	8	1.84(0.65)		100.00	1.17 [0.12, 2.23]
Subtotal (95% CI)	9		8			100.00	1.17 [0.12, 2.23]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 2.18 (P = 0.03)							
04 Parent report of phrase complexity							
Gibbard 1994b	9	4.90(3.00)	8	3.80(1.70)		100.00	0.42 [-0.54, 1.39]
Subtotal (95% CI)	9		8			100.00	0.42 [-0.54, 1.39]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.85 (P = 0.39)							
05 Measures of overall vocabulary development							
Gibbard 1994b	9	20.60(12.20)	8	16.50(11.00)		100.00	0.33 [-0.63, 1.29]
Subtotal (95% CI)	9		8			100.00	0.33 [-0.63, 1.29]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.68 (P = 0.50)							
06 Parental report of vocabulary size							
Gibbard 1994b	9	236.70(152.00)	8	210.00(232.50)		100.00	0.13 [-0.82, 1.08]
Subtotal (95% CI)	9		8			100.00	0.13 [-0.82, 1.08]
Test for heterogeneity: not applicable							
Test for overall effect: Z = 0.27 (P = 0.79)							

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         -4    -2     0     2     4
        Favours traditional   Favours experimental
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