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Research Report

Cost analysis of direct versus indirect and individual versus group modes of manual-based speech-and-language therapy for primary school-age children with primary language impairment

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Abstract

Background: The study is the first within trial cost analysis of direct versus
indirect and individual versus group modes of speech-and-language therapy for
children with primary language impairment.
Aims: To compare the short-run resource consequences of the four
interventions alongside the effects achieved measured by standardized scores
on a test of expressive and receptive language.
Methods & Procedures: The study design was a cost analysis integrated within a
randomized controlled trial using a 2×2 factorial design (direct/indirect versus
individual/group therapy) together with a control group that received usual levels
of community-based speech-and-language therapy. Research interventions were
delivered in school settings in Scotland, UK. Children aged between 6 and 11 years,
attending a mainstream school, with standard scores on the Clinical Evaluation of
Language Fundamentals (CELF-III[UK]) of less than -1.25 standard deviation (SD)

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(receptive and/or expressive) and non-verbal IQ on the Wechsler Abbreviated Scale of Intelligence (WASI) above 75, and no reported hearing loss, no moderate/ severe articulation/phonology/dysfluency problems or otherwise requiring individual work with a speech-and-language therapist. The intervention involved speech-and-language therapists and speech-and-language therapy assistants working with individual children or small groups of children. A therapy manual was constructed to assist the choice of procedures and activities for intervention. The cost analysis focused on the salary and travel costs associated with each mode of intervention. The cumulative distribution of total costs arising from the time of randomization to post-intervention assessment was estimated. Arithmetic mean costs were compared and reported with their 95% confidence intervals.

Outcomes & Results: The results of the intention-to-treat analysis revealed that there were no significant post-intervention differences between direct and indirect modes of therapy, or between individual and group modes on any of the primary language outcome measures. The cost analysis identified indirect therapy, particularly indirect group therapy, as the least costly of the intervention modes with direct individual therapy as the most costly option. The programme cost of providing therapy in practice over 30 weeks for children could represent between 30% and 75% of the total gross revenue spend in primary school per pupil, depending on the choice of assistant led group therapy or therapist-led individual therapy.

Conclusions & Implications: This study suggests that speech-and-language therapy assistants can act as effective surrogates for speech-and-language therapists in delivering cost-effective services to children with primary language impairment. The resource gains from adopting a group-based approach may ensure that effective therapy is provided to more children in a more efficient way.

Keywords: Speech-and-language therapy, primary language impairment, manual therapy, cost, cost-effectiveness, economics, economic evaluation.

What this paper adds

What is already known on this subject

Few studies have considered the cost-effectiveness of different ways of delivering effective speech-and-language therapy for children with primary language impairment. No study has examined the relative cost of using speech-and-language therapy assistants versus speech-and-language therapists working with children either individually or in groups in a trial designed to assess the effects on primary language outcomes.

What this study adds

This study, using a detailed analysis of resource consequences within a randomized controlled trial of different therapy interventions, demonstrates that speech-and-language therapy assistants can act as effective surrogates for speech-and-language therapists in delivering cost-effective services to children with primary language impairment.

Background

As with other National Health Service (NHS) services, speech-and-language therapy is faced with financial and resource constraints. Those who plan, provide and pay

for health services are expected to determine not only the efficacy, effectiveness and availability of any service, but also whether the provision of the service makes the best use of the scarce resources that are available (Drummond *et al.* 2005). Whilst there are many published papers that explore the efficacy, effectiveness and availability of speech-and-language therapy there are a much smaller number that consider the economic aspects of service provision (Gibbard *et al.* 2004, Law *et al.* 2006). The present paper seeks to present a cost analysis of a randomized controlled trial (Boyle *et al.* 2007) that explored the efficacy and effectiveness of manual-based therapy for primary school-age children with primary language impairment delivered by a speech-and-language therapist (SLT), direct therapy, or speech-and-language therapy assistant (SLTA), indirect therapy, in a group or individual setting.

Speech and language delays are amongst the most common developmental problems of childhood affecting some 6% of children overall (Law *et al.* 2000). Some 30–60% of children with a primary language impairment that cannot be accounted for in terms of non-verbal ability, behaviour or emotional problems, hearing or neurological impairments may experience difficulties in school achievement or social, emotional or behavioural problems which persist into adolescence and beyond. Language skills are an important component of human capital. Investing in children when they are young may lead to an increase in expected returns. There are studies that focus on the returns to language skills in terms of labour market outcomes such as earnings and employment (Barnett *et al.* 1988, Eiserman *et al.* 1990) and the potential long-term economic impact of not investing in these children at an early age.

Questions about the best way to deliver a service, where best refers to the efficacy, effectiveness and availability, are considered within the development of the primary aims of the randomized controlled trial (RCT). The trial revealed that there were no significant post-intervention differences between direct and indirect modes of therapy or between group and individual modes for the primary language outcome measure. Full results from the study are published in Boyle *et al.* (2007). This paper presents the within trial cost analysis of the therapy options evaluated in the RCT. The economic evaluation was designed to assess the short-run primary language and resource consequences following the different modes of therapy. Treatment costs were used to measure resource consequences of the trial.

The trial showed that, compared with controls, children receiving project therapy made short-term improvements in expressive ($p=0.031$), but not receptive, language immediately following intervention. Children with specific expressive language delay were more likely to show improvement than those with mixed receptive–expressive difficulties. The four modes did not differ on language outcomes (all $p>0.392$) and there were no improvements evident at follow-up.

Description

Trial

The study design was an RCT with a 2×2 factorial design (direct/indirect versus individual/group therapy). Eligible children were randomly allocated to one intervention arm of the study. Eligibility criteria for inclusion in the study were as follows:

- Aged between 6 and 11 years.
- Attend mainstream school.
- Standardized score on the CELF-III[UK] receptive or expressive language scales of < -1.25 SD and a non-verbal IQ on the Wechsler Abbreviated Scale of Intelligence (WASI) >75.
- No reported hearing loss.
- No moderate/severe articulation/phonology/disfluency problems requiring the specialist skills of an SLT.

Children were assessed at baseline by the project team and by SLTs blind to the intervention arm thereafter. The participants in the study were children with a primary language impairment attending mainstream primary schools in either Glasgow and surrounding areas or Edinburgh. Participants were referred to the project by local speech-and-language therapy services, paediatricians or local authority educational psychologists. All of the children were known to speech and language services.

Intervention

Therapy was provided in school settings with some of the children randomized to group therapies, where necessary children were transported from their school to join their therapy group in a different school. Therapy was delivered through the application of interventions outlined in a manual that had been developed to meet the needs of the research population. The manual was constructed to guide the therapy offered, and was designed to be used both by the research SLTs and their SLT assistants. The manual was not designed as a 'do-it-yourself' therapy kit, a 'cookbook' of therapy activities or a complete therapy programme – it did not spell out each step of the therapeutic process, and there was considerable room for therapists' judgement to be used. It was intended as a guiding protocol, to ensure that the therapy received by the research children could be planned coherently. The manual proved helpful in facilitating therapy planning, language target setting, explanation to assistants and record keeping during the research intervention period. It was designed to support assistants who had undergone training, and who worked under the close direction of SLTs. Assistants delivered therapy, but did not have a decision-making role: the research SLTs decided upon the therapy activities to be used with each child, and when to move on to new activities. The following areas of language intervention were included; comprehension monitoring, vocabulary development, grammar and narrative therapy. The process through which the manual was constructed, its rationale and theoretical basis and the therapy programmes adapted are described in McCartney *et al.* (2004). An online version edited from the informal format used by the research team is available at: http://www.strath.ac.uk/media/media_100682_en.pdf/.

The care aim was habilitative. The children's language impairments were broadly specified by the eligibility criteria but specific language needs were predicted to vary and language therapy had to be flexible to adapt to each child's needs whilst being specified sufficiently carefully to provide comparable child experiences. Detailed target setting within areas was decided upon by SLTs for each child at the start of each intervention period and reviewed as progress was made.

Children were scheduled to receive therapy for 30 min, three times a week over a 15-week period. This applies to all four modes of therapy in the intervention groups. If children attained 100% attendance they would have received 45 therapy sessions.

Economic evaluation

The economic evaluation was designed to assess the short-run primary language and resource consequences following the different modes of therapy. A short-run cost consequence analysis was carried out using the change in CELF-III^{UK} total language score from T1 (baseline) to T2 (6.6 completed months) and from T2 to T3 (18.7 completed months) as the primary outcome measure. Analyses across the therapy modes and between the possible two-way choices were performed with appropriate statistical tests for significance where required. Marginal analysis, exploring the mean cost and change in outcome by therapy mode is also provided.

Methods

Participants

The cost analysis in this paper refers to the 124 children who were randomized to one of the four research intervention arms of the trial and 28 children who received standard therapy who were treated as a control group. Figure 1 shows the flow of participants through the trial.
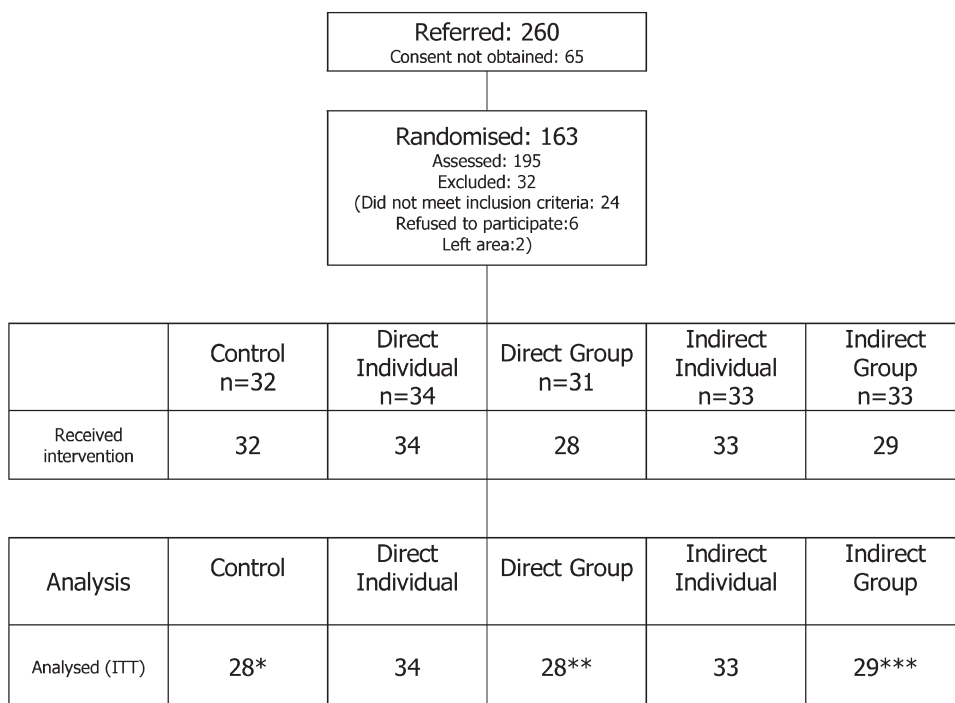
Assessment measures

Standardized scores on the CELF-III^{UK} (receptive, expressive and composite) are the primary outcome measure of the study. Secondary outcome measures were scores on the BPVS II of receptive vocabulary, together with questionnaires, rating scales and focus group data from parents, teachers and project SLTs and SLTAs. All analyses were carried out on the basis of intention to treat using the perspective of the individual child for the primary outcome measure and the teaching setting for resource use.

Resource use and costs

The cost of delivering the therapy had two components. The first was the salary cost associated with each mode of delivery and the second was the travel cost associated with the delivery method.

Salary costs

The salary costs had three elements. The first was the time spent actually delivering the therapy by either the therapist (direct) or the assistant (indirect). The second was the preparation time for the therapist and/or assistant, as relevant, associated with each child. The third was the travel time for the therapists and assistants to the centres where the intervention was delivered.

| Referred: 260 |
| Consent not obtained: 65 |

| Randomised: 163 |
| Assessed: 195 |
| Excluded: 32 |
| (Did not meet inclusion criteria: 24 |
| Refused to participate:6 |
| Left area:2) |

	Control n=32	Direct Individual n=34	Direct Group n=31	Indirect Individual n=33	Indirect Group n=33
Received intervention	32	34	28	33	29

Analysis	Control	Direct Individual	Direct Group	Indirect Individual	Indirect Group
Analysed (ITT)	28*	34	28**	33	29***

*Within the control group 1 child was randomised with an IQ outwith admission criteria, 2 children were lost at 1 year follow-up and one child left the area.

**Within the direct group 2 children's ages were outwith admission criteria and 1 child was lost at 1 year follow-up.

***Within the indirect group 2 children's ages were outwith admission criteria, 1 child was randomised with an IQ outwith admission criteria and 1 child was lost at 1 year follow-up.

Figure 1. Trial participants.

The salary costs for SLTs were based on NHS salaries (2004/2005) at the midpoint of the scale for a Band 2 SLT. This salary range is from £20 474 to £30 302. The gross costs to the NHS employer, including National Insurance (NI) contributions and superannuation is £30 270. For the assistants it was based on the midpoint of a SLTA scale. The 2004/2005 salary for this grade was from £11 195 to £12 815 (NHS 2004). The gross cost to the employer at the midpoint of the scale is £14 280. The hourly rate calculated assumed a 37-hour working week.

The salary costs for the delivery of the therapy are based on the actual attendance of the children in groups, and scheduled attendance for those receiving individual therapy. Although variation in attendance is mainly due to child absence from school, different assumptions are made about groups and individual therapy modes. It is assumed that the time scheduled for direct therapy could not always be productively reallocated if a child was absent at short notice, and that non-attendance by a child in individual therapy represents a real time cost to the therapist or assistant. It is further assumed that group sessions would run productively even if a child or children were absent. However, experience during the trial period was that SLT/As were able to attend to other tasks such as preparation or report writing when they were told that an individual mode child could not attend, and group

mode children who miss sessions still have to receive intervention later. The salary costs for the delivery of therapy should be considered in this light.

The costs of non-contact time are associated with preparation for the therapy sessions. These are based on the number of sessions scheduled for each child, rather than the number actually attended. Using the information from the study regarding the length of time that was allocated to the therapists for preparation, the average non-contact time per scheduled session was calculated as just under 9 min (8.73 min). The preparation time allocated to SLTAs was approximately 14 min for each scheduled session.

Travel costs

Therapists and assistants travelled to the various locations around both cities to deliver the therapy. An estimation of the cost of travel time for therapists and assistants was based on travel to the five therapy centres used in Edinburgh and eleven locations in Glasgow from a central base in each city as appropriate.

The travel arrangements put in place for the trial impacted on the travel, and subsequently, total costs. Transport to group therapy locations for children was by escorted taxi. Standard regulated hackney cabs ('black taxis') were used in both cities. SLT/As travelled by car, except in cases of emergency, illness or breakdown, using a fixed mileage rate. The extent and pattern of transportation necessitated by the randomization is unlikely to be replicated in future therapeutic provision.

The travel costs for children are based on the cost of a return journey by taxi from the primary school they attended to the nearest therapy location, for each session attended. The cost of transport of the therapists, for each session given, is based on a return journey from a central base in each city to the nearest school where a group was held in Edinburgh and in Glasgow. The costs for both Glasgow and Edinburgh journeys are based on the published price of the taxi tariff published by the City of Edinburgh Council (2004). Although the actual travel costs incurred included the additional cost of the escorts who accompanied the children on each journey, Lothian Educational Authority advised that they would normally charge for this type of service on a contractual basis and could not supply a unit cost. The cost of escorts are therefore not included here.

The full sample method was used to summarize the cumulative distribution of within trial total (therapy and travel) costs arising from the time of randomization to follow-up at T2 using arithmetic mean costs observed for all children. Confidence intervals for estimated untransformed arithmetic mean costs were estimated analytically and empirically using bootstrapping techniques to check for the adequacy of the assumptions made regarding the normality of the cost distributions.

Analysis

The cost analysis focused on the salary and travel costs associated with each mode of intervention. The cumulative distribution of total costs arising from the time of randomization to post-intervention assessment was estimated. Arithmetic mean costs were compared and reported with their 95% confidence intervals. Individual cost of therapy for each child against their primary outcome measure and marginal analysis using the mean costs and change in outcome is also shown.

Results

This analysis focuses on the short-run resource consequences between T1 and T2. When comparisons are made between the difference in costs and therapy outcomes across the different therapy modes we use the change in total CELF-III^{UK} score for each child between time periods T1 and T2 as the outcome measure, as there was no significant difference between receptive and expressive scores across these four modes.

Mean costs and cost differences

Average (arithmetic mean) salary, travel and total costs are presented in table 1. The average costs refer to the cost per child excluding those lost at T2 follow-up.

Average salary costs are higher for therapists thus the highest average cost per child in terms of salary cost was incurred by children being treated on an individual basis by a therapist, £690. The lowest average salary cost per child was incurred by those treated in a group by a therapist, £262. The average travel costs were higher for those children seen on an individual basis, £455 and £442 for modes 2 and 4, respectively. Group treatment resulted in decrease in travel cost, £257 and £225 for modes 3 and 5, respectively. The average total cost per child for the 15-week therapy duration was highest for children receiving individual therapy from a trained therapist, £1144 (mode 2). The lowest cost per child for the duration of the therapy was for the children who were treated in a group by a SLTA, £493 (mode 5). The overall average cost per child, across all the therapy modes, was £786. Analysis using ANOVA shows that there is a statistically significant difference in the average total cost across the five modes ($\alpha = 0.05$). We also calculated confidence intervals based on simultaneous estimation of the ratios formed by contrasting the costs of all of the pairwise treatment comparisons. Graphical visualization of the cost ratios is presented in figure 2. When the cost ratio is less (greater) than one the costs of the numerator treatment is less (greater) than the costs of the denominator treatment. When the 95% confidence interval spans 1 there is no significant difference in the

Table 1.   Average salary, travel and total programme cost by therapy mode

		Direct		Indirect	
	1. Control	2. Individual	3. Group	4. Individual	5. Group
Salary cost*	(*n*=28)	(*n*=34)	(*n*=28)	(*n*=33)	(*n*=29)
Average (£)	102	690	262	457	268
(95% CI)	(30, 174)	(643, 736)	(236, 289)	(433, 482)	(250, 286)
Travel cost**					
Average (£)	79	455	257	442	225
(95% CI)	(25, 134)	(408, 501)	(216, 298)	(395, 490)	(189, 262)
Total cost					
Average (£)	181	1144	519	900	493
(95% CI)	(56, 307)	(1057, 1232)	(461, 578)	(837, 963)	(445, 542)

*Based on National Health Service (NHS) (2004) midpoint salary costs for Grade 2 speech and language therapist, including employer costs.
**Based on taxi tariff set by Licensing Committee, City of Edinburgh Council (2004).

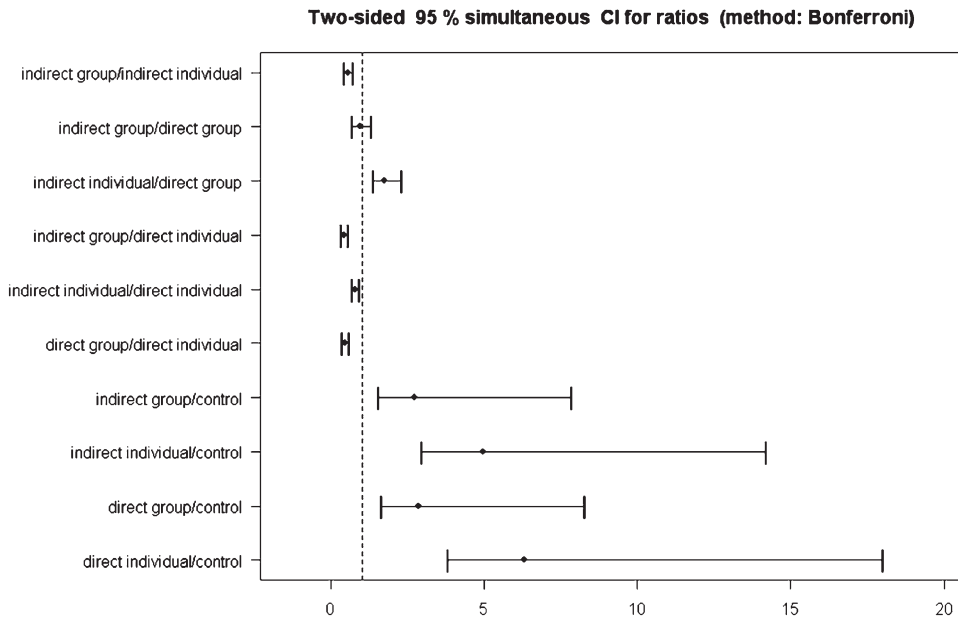**Two-sided 95 % simultaneous CI for ratios (method: Bonferroni)**

Figure 2. Cost ratios for pairwise group restraints.

cost of the two treatments being compared. The cost ratio for group versus individual therapy is less than 1 for both direct and indirect therapy. A two- (five) fold increase in relative costs can be seen when group (individual) therapy is compared to the control mode.

Figure 3 plots the individual total cost of therapy for each child against his/her primary outcome measure (difference in total CELF-III^{UK} score between periods
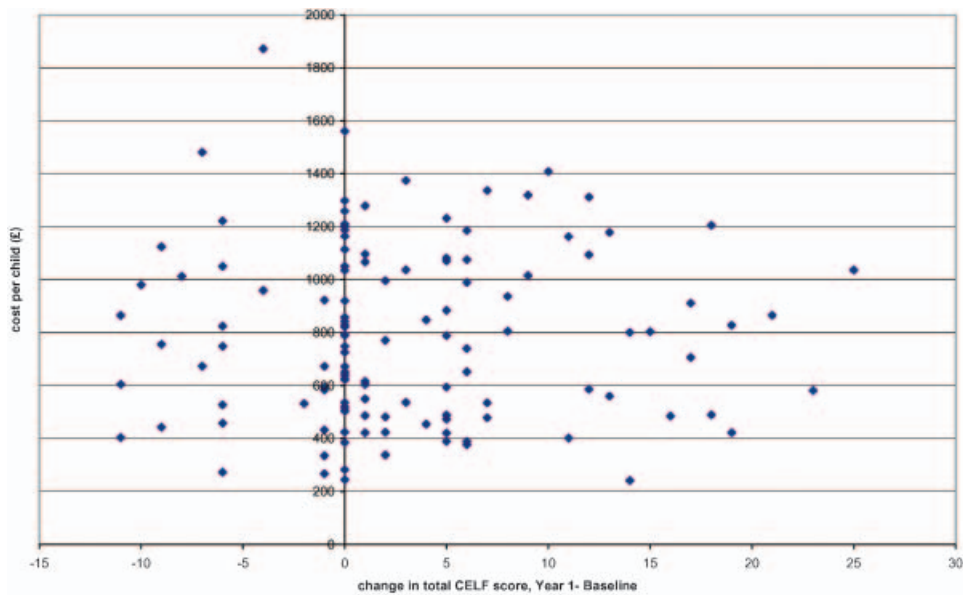

Figure 3. Scatterplot of CELF-III^{UK} T and cost.

T1 and T2). It shows the variation in outcome at an individual level. Within the total group of 124 children there are both those for whom there was little or no positive change in the primary outcome, independent of cost, and those for whom the assessed total CELF-III[UK] score did improve.

Marginal analysis

If the mean costs and change in outcomes for each therapy mode are considered in turn, it can be seen that mode 3, therapy delivered in a group by a therapist, provides more outcome for less resource than either mode 2, therapy delivered in a group by an assistant, or mode 4, therapy delivered to an individual by an assistant. Table 2 shows the total costs listed in ascending order which makes this clearer.

The additional cost required to provide therapy in a group with a therapist is £26 (mean cost for therapist group of £519 minus mean cost for assistant group of £493 compared with therapy in a group with an assistant) for an additional mean change in total CELF-III[UK] score of 2.91 points. This implies a cost per each additional point change in the CELF-III[UK] score of just under £9. If therapy were to be delivered in groups, decision-makers would have to decide if the incremental increase in change in CELF-III[UK] score was worth the incremental cost of moving from assistants to therapists. However, these point estimates of the ratio of additional costs to additional gains in language scores should be qualified by the wide confidence intervals surrounding the CELF-III[UK] score gains recorded at T2 and the lack of sustained improvement at T3.

Limitations

As with any study of this nature there are limitations in generalizability of the analysis as a result of assumptions made and uncertainty within the trial. The economic analysis provided here uses a narrow cost perspective. More detailed exploration of cost within the provision of a service may impact on the outcome of the analysis. The trial had a relatively short follow-up period. It would be preferable to have extended this period and explored the impact of the outcomes and costs over a longer period of time. Whilst the discussion section explores the impact of relaxing a number of the key assumptions this could be explored further.

Table 2.   Mean costs and change in outcomes for each therapy modes

Mode	Mean cost per child (£)	Mean change in CELF-III[UK] total language score	Cost per unit increase in CELF-III[UK] total language scores (£)
1. Control group	181	0.75	241
2. Assistant group	493	1.59	310
3. Therapist group	519	4.50	115
4. Assistant individual	900	2.45	367
5. Therapist individual	1144	3.32	345

Discussion

When implementing a therapy package, it is likely that the use of groups is considered following assessment. Therapists and assistants are likely to use a number of criteria when forming groups. The first would be the geographical location of the child's home and school. The aim would be to minimize travel. Other criteria could be age and language skills/difficulties. Groups could then be defined by having children with similar ages and/or similar therapy requirements. Another criterion might be the therapist's assessment of whether a child could and/or would interact within a group to his/her advantage. The randomization process in the RCT meant that the groups were not formed in this way.

It is likely that therapeutic groups would have a minimum of two children and a maximum of six. In the trial, group size varied from two to five. If the therapy were to be scheduled in a similar way, 3×30-min sessions per week, and run throughout the academic year of approximately 30 weeks, the cost per child of providing group therapy is shown in table 3.

Possible costs are provided for this 30-week scenario. The assumptions used are based on the trial experience. In this analysis it is assumed that therapists require to review and prepare for each scheduled session for each child, irrespective of who delivers the therapy. The estimate of non-contact time is that calculated from the trial, 9 min per session, per child for the therapists and 14 min for an assistant.

Average travel time and average travel costs are based on the data from the study and applied to groups of one to five for assistants and/or therapist-led groups. They also assume that the child would attend all scheduled sessions and would not incur additional scheduled sessions. This may be unrealistic given the compliance observed in the trial where across all groups there was an average of five sessions scheduled, but not attended.

Another possibility, in a therapeutic intervention, highlighted by therapists (McCartney *et al.* 2005), is that children might have therapy delivered in a mixture of the modes, over the period of an intervention. Therapists felt that they might require a period of assessment to establish the required therapy before handing over to an assistant. It might also be necessary for the therapist to reassess the child and the therapy throughout the intervention period.

A number of hypothetical scenarios with costs attached are illustrated in figure 4. The mix of therapist and assistant is accounted for on the axis entitled TvsA, which

Table 3.   Real-world cost per child of providing group therapy over 30 weeks

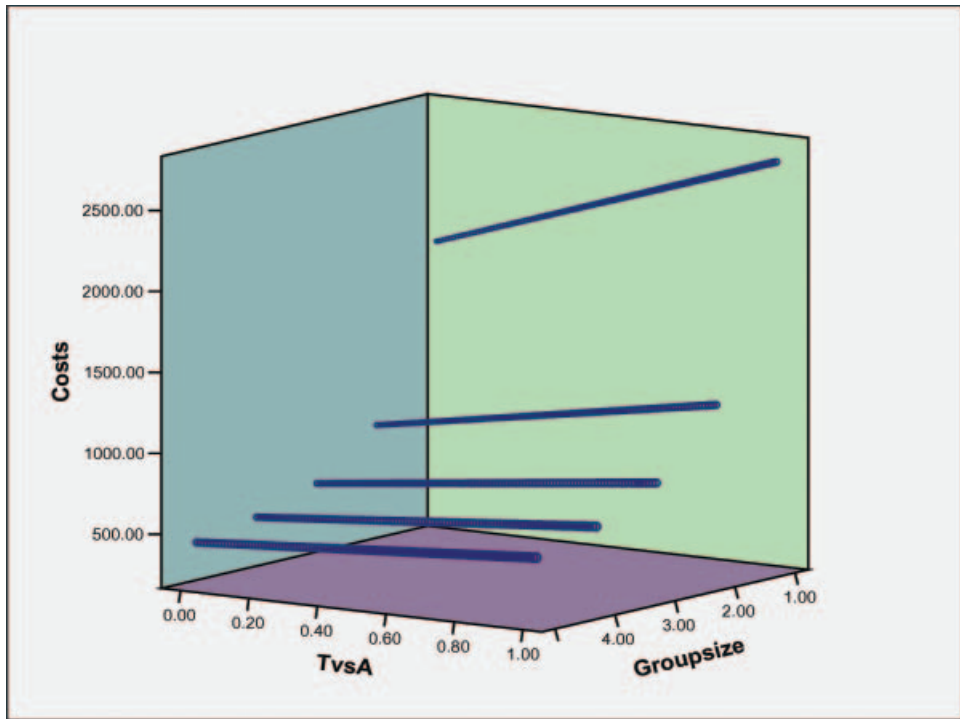|	Number of children in the group	Total salary costs (£)	Total travel costs (£)	Average total cost over 30 weeks (£)
Therapist	1	1603	1086	2689
	2	1809	1485	1647
	3	2015	1884	1300
	4	2221	2283	1126
	5	2427	2682	1022
Assistant	1	1024	1086	2110
	2	1388	1485	1437
	3	1753	1884	1212
	4	2117	2283	1100
	5	2482	2682	1033

Figure 4. Costs of modes of therapy.

represents the percentage of total therapy delivered by the therapist rather than an assistant, e.g. 0.40 on the axis represents 40% of therapy delivered by the therapist.

The diagram reinforces that the most expensive way to deliver therapy is for 100% of it to be delivered on an individual basis by a trained therapist. It illustrates the cost differences between individual and group therapy.

The total gross revenue spend in primary schools in the year 2003/2004 was £3537 per pupil (Scottish Executive 2005). No comparable NHS data are collated. The cost of the most expensive way of providing therapy, individual work with a therapist, over the school year represents around 75% of the total annual spend. Even if travel costs could be eliminated and/or reduced — perhaps by basing the therapy at the child's school — the cost of this mode of therapy would still be around 45% of annual spend per child.

If it were possible to form groups within a school, travel costs for children would be eliminated. Project data suggest that there were a few schools where several children received therapy and might have formed a group if this proved age appropriate and clinically feasible. If parents or carers were willing to transport children to groups then costs would be transferred to them and removed from providers. Individual parents or carers would then have to choose whether they were willing to pay the travel and time costs involved. The minimum spend would be incurred if travel costs could be eliminated or reduced and the majority of therapy provided in a group setting by an assistant. Even in this scenario, the cost per child could be equivalent to around 10% of annual spend.

Regardless of the scenario presented the cost would have to be considered against both the potential gains to the children and the opportunity cost of spending on this type of intervention. The overall value of the novel interventions we present will reflect the preferences of parents, speech and language professionals and schools. Parents' views regarding their child's progress and their experience of the project expressed by means of questionnaires and focus groups were generally positive, as were those of the children's teachers. Overall, it appeared that all four intervention modes were acceptable to parents, schools and project SLTs, and that each could be operated successfully within mainstream schools.

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