AUDITORY VERBAL[UK]

Creating a sound future for deaf children

Investing in a sound future for deaf children:

A cost benefit analysis of auditory verbal therapy at Auditory Verbal[UK]

June 2016

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Foreword

Far too many deaf children are missing out on vital support in the early years. The first three and a half years are critical for the development of listening and talking and for the foundations of literacy and numeracy. With effective early intervention, we know that deaf children can achieve on a par with their hearing peers.

Since 2003, Auditory Verbal[UK] has worked with families of deaf babies and young children from across the UK. 80% of children who graduate from Auditory Verbal[UK]'s early intervention programme achieve age-appropriate language and most attend mainstream schools.

We want to see a world where all deaf babies and children have access to effective early intervention programmes so as to make the most of life's opportunities and for parents to have the opportunity to access an auditory verbal programme close to where they live.

To enable commissioners and professionals across the education and health sectors to better understand the cost and benefits of this approach, we are delighted to publish this report. It uses the HM Treasury model and robust evidence to quantify the cost and benefits of the auditory verbal programme at Auditory Verbal[UK].

It shows that for every £1 invested, there is a £4 return. The literature review within this analysis also shows that the earlier the intervention begins the better the prognosis for language development and the greater are the gains in areas such as quality of life, employment and productivity, which are expected to be life-long.

I hope that commissioners and service providers will consider the significant benefits of this early intervention programme and consider investing in the training of speech and language therapists, teachers of the deaf and audiologists across the UK in auditory verbal practice.

I am extremely grateful to Ellie Goldblatt from the Civil Service Fast Stream for preparing this report whilst on secondment to Auditory Verbal[UK] and to ProBono Economics for the support in peer review and advice.

Anita Grover
Chief Executive, Auditory Verbal[UK]

Executive Summary

This cost benefit analysis (CBA) quantifies the costs and benefits of auditory verbal therapy (AVT) provided by Auditory Verbal[UK] to help children with hearing loss develop listening and spoken language skills. To date, there has been no published CBA of AVT in the UK. This CBA uses a similar methodology used by First Voice's 2011 Cost Benefit Analysis in Australia.

AVT aims to develop spoken language by learning through listening. At Auditory Verbal[UK], AVT is a highly specialist early intervention programme for children under the age of 5 that equips parents with the skills to maximise their deaf child's speech and language development in everyday life. The auditory verbal approach stimulates auditory brain development and enables deaf children with hearing aids and cochlear implants to make sense of the sound relayed by their devices. It is delivered by a listening and spoken language specialist (LSLS Cert AVT®). An LSLS Cert AVT has undertaken 3 years additional training further to their qualifications as a teacher of the deaf, audiologist or speech and language therapist. In this report we cover the AVT programme at Auditory Verbal[UK]. AVT is part of internationally recognised auditory verbal practice.

Auditory Verbal[UK] is an award-winning national charity that works with families from across the UK, helping babies and young children with permanent hearing loss to listen and talk through AVT.

The children enrolled with Auditory Verbal[UK] have different types and degrees of hearing loss and use a range of hearing devices. More than 30% of these children have additional needs.

The literature reviews carried out for the CBA revealed that:

- Research on language development shows that speech and language competency responds to early intervention and training.
- AVT is an early intervention that has been adopted by a number of countries internationally.
- The earlier the intervention begins, the better the prognosis for language development.
- Customised, intensive interventions produce better outcomes.
- The proportion of deaf children that can benefit from AVT is high.

- Benefits of early intervention include likely gains in areas such as quality of life, employment and productivity, which are expected to be life-long.

The CBA uses a 50 year project horizon to reflect the fact that the majority of the benefits flow later in life, using a discount rate of 3.5%. This is highly conservative, given the average life expectancy today is 81.5 years. The costs incurred in a child's early years can therefore be seen as an investment in the child's future.

What are the costs?

This CBA presents a comprehensive assessment of a range of costs involved in accessing AVT. The following estimated, average annual costs are incurred when a child is enrolled in the auditory verbal programme at Auditory Verbal[UK]:

Operational costs	£6,557
In Kind costs (volunteer time and free use of venues)	£ 396
Carer's loss of income	£1,709
Travel	£ 523
Childcare for siblings	£ 427

To ensure that a conservative CBA is derived, it is assumed that the average amount of time a child stays on the programme is 3.5 years. This takes some account of the greater programme duration of a child with more complex needs: the average duration of a therapy programme at Auditory Verbal[UK] is 2.5 years.

The present (discounted) value of all costs is therefore £31,119. The total value of cost is incurred within the first 3.5 years while the child is enrolled on an auditory verbal therapy programme at Auditory Verbal[UK].

What are the benefits?

It is important to note that AVT and modern hearing technology are complementary: this has implications for the attribution of value. Conservatively, the CBA replicates assumptions made by First Voice that half the benefits are attributed to the technology and half to AVT.

Evidence on the long-term impacts of early intervention on outcomes such as educational attainment, employment status and productivity is still emerging, as the

early beneficiaries of modern technology and AVT are only just reaching adulthood. However, investment decisions have to be taken now and there is considerable evidence from Australia and the United States where programmes have been in place for 20-30 years.

Considering just one aspect of these benefits, the vast majority of children who complete an auditory verbal programme at Auditory Verbal[UK] have language competency within the typical range of hearing children: approximately 80% of children enrolled on Auditory Verbal[UK]'s early intervention programme who remained on the programme for more than two years graduated with age-appropriate language and most attended mainstream schools. This contrasts favourably and markedly with the figures published by the National Deaf Children's Society that show only 26% of deaf children achieve a good level of development in the Early Years' Foundation Stage.

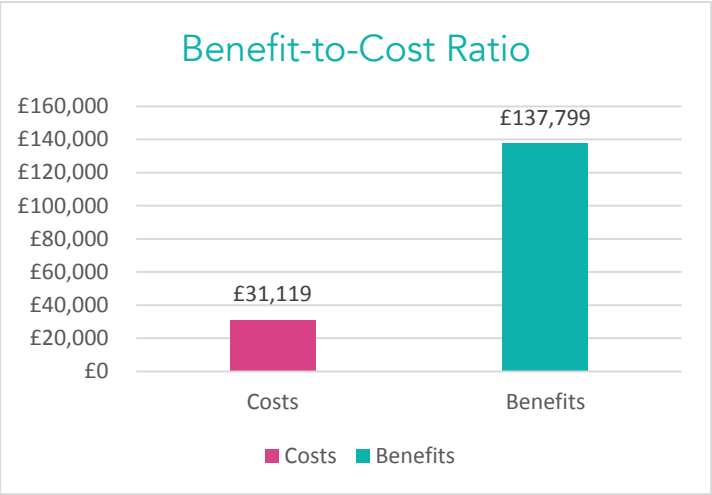
The approach taken in this CBA to quantifying these benefits is extremely conservative. To estimate improved quality of life, a 7% improvement is attributed to AVT. To estimate productivity gains, it is assumed that, on average, AVT generates only one additional year of school attendance, and a 6% increase in labour force participation.

The quantified annual benefits are estimated as follows:

Improved quality of life	£1,607
Increased employment	£1,125
Higher income/productivity gain	£3,443
Lower costs of schooling	£ 797
Lower dependence on government support	£ 8
Injuries avoided	£ 12

Using a 50 year project horizon, the present (discounted) value of these benefits is £137,799.

The benefit-to-cost ratio (BCR) is therefore positive despite a conservative approach to valuation at 1:4 – for every £1 invested in AVT, £4 is returned. This compares favourably to First Voice's Cost Benefit Analysis (2011) which reported a BCR of 1:2.



Sensitivity Analysis

The key result of this CBA – a BCR which is greater than 1 – is robust to changes in assumptions. Reducing the project horizon to 30 years, as is the norm in public infrastructure CBAs, does not affect this key result as the BCR continues to stay above 1 at 1:2.7. As benefits are life-long, a more plausible alternative project horizon of 80 years was also tested, in line with the average life expectancy. Extending the timeline in this way produces a higher BCR of 1:5.59.

Government Perspective

This CBA is based on the current expenditure of Auditory Verbal[UK]. The charity is currently only able to support a maximum of 114 children a year. Unlike its Australian counterpart, Auditory Verbal[UK] receives no government funding and relies heavily on the generous support of trusts, foundations, companies and individuals.

One to two babies in every 1,000 are born with permanent hearing loss in one or both ears. On this basis, there are currently approximately 7,200 severely or profoundly deaf children under the age of 5 in the UK and of these children, 90% are born to hearing parents.

With government funding, the social and economic benefit of AVT would be available to more families in the UK that Auditory Verbal[UK] is currently able to support.

Unquantified costs and benefits

A number of costs and benefits could not be quantified. On the cost side, the greater effort that deaf children put in to acquiring language could not be valued, nor could

the potential impact of a shifting cultural identity away from the Deaf community. Finally, the cost to parents of acquiring literature and researching the different communication options could not be quantified.

On the benefit side, items that could not be quantified at this stage include benefits to carers over the long-term such as reduced anxiety and stronger family relationships. A further type of benefit that could not be quantified but which is likely to be significant is the demonstration and research value created by the programme outcome analyses conducted by Auditory Verbal[UK].

Conclusions and Recommendations

From a social cost-benefit perspective, early intervention is clearly a worthwhile investment even under stringent assumptions about the flow of future benefits. This investment may come from private or public sources. The argument for government funding is however strengthened by the findings of this CBA.

Other conclusions and recommendations include:

- There is a need for more research and consistent collection of statistics, including a longitudinal study of the outcomes resulting from auditory verbal practice. Auditory Verbal[UK] is well placed to take a national leadership role in this space.
- Auditory Verbal[UK] needs to be able to further promote its outreach activities in the NHS and Local Authorities to engage professionals supporting families of children who would otherwise miss out on effective services.
- There needs to be greater information published by organisations supporting deaf children on the costs, benefits and outcomes of interventions and analysis undertaken on the areas where there is currently no data to assist long term investment in effective interventions for children with hearing loss.

1. Introduction

The UK has one of the world's best newborn hearing screening programmes: all babies born or resident in the UK are offered hearing screening for their baby within 4 to 5 weeks of birth.[1] Along with the technological advances made over the last 20 years in hearing aids and cochlear implantation, this means that more deaf children than ever before have the potential for acquiring spoken language.

Early identification and amplification alone, however, do not allow for optimal spoken language development.[2] Access to sound does not directly translate into access to language. Children must first learn how to listen and then to talk. Auditory verbal therapy (AVT) coaches parents to help their children to develop the lifelong communication and social skills they need to participate fully in the hearing world. It is an individualised, auditory, developmental programme, implemented by the child's family in close collaboration with a therapist. The goal is to achieve age appropriate spoken language and full social participation throughout childhood and beyond.

In 2014, The Ear Foundation estimated the real financial cost of hearing loss and deafness to be over £30 billion per annum on a conservative basis.[3] These costs relate to the direct costs of treating hearing loss which are comparatively low, and the much larger costs of dealing with the health and social impacts of deafness. Research has shown that early identification of hearing loss, optimally fitted hearing amplification technology and individualised intensive early intervention result in better speech perception and language development outcomes.[4] These in turn lead to achievements in education, employment and productivity.

However, no Cost Benefit Analysis (CBA) has been published to date in the UK to quantify how cost effective AVT as an early intervention programme is. Only one CBA of this type currently exists, 'A Social Cost-Benefit Analysis: Early intervention programs to assist children with hearing loss develop spoken language', published by First Voice in 2011.[5] This report uses the same methodology as the 2011 First Voice

[1] Public Health England (2015), *Newborn Hearing Screening: Programme Overview* [https://www.gov.uk/guidance/newborn-hearing-screening-programme-overview]

[2] Wilkins, M., & Ertmer, D. (2002), *Introducing young children who are deaf or hard of hearing to spoken language: Child's Voice, an Oral School. Language, Speech, and Hearing Services in Schools*, 33(3), 198-204.

[3] Archbold, S., Lamb, B., O'Neill, C., Atkins, J. (2014), *The Real Cost of Adult Hearing Loss: reducing its impact by increasing access to the latest hearing technologies.*

[4] Lim, S., (2005), 'Auditory-Verbal Therapy for Children with permanent hearing loss', *Annals Academy of Medicine*, vol. 34. No. 4.

[5] First Voice (2011), *A Social Cost-Benefit: Early intervention programs to assist children with hearing loss develop spoken language*.

publication and we are very grateful for the support and help of our Australian colleagues.

1.1 Context of Childhood Hearing Loss

One to two babies in every 1,000 are born with permanent hearing loss in one or both ears. This increases to one in every 100 for babies who have spent more than 48 hours in intensive care.[6] On this basis, there are currently approximately 7,200 severely or profoundly deaf children under the age of 5 in the UK and of these children, 90% are born to hearing parents.[7]

1.1.1 Educational Attainment

It is widely acknowledged that hearing loss can significantly affect a child's quality of life. Linguistic, cognitive, emotional, educational and social development can all be impacted.[8] Being born with, or acquiring, hearing loss has a particularly damaging impact on a child's ability to learn language and children born with profound deafness can develop language at approximately half the rate of their hearing peers.[9] Significantly fewer (34%) children with hearing loss achieve the expected standard in the Department for Education Early Learning Goals than those with no Special Educational Needs and nearly three-quarters of children with hearing loss arrive at primary school having not achieved a good level of development in those early years.[10] Data published by the Department for Education in January 2015 showed that 36.3% of deaf children achieve five A*-C GCSEs compared to 65.3% of their hearing classmates.[11] This gap widens further as a young person reaches 16 with 33.6% of deaf young people taking a Level 3 qualification (AS Level, A Level or equivalent) compared to 82.5% of all 16-18 year olds.[12] Of this 33.6%, fewer than 4% of deaf children attain their qualification.[13]

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[6] http://www.nhs.uk/conditions/pregnancy-and-baby/pages/newborn-hearing-test.aspx [accessed 15th January 2016]

[7] http://www.ndcs.org.uk/about_us/about_the_national_deaf_childrens_society/ [accessed 22nd January 2016]; Mitchell, R. E. and Karchmer, M. A, (2004), Parental Hearing Status for Deaf and Hard of Hearing Students in the United States, *Sign Language Studies*, 4 (2), 138-163.

[8] National Institute for Health and Care Excellence, (28 January 2009), *Cochlear implants for children and adults with severe to profound deafness*, p. 5.

[9] Miyamoto R.T., Houston D.M., Kirk K.I., Perdew A.E., Svirsky M.A. (2003). Language Development in Deaf Infants Following Cochlear Implantation. *Acta Otolaryngol* 2003; 123: 241/244

[10] NDCS note on Department for Education figures on attainment for deaf children in 2014 (England), January 2015.

[11] NDCS note on Department for Education figures on attainment for deaf children in 2014 (England), January 2015.

[12] Young, A., Oram, R., Squires, G., Sutherland, H., (University of Manchester, January 2015), *Identifying effective practice in the provision of education and education services for 16-19 year old deaf young people in Further Education in England*, p. 12.

[13] Young, A., Oram, R., Squires, G., Sutherland, H., (University of Manchester, January 2015), *Identifying effective practice in the provision of education and education services for 16-19 year old deaf young people in Further Education in England*, p. 12.

1.1.2 Employment Prospects

Furthermore, research has shown that unemployment rates for people with hearing loss are much higher compared to the national average, with 30% of people of working age with severe hearing loss unemployed.[14] Recent estimates suggest that the UK economy loses £25 billion a year in productivity and unemployment through hearing loss.[15]

1.1.3 Social Inclusion and Mental Health

Though not as easily quantifiable, research has shown that children with hearing loss frequently experience difficulty with peer relationships and are at a greater risk of social isolation and loneliness, influencing academic success, school adjustment and social-emotional development. [16,17] Figures published by the Department of Health in 2005 showed that over 40% of deaf children will have mental health difficulties during childhood or early adulthood.[18]

The emotional, educational, and financial implications of hearing loss upon a child mean that early intervention is crucial. In a 2003 study, Yoshinago-Itano showed that with both early identification and intervention, deaf children can achieve language development and personal social development proportionate to their age.[19] Early intervention is twofold. Firstly, optimal technology, either through hearing aids or cochlear implants, needs to be in place to allow children to gain access to a substantial amount of auditory information.[20] By the age of three and a half, the human brain has completed 85% of its physical growth, a significant part of the foundation for all thinking and learning.[21] Neuroplasticity - where the brain remains receptive to new stimuli – is most active during this sensitive period, creating a limited window during which a child can learn to make sense of sound.[22] This makes the first three years of a deaf child's life crucial for developing their listening capabilities. If children are not exposed to language early, the window of opportunity to acquire it

[14] Action of Hearing Loss (2013) Unpublished Secondary Analysis from the Labour Force Survey 2013, *Quarter 2*, April-June.
[15] International Longevity Centre (2014) *Commission on Hearing Loss: Final Report*, 7 July 2014
[16] Du Feu, M, and Fergusson, K. (2003) Sensory impairment and mental health, *Advances in psychiatric treatment*, 9:95-103.
[17] Hindley, P., Hill, P.D., McGuigan, S. & Kitson, N. (1994) Psychiatric disorder in deaf and hearing impaired children and young people: A prevalence study. *Journal of Psychiatry and Psychology*, 35, 917–934.
[18] Department of Health (2005) *Mental Health and Deafness: Towards equity and access.*
[19] Yoshinago-Itano, C (2003) From Screening to Early Identification and Intervention: Discovering Predictors to Successful Outcomes for Children with Significant Hearing Loss, *Journal of Deaf Studies and Deaf Education* 8:1 Winter 2003.
[20] Miyamoto R.T., Houston D.M., Kirk K.I., Perdew A.E., Svirsky M.A. (2003). "Language Development in Deaf Infants Following Cochlear Implantation". *Acta Otolaryngol* 2003; 123: 241/244
[21] Suskind, D, Thirty Million Words: Building a Child's Brain (2015)
[22] Sharma, A, Dorman M, Spahr, A. (2002) A sensitive period for the development of the central auditory system n children with cochlear implants: implications for age of implantation. *Ear & Hearing*, 23, 532-539.

starts to close, and by five years of age, it is substantially shut.[23]

Secondly, early intervention requires an approach that emphasises the development of auditory brain pathways through listening and spoken language.[24] Research shows that the earlier and the more intensive the intervention, the more impact it will have.[25] This is in line with the Position Statement by the US Joint Committee on Infant Hearing (JCIH):

> The goal of early hearing detection and intervention is to maximise linguistic competence and literacy development for children who are deaf or hard of hearing. Without appropriate opportunities to learn language, these children will fall behind their hearing peers in communication, cognition, reading and social-emotional development. Such delays may result in lower educational and employment levels in adulthood.[26]

1.2 Why is a Cost Benefit Analysis important?

A Cost Benefit Analysis (CBA) demonstrates the value of an intervention, by calculating both the costs and the benefits. A CBA may be used in the planning stages of a project or once the project has been delivered as an element of project evaluation. In this case, the CBA examines the benefits that can be expected, given the existing levels of expenditure in auditory verbal therapy by the charity Auditory Verbal[UK]. If a positive Cost-Benefit Ratio is found, it will demonstrate the importance of investing in the training of professionals in the auditory verbal approach and highlight the value of similar services being available more widely. It will also demonstrate the impact of an early intervention programme of AVT at Auditory Verbal[UK] to potential funders. Whilst a Social Return on Investment (SROI) uses stakeholders to identify proxies in order to value outcomes, which can result in different valuations of the same interventions, this CBA will use figures taken from the Cabinet Office's Unit Cost Database for consistency and rigour.[27]

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[23] Niparko JK, Tobey EA, Thal DJ, et al: Spoken language development in children following cochlear implantation. *JAMA* 303: 1498-506, 2010

[24] Dimity Dornan (2009), Hearing Loss in babies is a neurological emergency, *Alexander Graham Bell Association for the Deaf or Hard of Hearing*.

[25] Joint Committee on Infant Hearing: Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. Joint Committee on Infant Hearing, American Academy of Audiology, American Academy of Paediatrics, American Speech-Language-Hearing Association, and Directors of Speech and Hearing Programs in State Health and Welfare Agencies. *Paediatrics* 106:798-817, 2000.

[26] Joint Committee on Infant Hearing: Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. *Paediatrics* 120:898-921 2007.

[27] Cabinet Office: Centre for Social Impact Bonds, Cost-benefit Analysis Guidance and Unit Cost Database [https://data.gov.uk/sib_knowledge_box/toolkit]

Along with this database, three key documents have supported the development of this CBA: HM Treasury and New Economy's Cost Benefit Analysis guidance[28], HM Treasury's Green Book[29] and Pro Bono Economics' Guide to Cost-Benefit Analysis.[30]

1.3 The Cost Benefit Argument in Simple Terms

It is clear that investing in early language training reduces a range of potential future costs and delivers a number of additional benefits to a variety of identifiable stakeholders including the child, the family, the community, the NHS and local and national governments. Children who have had AVT are more likely to start at a mainstream school, have improved literacy, numeracy and overall attainment throughout their education and greater opportunities and choice for employment[31]. There are also significant emotional benefits, including greater social inclusion, confidence, emotional intelligence and improved mental health.

There is also a benefit to parents knowing that their children will have a better chance to achieve their full potential, including improved emotional well-being for the child, the parents themselves and for the wider family, as well as improved family relationships. The benefits will also be shared by the rest of society. Costs of specialist schooling could drop, claims for disability benefits may decline, costs previously incurred by employers could fall and productivity increase.

In the shorter term, there is the operational cost of providing AVT and the cost for parents to attend (e.g. transport, child care for siblings) as well the potential loss of income for some parents who may stop work.

The challenge for this CBA is to come to a reasonable assessment of the balance of the costs imposed on children, their families and society at large, and the benefits that are generated by AVT. As benefits occur mainly in the future, and the future is discounted in economic assessments such as these, it cannot be assumed that they will always outweigh the upfront costs.

[28] HM Treasury & New Economy (April 2014) Supporting public service transformation: cost benefit analysis guidance for local partnerships [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300214/cost_benefit_analysis_guidance_for_local_partnerships.pdf]

[29] HM Treasury (2011) The Green Book: Appraisal and Evaluation in Central Government

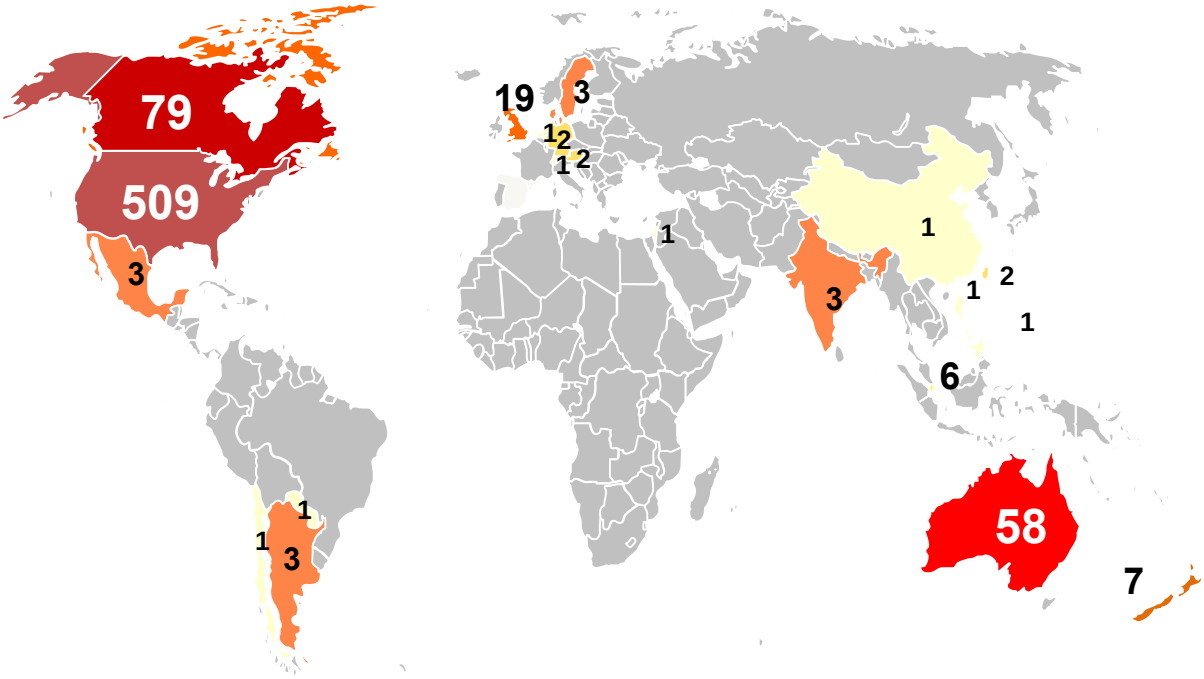
[30] Pro Bono Economics, Our Place Guide to Cost-Benefit Analysis [http://mycommunity.org.uk/wp-content/uploads/2015/07/Our-Place_CBA-guide_FINAL_eginc.pdf]

[31] Flexer C., & Goldberg D. (2001) Auditory-Verbal Graduates: Outcome Survey of Clinical Efficacy. *J Am Acad Audiol* 12: 406–414

1.4 Limitations

The Auditory Verbal approach to helping children learn to communicate is well established in North America and Australasia, but still very much in its infancy in Europe. As seen from the map below, the number of certified auditory verbal practitioners in the UK is considerably lower than in the United States, Canada and Australia.[32]

Figure 1: Number of certified Auditory Verbal Therapists globally



Jacqueline Stokes was the first certified Auditory Verbal Therapist (LSLS Cert. AVT®) in the UK, having trained with Dr Daniel Ling at McGill University, Canada. In 2003, she established the charity Auditory Verbal[UK] to provide access to auditory verbal therapy to deaf children and began delivering therapy to children for the first time in the UK.

As such, the first generation of beneficiaries of auditory verbal therapy are only just reaching adulthood. Evidence on the lifelong impacts of this therapy in the UK is therefore only just beginning to accumulate. As a result, highly accurate and scientifically robust estimates of long-term benefits of specific programs will only become available over the coming decades. Nonetheless, investment decisions about early intervention services such as AVT have to be taken now and there is considerable evidence from Australia and the United States where programmes have

[32] As of 30th October, 2015 (taken from AG Bell, Directory of Services)

been in place for 20-30 years.[33]

In line with other assessment reports on emerging health technologies, this report has to make assumptions about future impacts. The approach taken throughout this report is to use conservative assumptions and to test any results using sensitivity analysis, as is standard practice. The following confidence grades for cost and benefit data have been taken from HM Treasury and New Economy's Cost Benefit Analysis Guidance[34]:

Figure 2: Confidence Grades for Cost Data

Confidence grade	Colour coding	Data source	Age of data	Known data error	Optimism bias correction
1		Independently audited cost data	Current data (<1 year old)	+ -2%	0%
2		Formal service delivery contract costs	1-2 years old	+ -5%	+5%
3		Practitioner monitored costs	2-3 years old	+ -10%	+10%
4		Costs developed from ready reckoners	3-4 years old	+ -15%	+15%
5		Costs developed from ready reckoners	4-5 years old	+ -20%	+20%
6		Uncorroborated expert judgement	5+ years old	+ -25%	+40%

Source: HM Treasury & New Economy, Supporting public service transformation: cost benefit analysis guidance for local partnerships

[33] First Voice (2015). Sound Outcomes: First Voice speech and language data. [http://www.firstvoice.org.au/userfiles/file/150302_Sound_Outcomes_First_Voice_Speech_and_Language_Data.pdf]

[34] HM Treasury & New Economy (April 2014) Supporting public service transformation: cost benefit analysis guidance for local partnerships [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300214/cost_benefit_analysis_guidance_for_local_partnerships.pdf]

Figure 3: Confidence Grades for Benefit Data

Confidence grade	Colour coding	Data source	Evidence base (engagement/impact)	Age of data	Known data error	Optimism bias correction
1		Figures taken from agency data systems	Randomised control trial in UK	Current data (<1 year old)	+ -2%	0%
2		Figures derived from local stats	International randomised control trial	1-2 years old	+ -5%	-5%
3		Figures based on national analysis in similar areas	Independent monitoring of outcomes with robust evaluation plan	2-3 years old	+ -10%	-10%
4		Figures based on national analysis	Practitioner monitoring of outcomes with robust evaluation plan.	3-4 years old	+ -15%	-15%
5		Figures based on generic national analysis	Secondary evidence from a similar type of intervention	4-5 years old	+ -20%	-25%
6		Uncorroborated expert judgement	Uncorroborated expert judgement	5+ years old	+ -25%	-40%

Source: HM Treasury & New Economy, Supporting public service transformation: cost benefit analysis guidance for local partnerships

All assumptions are highlighted and referenced throughout the report.

1.5 The baseline or base case

A cost-benefit analysis requires a scenario *with* the investment to be compared to the situation *without* the investment. The latter is referred to as the 'base case', 'baseline', 'counterfactual' or 'do nothing' scenario.

For this CBA, the baseline refers to what would happen in the absence of auditory verbal therapy – a child who has received a hearing aid or cochlear implant but has not had the benefit of an auditory verbal early intervention programme.

1.6 Technology

As referred to earlier, amplification through hearing technology alone does not allow for optimal spoken language development.[35] Even if a child is diagnosed early and receives the optimal technology, it is likely that they will experience some form of language delay. Simply providing hearing devices does not mean the sound will be perceived or interpreted. The child needs to learn to listen and understand through

[35] Wilkins, M., & Ertmer, D. (2002). Introducing young children who are deaf or hard of hearing to spoken language: Child's Voice, an Oral School. *Language, Speech, and Hearing Services in Schools*, 33(3), 198-204.

these devices and learn that sound has meaning.[36] AVT teaches children to listen as the first step in language development. The role of AVT is therefore *complementary* to that of technology.

This has implications for the attribution of value (as discussed in 4.3.1). A conservative assumption for this CBA is that for any improvement in health state that is achieved with technology and auditory verbal therapy, half is attributed to the technology and half to auditory verbal therapy.

This assumption also mirrors the assumption made in the 2011 First Voice publication of 'A Social Cost Benefit Analysis'.[37]

2. The Auditory Verbal Therapy Model

2.1 What are Auditory Verbal[UK]'s objectives?

Auditory Verbal[UK] wants to see a world where all deaf babies and children have the same opportunities in life as hearing children.

The aim of auditory verbal therapy is to close the gap between a child's chronological age and language ability so that they may enter mainstream school with age-appropriate language and develop the social skills and confidence to participate fully in the hearing world.

About 40% of children with hearing loss have another condition at birth[38], and a proportion of these may always have some delay in speech and language due to the sometimes complex nature of the health challenges that they face in their everyday lives. For these children, AVT aims to enable them to reach their language potential.

AVT consists of the following key features:

- It aims to develop spoken language by learning through listening.
- It is delivered by a certified Listening and Spoken Language Specialist

[36] Chowdhry, J (2010), Auditory Verbal Therapy, South Asia Cochlear, *Jaypee Journals* [http://www.jaypeejournals.com/eJournals/ShowText.aspx?ID=636&Type=FREE&TYP=TOP&IN=_eJournals/images/JPLOGO.gif&IID=60&isPDF=NO]

[37] First Voice (2011). *A Social Cost-Benefit: Early intervention programs to assist children with hearing loss develop spoken language.*

[38] NDCS *Social care for deaf children and young people: A guide to assessment and child protection investigations for social care practitioners* (2011)

practitioner: an Auditory Verbal Therapist (LSLS Cert AVT) or Auditory Verbal educator (LSLS Cert Ed) in partnership with the child's parent(s) or carer.

- The sessions are play-based and highly functional in order to be integrated into a family's everyday routine.

AVT in the UK follows the 10 Principles of AVT, as set out by the AG Bell Academy for Listening and Spoken Language:[39]

1. Promote early diagnosis of hearing loss in newborns, infants, toddlers and young children, followed by immediate audiologic management and auditory verbal therapy.
2. Recommend immediate assessment and use of appropriate, state-of-the-art hearing technology to obtain maximum benefits of auditory stimulation.
3. Guide and coach parents[40] to help their child use hearing as the primary sensory modality in developing listening and spoken language.
4. Guide and coach parents to become the primary facilitators of their child's listening and spoken language development through active consistent participation in individualised auditory verbal therapy.
5. Guide and coach parents to create environments that support listening for the acquisition of spoken language throughout the child's daily activities.
6. Guide and coach parents to help their child integrate listening and spoken language into all aspects of the child's life.
7. Guide and coach parents to use natural developmental patterns of audition, speech, language, cognition and communication.
8. Guide and coach parents to help their child self-monitor spoken language through listening.
9. Administer ongoing formal and informal diagnostic assessments to develop individualised auditory verbal treatment plans, to monitor progress and to evaluate the effectiveness of the plans for the child and family.
10. Promote education in regular schools with peers who have typical hearing and with appropriate services from early childhood onwards.

[39] AG Bell Academy for Listening and Spoken Language (July 26, 2007) [http://www.agbell.org/AcademyDocument.aspx?id=563]

[40] Throughout this report, the term "parents" is used to label the child's main care-giver.

Eisa's Story

When our beautiful son Eisa first failed his newborn hearing screening test, the implications did not register. Immediately after he was born, he had been placed into special care with E-Coli Septicaemia, and we were just so happy and relieved that he had pulled through and we could finally experience the joy of bringing our baby home. But at 3 months, Eisa was retested and, after failing the test again, we discovered that the Meningitis he had fought as a baby had left him profoundly deaf.

From the moment Eisa received his hearing aids, I talked non-stop to him, about everything we went past, everything we touched, everything we saw. But the reality of Eisa being profoundly deaf really sunk in when we started looking for a pre-school to send him to. He was silent at his nursery and we felt so sad and confused as to how we could help him.

And then one day things changed. Another mum mentioned auditory verbal therapy to me and I couldn't believe no one had told me about it before. Our initial meeting at Auditory Verbal[UK] was so refreshing! Finally, we spoke to professionals who shared our desire to unlock the potential in Eisa. Instead of being met with, "no sorry he can't…..", "no sorry he won't be able to….", "no sorry he can only…", we heard the words, "yes he can…", "yes he will…", "he can reach his potential and even exceed it".

We started at Auditory Verbal[UK] immediately. Each and every session was hard work, but worth everything to hear Eisa saying new words, constructing sentences and answering questions without the need for signs or gestures. At the age of 4, we decided that Eisa would have a Cochlear Implant (CI). Auditory Verbal[UK] were amazing and helped to prepare Eisa and set expectations of what it would be like before and after the implant. I remember in one of the CI assessment appointments, the consultant said, "We can implant your child, but the success of the implants depends on what you do with it." Auditory Verbal[UK] have given us the skills not only to maximize the use of his CI, but also to unlock Eisa's potential and he now has spoken language skills that are age-appropriate. Eisa can have a conversation with unfamiliar people. He can run into the playground and ask his friends what game they are playing and what the rules are. He can stand up in front of parents and say his lines loud and clear in class assemblies.

Auditory Verbal[UK] have allowed us to dream again. They have provided us with a foundation for Eisa, and have enabled him to do whatever he chooses to do in life.

Eisa's mother, Azra

2.2 Description of the service model

Each programme is highly diagnostic and tailored for the individual child. As a minimum, all children enrolled at Auditory Verbal[UK] will benefit from 20 one-to-one auditory verbal therapy sessions per year at which a parent or carer is present; two of which are one-to-one parent consultations. Depending on the child, elements of their programme may include home visits, pre-school and nursery visits and transition visits, where their therapists visit the pre-school or primary school setting. Parent support groups, workshops and information sessions are available, free of charge, for all Auditory Verbal[UK] families in addition to the therapy sessions.

2.2.1 Initial Phone Call

As soon as families make contact with Auditory Verbal[UK], a therapist will call a family back within two working days. This is an opportunity for the therapist to understand more about the child and their medical history and to discuss in detail what AVT is and what Auditory Verbal[UK] can offer the family.

2.2.2 Initial Auditory Verbal Session

This is a 90-minute session that will help the therapist evaluate the child's listening potential. The parents are given practical strategies to develop their child's listening and speech in the home setting. It is at this point that the family can decide whether or not to join the programme.

2.2.3 Auditory Verbal Therapy Sessions

Sessions are offered on a fortnightly basis and are delivered by a fully qualified and/or trainee auditory verbal therapist. These are individual one-hour diagnostic sessions held with each family that focus on guiding and coaching the parents on how to teach their child how to learn to listen and speak. These are based on the 10 principles of AVT (above). Generally, a session will include 45 minutes of therapy with the child and 15 minutes' discussion with the parents, reflecting on what they will 'take home' from the session and use in their daily routine. A typical programme runs for about three years. Progress is regularly reviewed and, with the family's consent, the therapist works closely with other professionals, such as audiologists, speech and language therapists, teachers of the deaf and, in some cases, occupational therapists, where a child has particular sensory needs.

2.2.4 Parent Consultation

These appointments offer an opportunity to discuss the child's progress and review how the programme is working for the parents, without the child present. A plan is made for the next period. This is also a useful opportunity to discuss any concerns the parents may have and talk in more detail about key decisions such as choice of nursery or school.

2.2.5 Assessment of Progress

Short and long-term goals are set and reviewed with the parents on a regular basis. Where families give permission, these are also shared with the family's local team such as audiologists and teachers, so that all professionals are working towards the same end-goal.

Standardised assessments of a child's speech and language development are carried out at a minimum of 6-month intervals to monitor progress and results are discussed with the family and their wider team. These standardised assessments evaluate the child's progress and assist in ensuring that all children at Auditory Verbal^{UK} continue to make adequate progress over time.

2.2.6 Family Support

Families are able to access support from the Family Services team. They provide advice on finances, including accessing and applying for benefits, drawing up an effective Educational and Health Care Plan (EHCP) and helping with any family issues that may arise during the programme.

2.2.7 Parent Support Groups

Parent participation is integral to the auditory verbal journey. The Parent Support Group enables parents who are experiencing the challenges of raising a child with a hearing loss to meet regularly and provide support to each other through sharing their experiences, making play dates for their children and practicing AVT techniques. There is also a closed Parent Forum Facebook group so that parents can connect by sharing stories about their children and experiences, posting photographs, setting up events and seeking peer-to-peer emotional support.

2.2.8 Transition to School Programme

This is an optional package to help prepare the child for primary school. It is designed for children who have reached the end of their auditory verbal therapy programme,

by which time most will have age-appropriate language. The aim is to transfer the skills acquired by parents to the adults in the educational environment, enabling children to continue to succeed and reach their potential as they start school.

2.2.9 Staffing

Auditory Verbal[UK] employs a team of 17 staff (11 full time and 6 part time), covering a range of support service specialisms. This includes 6 listening and spoken language certified auditory verbal therapists and 4 specialist professionals (2 speech and language therapists, a dually qualified audiologist and speech and language therapist and a teacher of the deaf) in training to become LSLS Cert AVT®s.

The Auditory Verbal practitioners at Auditory Verbal[UK] are listening and spoken language certified auditory verbal therapists: they are qualified speech and language therapists, audiologists and teachers of the deaf who have undertaken the additional three-year full time training necessary to become listening and spoken language specialists certified auditory verbal therapists. They work closely together with other early intervention practitioners, audiologists, occupational therapists specialising in sensory integration and pre-school teachers in supporting the child and family's progress.

2.2.10 Implications for the CBA

The previous sections demonstrate that Auditory Verbal[UK] provides a range of services to the children enrolled in their early intervention programme. It is difficult to split the benefit of these services, meaning this CBA should not be seen as an assessment of AVT only but of the range of interventions offered by the organisation.

2.3 How does the auditory verbal approach differ from other communication routes?

There are a number of different options for the parents of a deaf child or baby, including sign language, bilingualism, cued speech, total communication, oral speech & language therapy and AVT. AVT is the approach that is most focused on the child learning to communicate via listening and spoken language.

The different communication approaches are broadly classified by the National Deaf

Children's Society as[41]:

- AUDITORY-VERBAL/ORAL-AURAL (the programme offered by Auditory Verbal[UK] falls within this category): Programmes using the auditory-verbal or oral-aural approach focus on the use of even minimal amounts of amplified hearing to develop speech and to process language through auditory pathways. These programs enable deaf children to learn to listen, understand spoken language and communicate through speech using their residual hearing.

- TOTAL COMMUNCIATION: Programmes supporting a total communication philosophy focus on the use of a variety of communication methods including sign, speech and listening, lip reading, finger spelling, facial expression and gesture in whatever combination works best for the child. It is based on the principle that deaf children can learn to communicate effectively by using any and all means that they can.

- BRITISH SIGN LANGUAGE (BSL)/BILINGUAL: Programmes supporting this BSL/Bilingual approach advocate for sign language to be a child's first language and the spoken language of the family to be learned as a second language for reading and writing. In school settings, children will also learn about the Deaf community and its history, language and culture and develop a strong positive Deaf identity.

The auditory verbal approach differs from other speech and language therapy approaches in a number of ways:

- AVT concentrates on developing the listening part of the brain (the auditory cortex) rather than relying solely or partly on visual cues. AVT seeks to make the most of the narrow window of 3.5 years within which the auditory cortex can develop as a listening brain.[42] Long-term deafness extending beyond the early school-age years may result in significant re-organisation of the brain, with areas becoming more visual.[43]
- AVT focuses on coaching the parents or carers of the child in the use of auditory verbal strategies and techniques in everyday activities and play so that every

[41] Communicating with your Deaf Child (accessed 15th January 2016) [http://www.ndcs.org.uk/family_support/communication/communicating_with_your_deaf_child/]

[42] Sharma, A, Dorman M, Spahr, A. (2002) A sensitive period for the development of the central auditory system n children with cochlear implants: implications for age of implantation. *Ear & Hearing*, 23, 532-539.

[43] Sharma, A, Campbell J, Cardon, G. (2015) Developmental and cross-modal plasticity in deafness: Evidence from the P1 and N1 event related potentials in cochlear implanted children. *International Journal of Psychophysiology* 95, 135-144

opportunity is used to develop their child's listening brain and spoken language skills.

- AVT can be an early intervention programme. By working intensively with the child in their first few years they should require much less additional support for the rest of their life.
- AVT aims to develop the child's social understanding and their 'theory of mind' – the ability to understand that their mind differs from another's.
- AVT is delivered by an auditory verbal therapist who is a qualified teacher of the deaf, speech and language therapist or audiologist who has undergone three years of post-graduate training to receive LSLS (listening and spoken language specialist) accreditation through AG Bell, the certifying body.[44]

2.4 Description of Auditory Verbal[UK]'s cohort

Figure 4 shows the breakdown of Auditory Verbal[UK]'s cohort from January 2003 to December 2015, including families who only made an enquiry, families who only attended an initial consultation and families who are currently on the programme. Within this period, a total of 714 families made contact with Auditory Verbal[UK], with 374 children embarking on an auditory verbal programme.

Figure 4: Enrolments in AV programme at Auditory Verbal[UK]

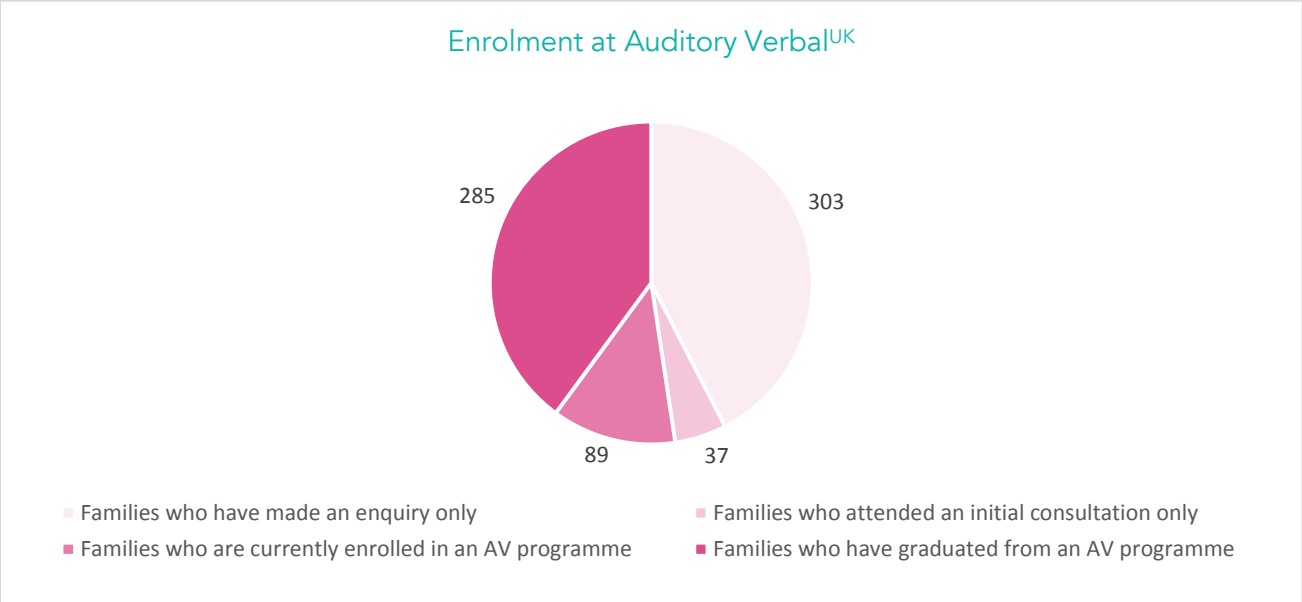


Figure 5 reveals the degree of hearing loss seen in the 285 children who have completed an Auditory Verbal[UK] programme, using descriptors recommended by

[44] The AG Bell Academy for Listening and Spoken Language, [http://www.agbell.org/Academy]

the British Society of Audiology 2011 and endorsed by the British Association of Teachers of the Deaf.

Figure 5: Percentage of children by degree of hearing loss at Auditory Verbal[UK]

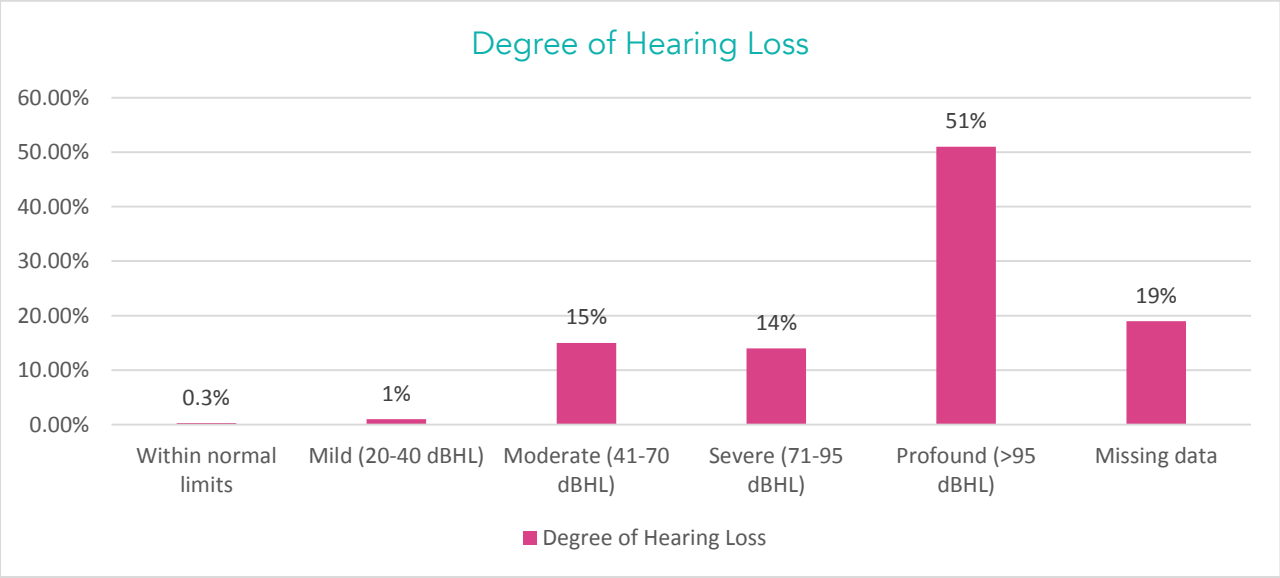


Figure 6 breaks the Auditory Verbal[UK] cohort down by type of device used. This shows that hearing aids are the most common at 51% of the cohort, followed by a combination of both hearing aids and cochlear implants at 35% of the cohort.

Figure 6: Devices used by children in Auditory Verbal[UK] cohort

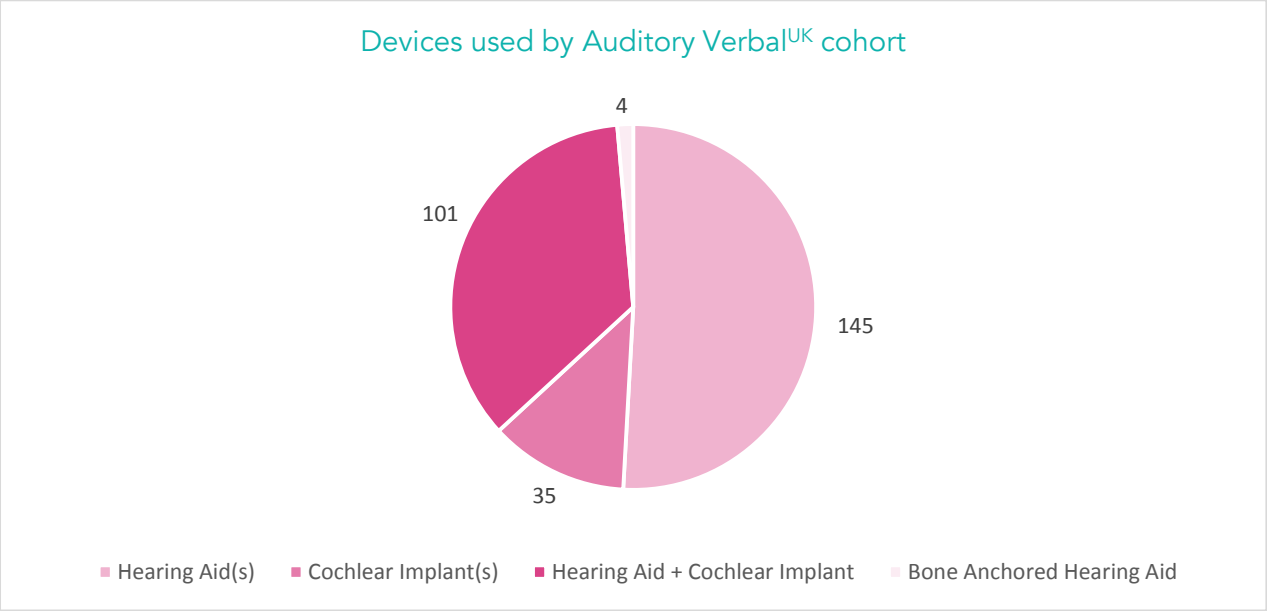
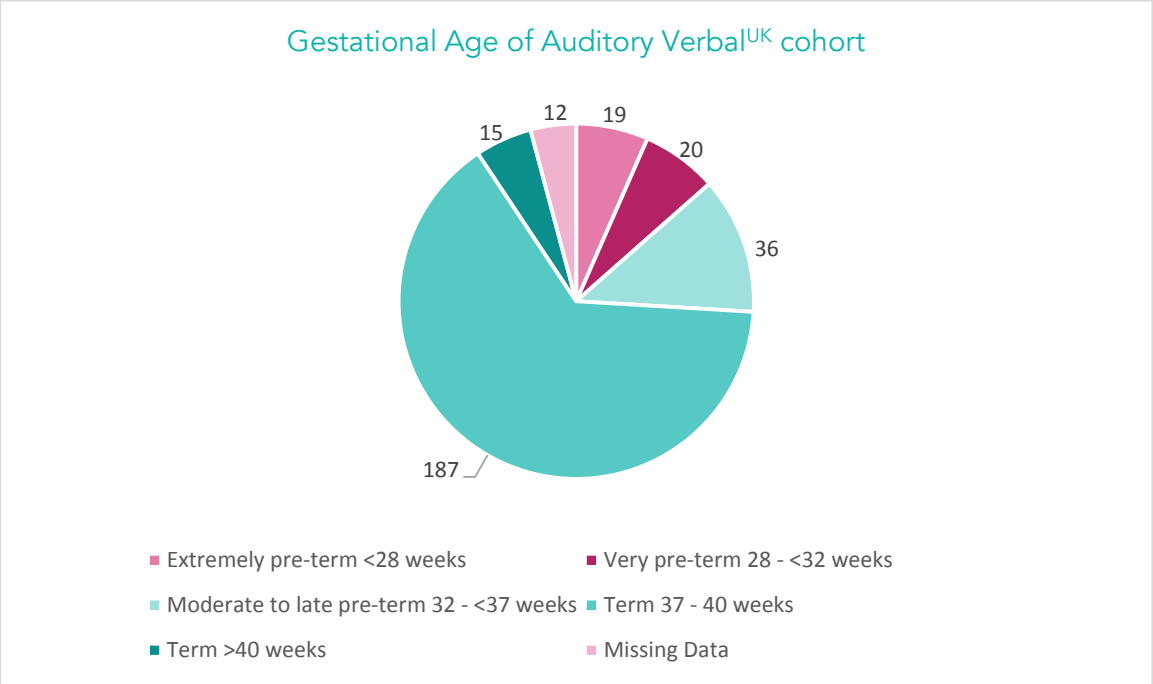


Figure 7 uses the World Health Organisation's definitions of prematurity to show the breakdown of gestational age of the Auditory Verbal[UK] cohort from January 2003 to December 2015.

Figure 7: Gestational Age of children in Auditory Verbal[UK] cohort



Sam's Story

In August 2011, we introduced our son Samuel into the world. At five weeks, Sam was diagnosed as being profoundly deaf. We were devastated. Why him? Why us? No one in our family was deaf and we had no experience of knowingly meeting anyone else who was deaf. 'Fear of the Unknown' is an oft used phrase but, for the first time in our lives, we were scared. Scared for our son's future. Hearing aids would prove of no practical use as there was next to no hearing to amplify. We would never be able to speak to him... We wouldn't hear his views and opinions on life, culture, politics... Nor, more importantly, would he ever be able to hear us tell him we love him. We worried about him making friends. Would he be able to go to mainstream school? How would he communicate with friends? How would *we* communicate with *him*? And how would we cope with this additional challenge as two new, first time, parents? So many questions. And so few answers.

Fast forward almost a year and, it would transpire that, Sam was lucky. It sounds almost perverse to say out loud but he was lucky that his level of deafness was as severe as it was. He proved to be a suitable candidate for cochlear implants and was implanted just before his first birthday. What a birthday present! Sam now had access to all the speech sounds. Armed with this miraculous knowledge, we knew immediately that we wanted to follow an oral approach to his communication rather than sign language.

A friend of a friend recommended Auditory Verbal[UK] to us, highly recommended in fact. Despite living on the south coast of England, we made the long journey to Bicester as we wanted to explore all of the options open to our deaf son. Straight away we knew that auditory verbal therapy was what we wanted for Sam. After our introductory meeting, we were sent a video copy of the session, and continue to receive a video copy of each and every session that Sam attends. This is great for the other parent if they are unable to attend or, simply as a reference tool, when you are putting the techniques you are shown in to everyday practice. We are given, mutually agreed, take home goals to work on with Sam, in between sessions, which gives us a structure to work with, and one that enables Sam not only to grasp concepts but also develop his understanding of the world around him. And the best thing about the 'take home' goals? They are realistic and achievable. In addition to the expert listening and spoken language approach we wanted, we came to realise that we would get a lot of invaluable support from Auditory Verbal[UK] along the way, both procedural and emotional. Auditory Verbal[UK] have been of immense help with Sam's Education, Health and Care Plan; writing detailed reports to facilitate this and to assist in our ambition of delaying Sam's entrance to his chosen Primary School's reception year. Nothing is too much trouble for the team at Auditory Verbal[UK]. There is always someone available to be contacted for help and advice.

It has been a long journey for Sam as he also had problems with his balance to cope with. Today our little boy is talking away and it is all thanks to the guidance and dedicated hard work of Auditory Verbal[UK]. Sam is currently scored at having the lower end of age appropriate speech. This is fantastic achievement for our little boy. And all before he has even started school! Just like the friend of a friend before us, we cannot recommend Auditory Verbal[UK] highly enough to anyone. We feel so optimistic about Sam's bright future and we don't feel his deafness will hold him back from achieving anything he wants to do. There are still lots of questions and not very many answers: what will he *want* to do? How will he narrow down all of the life opportunities and career avenues open to him? How will he find the time? And you know what? Auditory Verbal[UK] have held our hand and shown us that it isn't scary at all. It is exciting!

Sam's parents, Joanna and Andrew

3. What is the relevant evidence?

Having examined both the current context of childhood hearing loss and the auditory verbal therapy model, it must now be established whether auditory verbal therapy is effective at producing outcomes such as greater attainment at school and improved employment prospects.

The literature summary highlighted below replicates much of the work undertaken by First Voice's 2011 Social Cost-Benefit Analysis, with their kind permission. It covers early intervention, the link between hearing loss and language delay, the role of early intervention in hearing loss and reviews of auditory verbal therapy but it should not be considered exhaustive. Rather, by providing relevant background information, this chapter should help inform assumptions made in the CBA.

3.1 Early Intervention

There is a trend towards intensive early intervention across a range of fields, from autism to dyslexia, mental health to nutrition.[45] Much of this literature focuses on the importance of early intervention in childhood development programmes.

Doylea et al examined the 'antenatal investment hypothesis' and provided an overview of the impact of adverse risk factors during the antenatal and early childhood periods on outcomes later in life:

> Intervening in the zero-to-three period, when children are at their most receptive stage of development, has the potential to permanently alter their development trajectories.[46]

Hart and Risley's 1995 study of 42 children from different socio-economic groups found that by the end of three years of age, children from professional families heard 30 million more words than children from poorer families.[47] As Dr Dana Suskind reflected in her 2015 book, Thirty Million Words, the early language environment that a child experienced was the critical factor in determining a child's language capability:

> Counter to relevant thought at the time, neither socio-economic status, nor race,

[45] First Voice (2011). *A Social Cost-Benefit: Early intervention programs to assist children with hearing loss develop spoken language*, p.24.
[46] Doylea, O., Harmon, C.P., Heckman, J.J., et al (2009) 'Investing in Early Human Development: Timing and Economic Efficiency. *Econ Hum Biol* 7:1-6.
[47] Hart, B. and Risley, T (1995) *Meaningful Differences in the Everyday Experience of Young American Children*, Baltimore, Paul Brookes, (800, 638-3774).

> nor gender, nor birth order was the key component in a child's ability to learn because, even within groups, whether professional or welfare, there was variation in language. The essential factor that determined the future learning trajectory of a child was the early language environment: how much and how a parent talked to a child.[48]

3.2 Hearing Loss and Language Delay

A significant body of literature highlights the impact that hearing loss has on language delay. Despite advances in hearing aid and cochlear implant technology, the provision of intervention services, and a greater awareness of the effects of deafness among educators, language delay remains an enormous problem for children with hearing loss. Research over the last 15 years has shown that, on average, children with hearing loss learn language at only 50-60% of the rate of hearing children:

> Many children will have a language delay of at least 1 year by the time they are of school age, and around half have a severe language delay (greater than 2 standard deviations below the mean). Accordingly, academic achievement results for children with hearing loss have generally been poor and a significant proportion never achieve functional literacy.[49]

Weisleder and Fernald's 2013 study found that a richer language experience through more exposure to child-directed speech, positively influenced the efficiency of children's language-processing skills that promote language growth.[50] As Moeller and Tomblin argued in a recently published paper on the outcome of children with hearing loss:

> Children who are hard of hearing experience limitation in access to and perception of linguistic input, which leads to a decrease in uptake and an overall reduction in language experience.[51]

3.3 Early Intervention in Hearing Loss

Since the introduction of universal newborn hearing screening (UNHS) in the UK, there have been a number of studies published assessing the longer-term impact of early identification.

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[48] Suskind, D (2015) *Thirty Million Words: Building a Child's Brain*, p.34.
[49] Mayer, C (2007) 'What really matters in the early literacy development of deaf children', *Journal of Deaf Studies and Deaf Education* 12.4:411-431, p412
[50] Weisleder A., Fernald A. (2013) Talking to Children Matters: Early Language Experience Strengthens Processing and Builds Vocabulary, *Psychol Sci*. 2013 Nov 1:24(11):2143-52
[51] Moeller M., Tomblin, J. (2015) An introduction to the outcomes of children with hearing loss, *Ear and Hearing.*

> Universal newborn screening and early confirmation of permanent childhood hearing loss improves reading ability at primary school age and adaptive behaviour with respect to communication skills.[52]

Similarly, in 2014, Pimperton described the effects of UNHS on longer-term literacy outcomes, finding that early confirmation of hearing loss was associated with significant benefits to reading comprehension in the teenage years.[53]

In 2002, Sharma et al highlighted the crucial nature of early intervention for a child with hearing loss. As the stimulation and development of the auditory cortex in the brain was needed for a child to learn to listen, and consequently talk, the authors showed that:

> There is a sensitive period of three and a half years during which this central auditory system remains maximally plastic.[54]

Within this small window, the brain has greatest *neuroplasticity,* meaning early intervention needs to happen as soon as possible in a child's life for it to be maximally effective.

As Sharma, Campbell and Cardon found in their 2015 study[55], long-term deafness extending beyond the early school-age years without adequate auditory stimulation may result in significant re-organisation of the brain, with areas of the auditory cortex becoming more visual:

> A basic tenet of developmental neurobiology is that certain areas of the cortex will reorganize, if appropriate stimulation is withheld for long periods. Stimulation must be delivered to a sensory system within a narrow window of time (a sensitive period) if that system is to develop normally.[56]

A US study in 2011 reporting on the impact of early intervention on expressive vocabulary hypothesised that the number of words produced would be higher for children with hearing loss who were enrolled in early intervention before the age of three months. Using a prospective longitudinal matched cohort study design, the

[52] McCann, D.C et al., (2008) Reading and Communication skills after universal newborn screening for permanent childhood hearing impairment, *Arch Dis Child* 94:293-297.
[53] Pimperton, H., et al (2014) The Impact of universal newborn hearing screening on long-term literacy outcomes: a prospective cohort study, *Arch Dis Child* 10:1136.
[54] Sharma, A., Forman, M., Spahr, A.J. (2002) A sensitive period for the development of the central auditory system in children with cochlear implants: implications for age of implantation, *Ear and Hearing.*
[55] Sharma A, Campbell J, and Cardon G. (2015). Developmental and cross-modal plasticity in deafness: Evidence from the P1 and N1 event-related potentials in cochlear implanted children. *Intl Journal of Psychophysiology* 2014, doi: 10.1016/ j.ijpsycho.2014.04.
[56] Sharma, A, Nash A, and Dorman A. (2009). Cortical development, plasticity and re-organization in children with cochlear implants. *J Commun Disord*. Jul-Aug;42(4):272-9.

authors concluded that this was indeed the case, stating that:

> Although multiple factors are associated with expressive vocabulary growth of children with hearing loss, enrolment in early intervention </=3 months has sustained beneficial effects on expressive vocabulary at 18 to 24 months.[57]

Similarly, a US study found that children who were enrolled prior to the age of six months were more likely to have age-appropriate language skills than children who were enrolled at or after six months. These age-appropriate language skills were maintained over time.[58]

A study of a group of 112 children with hearing loss by Moeller et al strongly supported the current mainstream view that earlier intervention is associated with better outcomes:

> Children who were enrolled earliest…demonstrated significantly better vocabulary and verbal reasoning skills at 5 years of age than did later-enrolled children. Regardless of degree of hearing loss, early-enrolled children achieved scores on these measures that approximated those of their hearing peers. In an attempt to understand the relationships among performance and factors, such as age of enrolment, family involvement, degree of hearing loss and nonverbal intelligence, multiple regression models were applied to the data. The analyses revealed that only 2 of these factors explained a significant amount of the variance in language scores obtained at 5 years of age: family involvement and age of enrolment… Importantly, there were interactions between the factors of family involvement and age of enrolment that influenced outcomes. Early enrolment was of benefit to children across all levels of family involvement. However, the most successful children in this study were those with high levels of family involvement who were enrolled early in intervention services.[59]

The above findings are in line with earlier work by Yoshinaga-Itano who analysed data for the US state of Colorado, finding:

> Children who were early-identified and had early initiation of intervention services (within the first year of life) had significantly better vocabulary, general language abilities, speech intelligibility and phoneme repertoires, syntax as measured by mean length of utterance, social-emotional development, parental bonding, and

[57] Vohr B, Jodoin-Krauzyk J, Tucker R, et al (2011) 'Expressive vocabulary of children with hearing loss in the first 2 years of life: impact of early intervention. J Perinatol 31:274-80.
[58] Meinzen-Derr J, Wiley S, Choo DI (2011) 'Impact of early intervention on expressive and receptive language development among young children with permanent hearing loss, *Am Ann Deaf* 155(5):580-91
[59] Moeller, MP, (2000) Early intervention and language development in children who are deaf and hard of hearing, *Paediatrics* 106:3

parental grief resolution.[60]

A number of studies have examined the development of theory of mind – the ability to understand that others have beliefs, desires, intentions, and perspectives that are different from one's own – in children who are deaf:

> Effective and appropriate social communication/pragmatic language skills require a communicator to have a theory of mind (ToM). Deficits in ToM underlie many of the social communication difficulties exhibited by persons with a variety of conditions, including deafness. It is imperative that language specialists know how ToM develops, the effects of ToM deficits on social communication skills and discourse comprehension, the cognitive and linguistic foundations for ToM and how to promote development of ToM.[61]

A 2008 study found a correlation between early intervention and the development of theory of mind:

> Thirty children with cochlear implants (CI children), age range 3-12 years, and 30 children with normal hearing, age range 4-6 years, were tested on theory of mind and language measures. The CI children showed little to no delay on either theory of mind, relative to the NH children, or spoken language, relative to hearing norms. Results suggest that cochlear implantation can benefit spoken language ability, which may then benefit theory of mind, perhaps by increasing access to mental state language.[62]

Other papers looked more specifically at the relationship between speech and language outcomes and the age at which a child receives a cochlear implant. In one, the authors examined latent-growth curves for 100 children who had received their implants when they were between one and ten years of age and had used their devices for between one and twelve years, finding that:

> There seems to be a substantial benefit for both speech and vocabulary outcomes when children receive their implant before the age of 2.5 years. This benefit may combine a burst of growth after implantation with the impact of increased length of use at any given age. The added advantage (i.e. burst of growth) diminishes

[60] Yoshinaga-Itano C.(2003) Early Intervention after universal neonatal hearing screening: impact on outcomes, *Mental Retardation and Development Disabilities Research Reviews*, 9(4):252-266.
[61] Westby, C., and Robinson, L (2014) A Developmental Perspective for Promotion Theory of Mind, *Topics in Language Disorders* 34(4):362-382.
[62] Remmel E, and Peters, K (2008) Theory of Mind and Language in children With Cochlear Implants, *Deaf Stud Deaf Educ* 14(2):218-36.

systematically with increasing age at implantation.[63]

Similarly in 2012, Kral and Sharma found that:

> Children who become deaf before the development of language (i.e. prelingually deaf), if fitted with a cochlear implant early in childhood, demonstrate remarkable success in acquiring spoken language, especially if exposed to enriched language environments and supported by committed parents and caregivers… However, implantation in later childhood results in successively less benefit and implantation in the elementary school age or later, as a rule, does not lead to good speech understanding. Late-implanted subjects can detect the auditory stimulus (i.e. they hear) but the majority of them are not able to discriminate complex sounds appropriately in everyday situations, even after many years of implant use. The consequence is substantially compromised speech.[64]

In contrast, in a 2005 Australian paper, Wake et al came to the conclusion that the degree of hearing impairment was the predominant factor determining language outcomes for 88 seven-to-eight year olds with congenital hearing impairment, and not the age of diagnosis.[65] This paper raised considerable debate and highlighted the need for larger, well constituted and multi-centred studies to gather detailed information on all factors that could influence outcomes.

Despite this, the overall thrust of the findings quite clearly advocates that early intervention leads to stronger outcomes for a child with hearing loss. A 2016 study examined the effect of age of cochlear implantation in children with bilateral severe to profound hearing loss who received cochlear implants under 6 years of age:

> Results support provision of cochlear implants younger than 12 months of age for children with severe to profound hearing loss to optimize speech perception and subsequent language acquisition and speech production accuracy.[66]

[63] Connor CM, Craig HK, Rausenbush SW, et al (2006), The age at which young deaf children receive cochlear implants and their vocabulary and speech-production growth: is there an added value for early implanation? *Ear Hear* 27(6):628-44
[64] Kral A and Sharma A. (2012). Developmental neuroplasticity in deafness. *Trends in Neuroscience* 35(2):111-22
[65] Wake M, Pulakis Z, Hughes EK, et al (2005) Hearing impairment: a population study of age at diagnosis, severity and language outcomes at 7-8 years, *Arch Dis Child* 90(3):238-44.
[66] Dettman, SJ, et al (2016) Long-term Communication Outcomes for Children Receiving Cochlear Implants Younger than 12 Months: A Multicentre Study, *Otol Neurotol* 37(2),:82-95.

Beatrice's story

Through the Government's Newborn Screening Programme for hearing loss, our daughter Beatrice was diagnosed with a profound bilateral sensorineural hearing loss when she was just weeks old. We were advised that she wouldn't be able to hear speech or a dog barking but that she might just be able to hear a jet engine. It was devastating news. For months I awoke in the night, reliving the shock of being told. Would Beatrice ever hear my voice? Would she make friends and be happy? I felt completely isolated and the professionals' expectations for her seemed so low.

However, one teary telephone call to Auditory Verbal[UK] dramatically changed the path we were on. I was advised to get the best technology available for Beatrice and to start auditory verbal therapy with Auditory Verbal[UK] immediately. At last there seemed to be a sense of urgency to get Beatrice hearing as best she could. During our first session with Auditory Verbal[UK], we were horrified to find out that Beatrice, now 16 months old, had absolutely no understanding of sound – she didn't even associate sound with meaning. Whilst we were reeling from this, Beatrice, through play, began to respond to her name. It took just an hour. Witnessing my profoundly deaf daughter react for the first time to my voice was a miracle.

Every other week we travelled a 180 mile round trip to attend play sessions teaching us, the parents, how to help Beatrice gain age-appropriate language. Her progress was meteoric. By the time she was five, Beatrice was able to graduate from Auditory Verbal[UK] and start school with age-appropriate language, on a par with her hearing peers and with unbelievably clear diction.

Beatrice is now 12. She has aspirations just like her hearing peers; one minute she wants to be a barrister, the next an interior designer. She has just moved to secondary school where she is now independent and confident enough to manage her own hearing needs (liaising with teachers for extra support if needed). Beatrice is extremely popular; she's very funny and never misses an opportunity to joke or play a prank. She's one of her year's most advanced hockey players, loves listening to music and is studying hard too. The world is her oyster. We always believed that deafness should not overshadow Beatrice's character or preclude her from any opportunity in life. Thanks to Auditory Verbal[UK] it truly hasn't.

Beatrice's mother, Kate

3.4 Auditory Verbal Therapy

As discussed in Chapter 2, Auditory Verbal[UK] specialises in auditory verbal therapy (AVT). It is one of the main modern approaches to early therapy that is currently available to children with hearing loss:

> Auditory verbal therapists work over time with families to maximise listening and to ensure that they are equipped with knowledge and skills to maximise their child's spoken language potential… AVT is an approach based on the assumption that "hearing" is the most effective modality for the teaching of spoken language (speech), reading, and cognitive skills.[67]

Hogan et al's 2008 publication evaluated the AVT approach, comparing actual and predicted rates of language improvement in a group of 37 children with bilateral hearing loss in the UK, concluding that:

> For all age groups and for each of the different hearing technologies, AVT was found to be a highly effective programme for accelerating spoken language development when using RLD [rates of language development] as an outcome measure.[68]

In 2008, the same authors however also noted that:

> Due to the intensive nature of the post-graduate training, AVT is an expensive service. Although there have been some published studies looking into the efficacy of AVT which have been reviewed, there is not yet enough data on the benefit of AVT to conduct either cost-benefit analysis…or to be able to compare the benefits found from other therapies. To date, there have been no studies of randomised control trials involving large numbers of children undertaking AVT.[69]

Since then, in Australia, a paper by Dornan et al, which includes a brief review of previous evidence, has reported on a longitudinal study of 29 children with hearing loss in an AVT programme who were compared with a matched control group with typical hearing at 9, 21 and 38 months after commencement of the study. Children were matched for language age, receptive vocabulary, gender and socio-economic status. As eight children in the AVT group and two children from the typical hearing group moved away during the study period, only 19 match pairs remained for

[67] Hogan S., Stokes J., White, C., et al (2008) An Evaluation of Auditory Verbal Therapy Using the Rate of Early Language Development as an Outcome Measure, *Deafness & Education International* 10(3):143-167.
[68] Hogan S., Stokes J., White, C., et al (2008) An Evaluation of Auditory Verbal Therapy Using the Rate of Early Language Development as an Outcome Measure, *Deafness & Education International* 10(3):143-167.
[69] Hogan S., Stokes J., White, C., et al (2008) An Evaluation of Auditory Verbal Therapy Using the Rate of Early Language Development as an Outcome Measure, *Deafness & Education International* 10(3):143-167.

statistical analysis. The authors reported no significant differences between the groups for speech, language and self-esteem:

> An assessment battery was used to measure speech and language over 50 months, and reading, mathematics, and self-esteem over the final 12 months of the study. Results showed no significant differences between the groups for speech, language, and self-esteem ($p>0.05$). Reading and mathematics scores were comparable between the groups, although too few for statistical analysis. Auditory verbal therapy has proved to be effective for this population of children with hearing loss.[70]

Whilst there have still been no studies of randomised control trials to date due to ethical issues, a 2015 study from First Voice has collated the outcome data of 696 children in Australia, the largest data set used to date for evaluating the outcomes of auditory verbal therapy. The study found that:

> The mean language, vocabulary and speech standard scores fell within the average range for typical hearing peers. Most children also had scores within or above the average range for typical hearing children for language (74.4%-75.6%), vocabulary (79.6%) and speech performance (71.5%)… When children with additional disabilities were removed from the analysis, the number of children within or above the average range for typical hearing children increased for language (77.9%-80.2%), vocabulary (83.1%) and speech (73.1%) performance.[71]

It has been argued that the outcomes of AVT can be dependent on a child's socio-economic background:

> Fifty-seven percent of the clients who remained in the program for over 1 year were fully integrated into regular education, with no services from a teacher of the deaf. The population was affluent, with more females than expected.[72]

In 2010, however, Hogan et al conducted a study to evaluate language outcomes for 12 children from low-income families enrolled in AVT, finding that:

> There was a highly significant increase in the rate of language development for the group of 12 children over the period of intervention compared to the rate of language development at the start of the children's therapy ($p<0.001$). Financial

[70] Dornam D., Hickson L, Murdoch B, et al (2010) Is Auditory Verbal Therapy Effective for Children with Hearing Loss, *Volta Review* 110(3):361-387.
[71] First Voice (2015). *Sound Outcomes: First Voice speech and language data.* [http://www.firstvoice.org.au/userfiles/file/150302_Sound_Outcomes_First_Voice_Speech_and_Language_Data.pdf]
[72] Easterbrooks SR, O'Rourke CM, Todd NW (2000) Child and family factors associated with deaf children's success in auditory verbal therapy, *Am J Oto*l 21(3):341-4.

status of the family per se is not a factor that influences spoken language outcomes for families participating in AV therapy.[73]

This is supported by continuing evidence from Auditory Verbal[UK]'s programme and the latest outcome study to be published in 2016 (see 3.7).

3.5 Other Communication Methods

The evidence on other communication methods, such as total communication (TC) or oral communication (OC), when compared to AVT, appears to be limited to studies of children with cochlear implants. It is nevertheless valuable to review some of the evidence as this could affect the validity of assumptions for the base case in this CBA.

First, a summary presentation on research carried out at the University of Michigan from 2006 reports statistically significant and superior outcomes for AVT in children with cochlear implants, when compared to TC or OC methods.[74] The research was based on 174 children with cochlear implants, of which 97 were enrolled in OC, 54 in TC, and 23 in AVT. Those enrolled in AVT were younger on average, but these differences were adjusted for in the statistical analysis. Three different test measures for speech perception and three different measures for speech and language were used for this research project. Data were collected during routine one or two year post-activation evaluations. The striking result was that AVT scored significantly higher than the other two methods on all of these measures.

On speech perception measures, the AVT group scored around 90% or higher in two of the three tests at 12 months and in all three tests at 24 months. Children using other methods scored much lower at 12 months (at least 20% lower but up to 70% lower), and while they improved by 24 months, the gap to the AVT group was still very significant (between 10 % on one score and 60% on another score). The authors also noted that the AVT group's receptive vocabulary scores, which rose to around 85% at 24 months, was close to the average for typically hearing children in their age group. In speech production, AVT again scored highly and significantly above the two other methods, on all three tests. While children on the OC programmes did also improve between 12 and 24 months on the three tests used, children in the TC group recorded a decline in two out of the three tests.

[73] Hogan S, Stokes J, Weller I (2010) Language Outcomes for Children of Low-Income Families Enrolled in Auditory Verbal Therapy, *Deafness and Education International* 12(4):204-216.
[74] Heavener K, Griffin BL, El-Kashlan H, et al (2006) *The Relationship Between Communication Approach and Spoken Language in Young Cochlear Implant Recipients*, Report prepared by the University of Michigan Cochlear Implant Team.

An important earlier study published in the Lancet in 2000 examined the determinants of speech perception in children after cochlear implantation.[75] This study used a prospective design and tracked 40 children of which 26 used a total communication approach and 14 just communicated orally priory to implantation.

Speech perception was measured with connecting discourse tracking (CDT) which assesses understanding of speech in conversation without lip reading (unfamiliar text is presented by means of live voice to a listener). The study's summary report the following findings and interpretations:

> The mean number of words per minute perceived increased from 0 before implantation to 44.8 (SD 24.3) 5 years after implantation. Repeated-measured ANOVA showed that children significantly progressed over time (p=0.001). Age at implantation was a significant covariate (p=0.01) and mode of communication was a significant between-individuals factor (p=0.04)… Young age at intervention and oral communication mode are the most important known determinants of later speech perception in young children after cochlear implantation.[76]

The distinction between oral and AVT approaches was not made in this study but it would appear that children being educated using the oral approach, as defined in the study, would have included children enrolled in AVT. As the authors noted, the educational setting and communication approach varied between children, and depended on factors such as parental choice and local educational policy. On balance, this paper provided strong evidence for better speech perception in children whose education emphasised listening and speaking.

Another earlier study of 147 children came to a more ambivalent conclusion, noting mixed results. In this 2000 study, children's consonant-production accuracy and vocabulary development was measured over time, comparing oral with total communication. Children who participated in the study had profound sensorineural hearing loss and had used cochlear implants for between 6 months and 10 years:

> The results of this study suggest that children may benefit from using cochlear implants regardless of the communication strategy/teaching approach employed by their school programme and that other considerations, such as the age at

[75] O'Donoghue, G. M., Nikolopoulos T. P., Archbold, S.M (2000) Determinants of speech perception in children after cochlear implantation, *Lancet* 356:466-8.
[76] O'Donoghue, G. M., Nikolopoulos T. P., Archbold, S.M (2000) Determinants of speech perception in children after cochlear implantation, *Lancet* 356:466-8.

which children receive implants, are more important.[77]

As already noted, the literature reviews presented here cannot claim to be exhaustive, but given the age of some of the earlier studies and having reviewed a number of more recent papers it appears uncontroversial to echo First Voice's 2011 assertion that AVT as an intervention method for children who are deaf or hard of hearing is at least as good as other options, and potentially the best option for most of the children to whom it may be recommended.[78]

3.6 Other Cost Benefit Analysis of Auditory Verbal Therapy

As stated in the introduction, there has been no cost benefit analysis of AVT in the UK published to date. There is, however, one CBA of AVT that currently exists, 'A Social Cost-Benefit Analysis: Early intervention programs to assist children with hearing loss develop spoken language', published in Australia in 2011. This cost-benefit analysis was commissioned by First Voice, a coalition of leading Australian centres supporting children with hearing difficulties and their families.

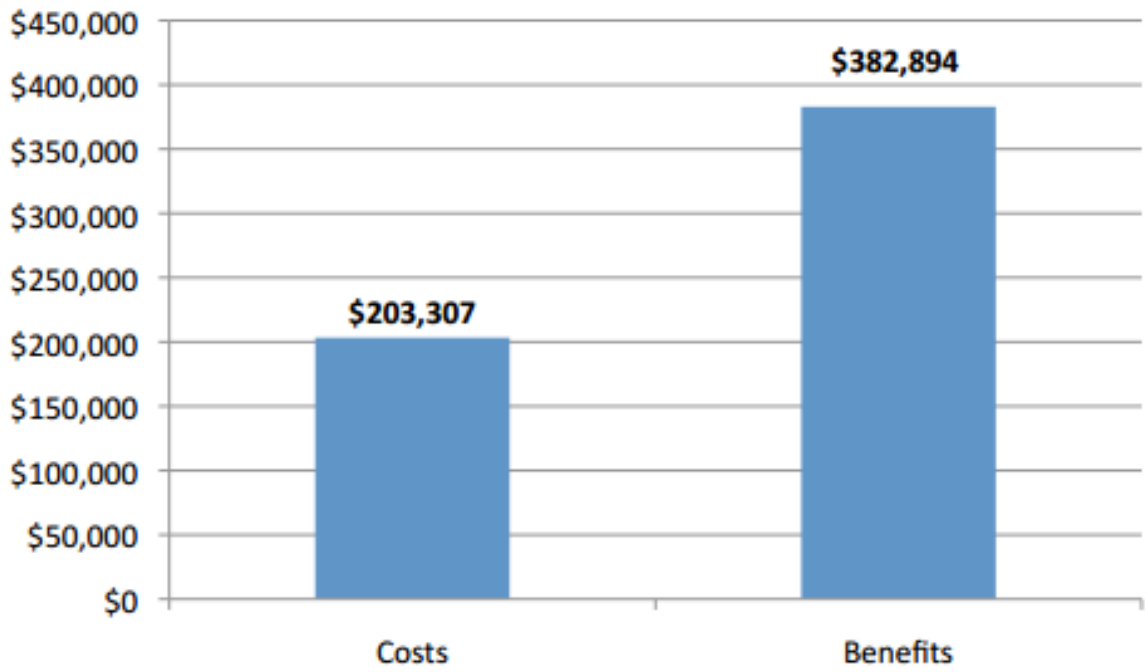
They present a comprehensive assessment of a range of costs involved in their early intervention programme, including operational costs, carer's wages forgone, opportunity cost of capital, deadweight loss associated with raising tax, better/earlier devices, travel, accommodation and meals, child care, short term psychotherapeutic intervention and possible complications. The assessment suggested that while the child is enrolled, the representative total annual cost is $39,697 AUD with follow up costs of $1,798 AUD per year per child until age 21. The present (discounted) value of all costs is $203,307 AUD. Over 90% of this cost is incurred in the five years while the young child is enrolled with the early intervention programme – a significant investment in the child's future.

When quantifying the benefits, the 2011 CBA was extremely conservative, aware that the long term impact of early intervention such as educational attainment, employment status and production is still emerging. Their estimate included the quantified benefits of productivity gain, reduction in disability, school costs avoided, likelihood of being in paid work and injuries avoided. The present value of these

[77] Connor C. M., Hieber S., Arts, H.A., et al (2000), Speech, vocabulary and the education of children suing cochlear implants: oral or total communication*? J Speech Lang Hear Res* 43:1185-204.
[78] First Voice (2011). *A Social Cost-Benefit: Early intervention programs to assist children with hearing loss develop spoken language.*

benefits is $382,894 AUD, using a discount rate of 3% and a time scale of 50 years.

Figure 8: The costs and benefits of early intervention (present values) - First Voice study, 2011

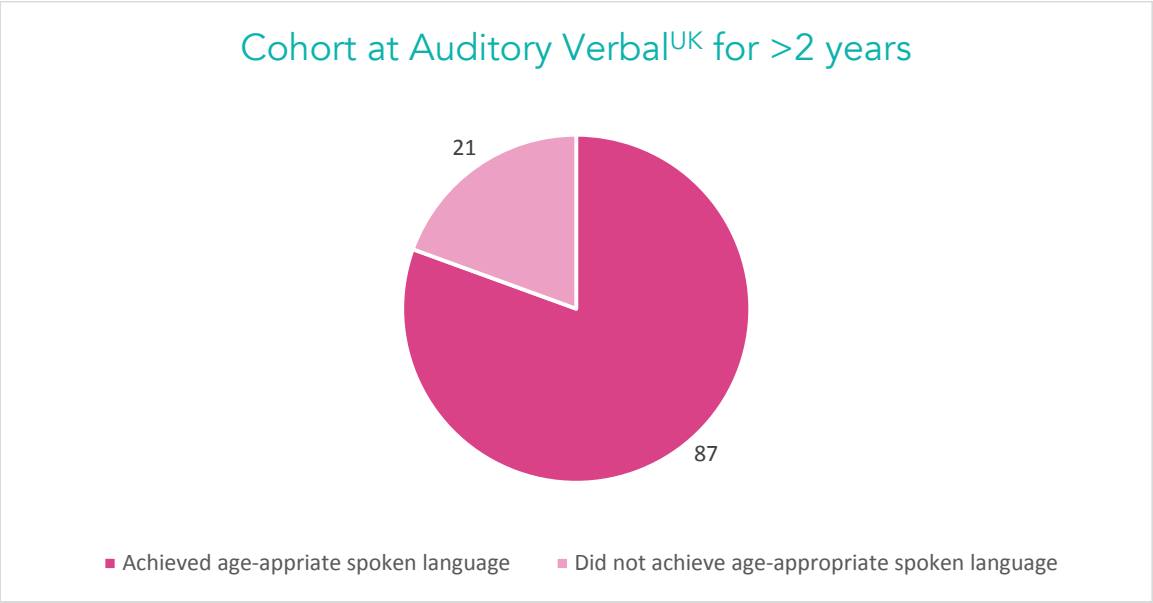


The benefit-to-cost ratio (BCR) is therefore 1.9:1 – indicating that a dollar invested produces nearly two dollars of benefits in return.

3.7 Evidence from Auditory Verbal[UK]

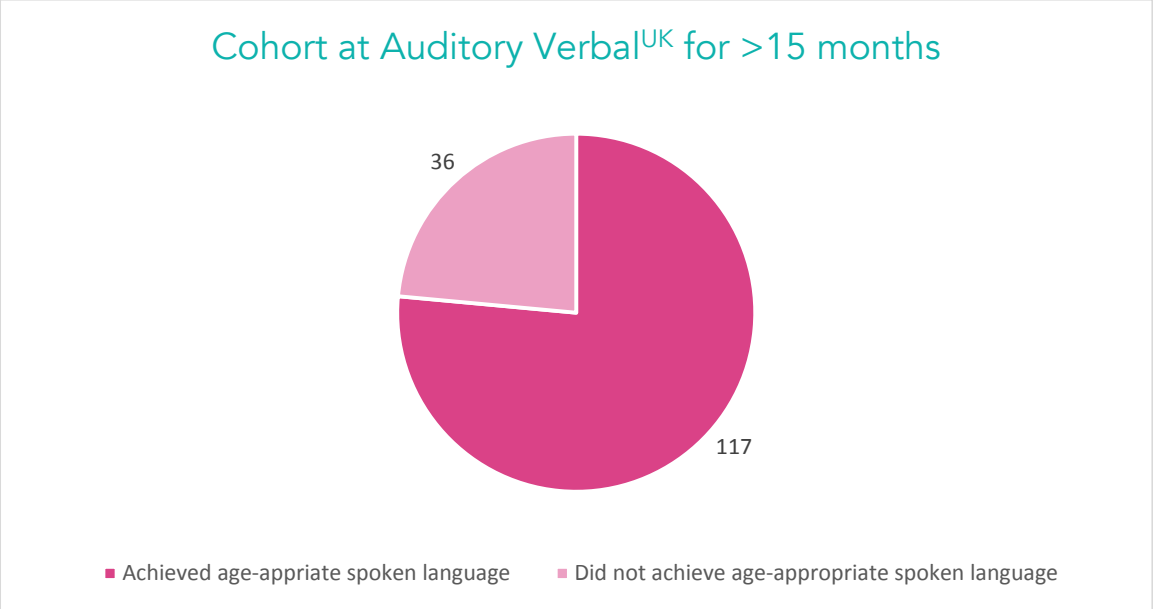
From January 2003 to December 2015, 285 children graduated from an auditory verbal programme at Auditory Verbal[UK] (see section 2.4). For the 108 children who stayed on the programme for 2 years or more, 81% achieved age-appropriate spoken language. This figure includes children with additional needs.

Figure 9: Cohort at Auditory Verbal[UK] for >2 years who achieved age-appropriate language.



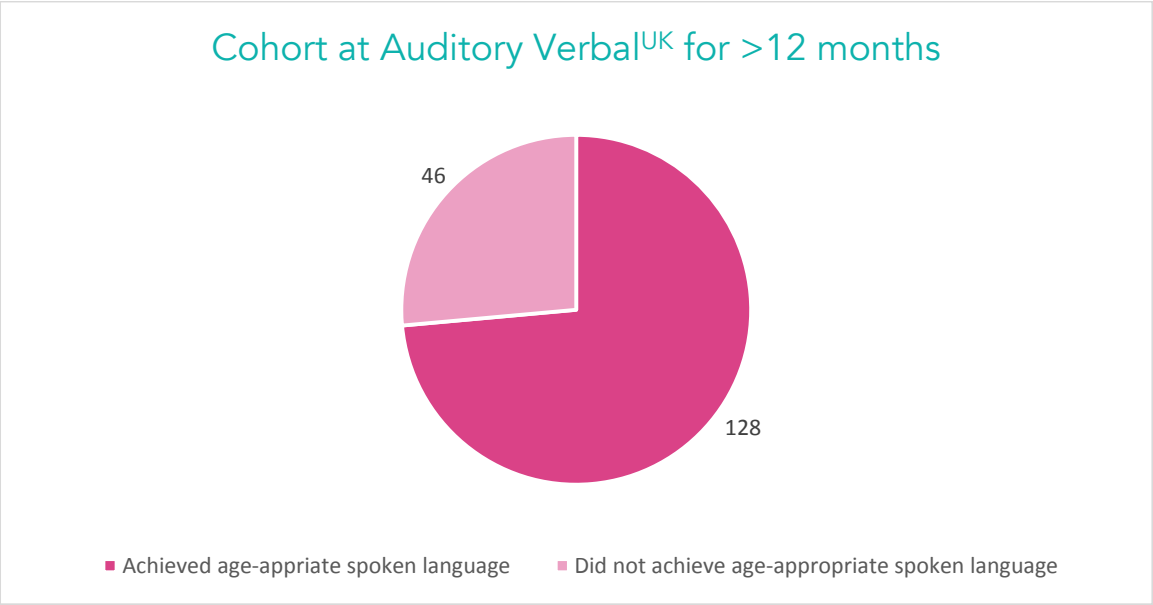
For the 153 children who stayed on the programme for 15 months or more, 76% achieved age-appropriate language. This figure also includes children with additional needs.

Figure 10: Cohort at Auditory Verbal[UK] for >15 months who achieved age-appropriate language.



For the 174 children who stayed on the programme for 12 months or more, 74% achieved age-appropriate language. This figure includes children with additional needs.

Figure 11: Cohort at Auditory Verbal[UK] for >12 months who achieved age-appropriate language.



3.8 School Leaver Outcomes

As explained earlier, because Auditory Verbal[UK] was only established in the UK in 2003, the first generation of beneficiaries of this early intervention programme are only just reaching adulthood and evidence on the lifelong impacts of this therapy is therefore only just beginning to accumulate.

Below is a table published by NDCS in 2014 that compares the educational attainment of deaf children in the UK against hearing children in the UK.[79] As the Auditory Verbal[UK] cohort increases and children progress through their educational career, an additional column can be added to show the attainment of children who have had an early intervention programme of AVT at Auditory Verbal[UK].

[79] NDCS note of Department for Education figures on attainment for deaf children in 2014 (England)

Table 12 – NDCS/Department for Education Figures on Attainment for Deaf Children in 2014 (England)

	Deaf children	Children with no identified SEN	All children (including deaf children)
5 GCSEs (including English and Maths) at grades A*-C	36.3%	65.3%	56.6%
5 GCSEs (in any subject) at grades A*-C	44.6%	74.7%	65.5%
Key Stage 2:			
Reading, Writing and Mathematics *(expected level)*	54%	90%	79%
Reading *(expected level)*	71%	96%	89%
Writing *(expected level)*	63%	95%	85%
Grammar, Punctuation and Spelling *(expected level)*	56%	88%	76%
Mathematics *(expected level)*	67%	94%	86%
Key Stage 1			
Reading *(expected level)*	66%	97%	90%
Writing *(expected level)*	60%	94%	86%
Mathematics *(expected level)*	72%	98%	92%
Science *(expected level)*	68%	97%	91%
Expected level of Phonic Decoding (Year 2)	64%	95%	88%
Expected level of Phonic Decoding (Year 1)	44%	81%	74%
Achieving a good level of development in the early years foundation stage	26%	66%	60%

Zack and Dylan's story

Our twin sons, Zack and Dylan, were born with severe to profound hearing loss in July 2011 in New York. The day we learnt about their hearing loss, we were shocked. We could not believe what and why this could have happened to us. Being an Italian family living abroad, we also questioned whether Zack and Dylan would be able to learn more than one language and we were concerned that exposing them to two languages would be too much for them.

The NYU Medical Centre Audiology team explained that cochlear implant surgery as early as six months, combined with auditory verbal therapy would give Zack and Dylan the opportunity to live a very normal life without limitations as to what they could achieve. At 1 month of age we started AVT in New York and at 6 months the twins received their bilateral cochlear implants (CI). Two weeks after their CIs were activated, they started repeating some sounds during the AVT sessions and every day was a discovery of new sounds and words.

After two years of AVT we asked my husband's employer to be transferred to the UK because I knew that Auditory Verbal[UK] was one of the best centres in the world for this therapy and we wanted the best for Zack and Dylan. We quickly started seeing them make incredible progress; they began to understand that they have their own ideas and opinions and they started to talk, ask and interact more and more with their peers.

We are hugely grateful to Auditory Verbal[UK]. Our therapist helped me to understand there are no limits for kids with cochlear implants, and no limits for bilingual cochlear implanted children either. We are convinced every cochlear implanted child can be bilingual or even learn more languages comfortably. Zack and Dylan are currently fluent in English and, during summer holidays in Italy, they speak good Italian with their friends and cousins. They have started Reception and despite being amongst the youngest children in their class, are doing very well.

I want to tell any new parents that AVT was the most important training for our children's brain and to remember that the sky is the limit!

Zack and Dylan's mother. Deborah

4. Costs and Benefits

A simple version of the cost-benefit argument has been presented in the Executive Summary of this report. This chapter provides more detail on how the numbers on the propositions put forward earlier have been calculated and provides more detail on the methodology behind the figures.

4.1 The project horizon and discount rates

An important decision in conducting a cost benefit analysis relates to the timeframe over which costs and benefits are assumed to flow. A 30-year horizon is typically used for projects that involve investments in physical assets such as roads and buildings, although a 50-year horizon can be applied where there is good reason to believe that the asset will yield benefits over a longer period.

The benefits of improved hearing and language are life-long and therefore it seems intuitive that the appropriate project horizon would be set by life expectancy. HM Treasury recommends a 3.5% discount rate for projects between 0-30 years and a 3% discount rate for projects between 31-75 years.[80]

A 50-year project horizon was adopted for this CBA and 3.5% discount rate is used for the first 30 years, with a 3% discount rate for the final 20 years.

4.2 What are the costs?

4.2.1 Operational Costs

The total Early Intervention Programme (EIP) costs for Auditory Verbal[UK] were £597,969 in 2015-2016. This includes the direct cost of providing the therapy, such as staff, travel, premises, training and courses, toys, books and membership subscriptions. It also includes the costs needed to support this activity, such as administrative and fundraising staff, IT, communications and repairs and maintenance.

With a caseload of 114, the average cost per child is £6,557 per annum.

There is no typical period of time that a child spends on the programme as the time it takes a child to achieve age-appropriate language can vary enormously. It also

[80] HM Treasury (2011), The Green Book: Appraisal and Evaluation in Central Government, p. 98.

depends on the age at which the child joins the programme.

On average a child spends between 2 and 3 years on the programme. Conservatively, this CBA assumes that a child spends 3.5 years on the programme.

4.2.2 In kind Costs

In kind costs are provided free of charge but should be counted within a CBA because of the associated 'opportunity cost' – if the resources were not used for this programme, they could have been used elsewhere.

4.2.2.1 Volunteer Staff Time

Auditory Verbal[UK] has 4 volunteers, 2 based in London and 2 based in Oxfordshire, who together give the equivalent time as 1.1 full-time member of staff. Using the average yearly income for administrative staff, weighted both geographically and for different skill levels, the average cost is outlined in table 13.

Table 13: Volunteer Staff Time

Admin staff salary outside London	£15,000
Admin staff salary in London	£18,000
Highly skilled admin staff salary outside London	£25,000
Highly skilled admin staff salary in London	£28,000
Average Admin salary	£21,500
Average Admin salary for 1.1 member of staff	£23,650
Cost per child (114 caseload)	£207
Optimism Bias	15%
CBA Cost per child	**£239**

Four members of staff at Auditory Verbal[UK] are being mentored by a Human Resources specialist. In total, this volunteer gives 16 hours of support per year and would charge £225 per hour. They would also normally charge for their travel: a return trip of 203.6 miles, 3 times a year at £0.45 per mile. The total cost is therefore £3,874.86 which is an in kind cost of £34 per child. No optimism bias correction is needed as this is independently audited cost data.

An IT consultant has also provided Auditory Verbal[UK] with 10 days of consultancy work

to optimise data collection methods. This would be charged at £6,000 which is an in kind cost of £53 per child. Again, no optimism bias correction is needed as this is independently audited cost data.

The team also benefited from individual team profiles and a team awareness day from a consulting firm that specialises in organizational effectiveness. With consultancy fees of £5,000, seventeen profiles at £93.50 per person, £70 of printing costs and £10 for travel, the total cost would have been £8003.40. This is an in kind cost of £70 per child. Again, no optimism bias correction is needed as this is independently audited cost data.

4.2.2.2 Free use of venues

Auditory Verbal[UK] also benefit from the free use of venues to hold an annual team away day. This alternates each year between London and Oxford. Weighted geographically, the average cost of a conference room for 20 members of staff is £147.50. With an optimism bias of 5%, this is an in kind cost of £1.35 per child.

4.2.3 Travel

Detailed client surveys were not available to inform the discussion of this cost factor; however, it is clear that families travel to and from the Auditory Verbal[UK] centres in Bermondsey, London and Bicester, Oxfordshire from throughout the UK.

This CBA assumes that 20 trips to and from AV[UK] centres are made by each family, on average, each year. It is assumed that the average distance travelled is 200 miles in one return trip at 11.38 pence per mile. Parking has been assumed to be free of cost. Using these assumptions and applying a 15% optimism bias, the average annual cost per child is estimated at £523.

4.2.4 Childcare for Siblings

Due to the nature of AVT and the focus on parent-coaching, it may be necessary for siblings to be looked after by someone else while the parent(s) is attending a therapy session.

According to the Office for National Statistics, as of March 2013, 39% of the 7.7m families in the UK had 2 children and 14% had 3 or more children, giving a total of 53% of families. For families like these, it is likely that some form of child care will have to be organised for each session. Even if a child is in the care of a relative or friend, or being cared for by a volunteer at AV[UK], a value needs to be put on their time.

Using a valuation of £7 per hour for either paid or unpaid child care, and a 5 hour requirement of child care each time a sibling attends auditory verbal therapy, an economic cost of £35 per occasion is suggested. Assuming 20 trips per year on average, for 53% of the cohort to which this applies, this equates to a £427 cost per child per year, with a 15% optimism bias.

4.2.5 Carer's Loss of Income

There is no survey data available to ascertain whether a parent is more likely to give up work if their child is enrolled in an AVT programme compared to parents of hearing-impaired children not enrolled in AVT. However we know anecdotally that at least one parent – if not both – may forgo income to bring their child to sessions. On average, including travel time and appointment time, a parent can have to take at least 5 hours from work for each time their child attends AVT. It is conservatively assumed that this time equates to one parent taking a full day off work for each of the 20 sessions across the year.

In 2014, the labour participation rate in the UK was 76.5%; 74.6% for women and 83.1% for men.[81] The Office for National Statistics does not publish the participation rates of men dependent on child age.

For women, their participation rate dropped to 65% when they have a child between the ages of 0-4 and increased to 78.8% when a child was between the age of 5 and 10. Given that Auditory Verbal[UK]'s cohort is split across ages 0-5, the average participation rate for mothers with children enrolled in AVT is therefore 67.9%.

In addition, it must be recognised that mothers of disabled children have a lower rate of workforce participation than other mothers, with child disability estimated to reduce maternal employment by 7.6% among women when they are secondary earners and by 10.8% when they are primary earners.[82] As 31% of women are the primary household earners, we can estimate that there is, on average, an 8.59% reduction in employment amongst mothers of children with a disability.[83] This gap is acknowledged in this CBA by deducting 9.7% from the initial 67.9% participation rate identified above.

This means that 59.31% of the mothers of children in the auditory verbal cohort could be expected to be in paid employment and 83.1% of men. Taken from the Office of

[81] Office for National Statistics (2014), Participation Rates in the UK Labour Market.
[82] Powers, E. (2001) Estimates of the Impact of Child Disability of Maternal Employment , *American Economic Review* 91(2)
[83] Ben-Galim, D, and Thompson, S., (2013) Who's Breadwinning? Working Mothers and the New Face of Family Support, *Institute for Public Policy Research*

National Statistics, the average female salary in 2014, was £23,889 and the average male salary was £29,441.[84] Conservatively assuming parents are working full time, this is a day rate of £113.23 and £91.88 respectively. It is recognised that each family will vary enormously but for the purpose of this cost benefit analysis, it is assumed that the 59.31% of working mothers will take off 10 days a year and the 83.1% of working fathers will also take off 10 days a year.

The representative or average loss of income is, on this basis, estimated at £1,485.80 per year per child in an early intervention programme of auditory verbal therapy at Auditory Verbal[UK] ((£113.22 x 10 x 0.831)+(£91.88 x 10 x 0.5931)). With an optimism bias of 15% added, the average loss of parental income is £1,709.

4.2.6 Unquantifiable costs

Whilst the list of costs identified above is highly conservative, there are a number of costs that are currently unquantifiable, that need to be recognised. One type of cost that is currently difficult to quantify is the greater effort that deaf children have to put in to acquire language compared to hearing children.[85,86] Another type of unquantifiable cost may be related to cultural identity issues; children may identify less with the Deaf community and may feel rejected by it once they have completed their journey through their auditory verbal programme. This may lead to mental health issues requiring support with associated costs. Finally, as families adjust to the EIP, they may acquire literature and spend time researching different communication options. This clearly takes time and resources but an estimation was not possible for the current study.

4.2.7 Summary of Costs

Table 14 summarises all of the costs described above for the 3.5 years that a child participates in the programme. After the child has left the programme, approximately 5% of families request continuing 'ad hoc' support. For the purposes of this CBA, it is assumed that no further follow up takes place and costs consequently drop to zero for the rest of the project horizon.

Table 14 also takes into consideration the 3.5% discount rate over the 3.5 years.

[84] Office for National Statistics (2014) Annual Survey of Hours and Earnings
[85] McGarrigle, R et al (2014) Listening Effort and Fatigue: What exactly are we measuring? A British Society of Audiology Cognition in Hearing Special Interest Group White Paper, *International Journal of Audiology* 53(7):433-445.
[86] Hicks, C.B, & Tharpe, A.M (2002) Listening Effort and Fatigue in School-Aged Children with and without Hearing Loss, *Journal of Speech, Language and Hearing Research* 45:573-584.

The net present value of costs is £31,119. This can be seen as the investment that is made in the child's future.

Table 14: Summary of costs over time, per child per year.

Cost	Value	Year 1	Year 2	Year 3	Year 3.5	Present Value
Operational	£6,557	£6,335	£6,121	£5,914	£2,857	£21,227
In Kind	£397	£383	£370	£358	£173	£1,284
Travel	£523	£506	£489	£472	£228	£1,695
Childcare for siblings	£427	£421	£398	£385	£186	£1,381
Carer's Loss of Income	£1,709	£1,651	£1,595	£1,541	£745	£5,532
Total Net Present Value						£31,119

The total value of costs in this CBA is much lower than the total value of costs in First Voice's 2011 Social Cost Benefit Analysis - $203,307 (£103,910). This is because the First Voice model of AVT is for 5 years from 0-5 and includes an annual follow-up with children from the ages of 0-21, adding an additional $1798 per year to the overall cost. Additionally, the authors of the Australian study assume that at least one member of the family stops working for the five years that a child is on the programme, adding an annual cost of $16,162 per year. This CBA does not assume that one member of the family stops working due to AVT because AVT is designed to fit into everyday life. Anecdotal evidence from parents of children on our programme also shows that if a parent does choose to stop working, pursuing an auditory verbal approach is not the reason for doing so.

4.3 What are the benefits?

Hearing loss, and the associated delays in language development, can have a number of well-documented negative impacts on a child's life.[8,9,10]

Auditory Verbal[UK]'s EIP aims to accelerate language development so that AV[UK]

graduates achieve spoken language and communication skills that are on a par with their hearing peers and will enable them to join and flourish in a mainstream school. Where this is achieved, children are able to communicate better with their teachers and participate more actively alongside other pupils in mainstream schooling.

In the short term, a key benefit for the child involved is that he or she better access the language of the curriculum. Later on, this should translate into stronger academic attainment and higher participation in further education, which in turn improves the child's long-term earnings outlook.

Improved social integration also has consequences for a child's sense of achievement and emotional wellbeing in the short as well as longer term, and helps improve participation in a range of settings continuing from childhood into adulthood.

kurran's story

Kurran was born two months premature, in 2003, and quickly fell victim to a severe necrotizing enterocolitis (NEC) infection. He spent the first two years of his life in hospital, underwent three lifesaving operations and has only 40% of his bowel intact. Having survived the first two years and, just when Kurran's family thought their life was stabilising, they learnt that their son is profoundly deaf. Kurran received a cochlear implant relatively late, at four years and three months. He also has mild cerebral palsy and developmental delay. His father, Avy, tells their story.

"It felt like there was a constant barrage of bad news every day – 'he's not going to walk', 'his limbs aren't working', 'his femoral artery has been damaged' and so on. Two years of coping with this and living in a hospital came close to destroying us. Then came the deafness diagnosis. To be honest, I felt helpless for the first time in my life and I was probably at my lowest ebb. Hearing aids made no difference and by the age of four, Kurran still hadn't uttered a single comprehensible word. Despite Kurran being older than most children who are implanted, Great Ormond Street Hospital agreed to a single right-sided cochlear implant in September 2007. I'll never forget the first time he was 'switched on'! His eyes were like a rabbit in the headlights but though he could hear, crucially, he couldn't interpret what the sounds meant.

Discovering Auditory Verbal[UK] was like finding a huge inflatable balloon full of hope, help and real progress. Every time we went to AV[UK], we were inspired and had complete confidence that we were in the safest, expert pair of hands. Through intensive AVT, Kurran managed to hear his first sound – a door bell – approximately 6 months after implantation and our therapist helped us put the very first words in Kurran's mouth. For my wife, who had not heard her son say a single word, the best part of four and a half years came when he uttered his first word, "Mummy". It started to feel like we were on a roll and very soon Kurran had 50 or 60 words and was able to articulate most of his needs and demands. Mobility was still a huge issue for Kurran. He spent a lot of time in splints and crutches, as well as the walking frame. He had regular physiotherapy and everything in the house was adapted, but we kept his life as normal as possible, never restricting his capabilities or hope. Progress was painfully slow but I could see results. Around 2008, Kurran took his first independent steps. This small miracle was now unfolding and he could walk, listen, talk and read! Thanks to auditory verbal therapy, he had a rapidly developing vocabulary. He was also starting to eat everything orally and the doctors decided to close his gastro peg permanently.

He is now 12 years old, standing upright and walking and talking, a lot. He doesn't stop talking to be honest and he asks so many questions! Kurran is a vegetarian by choice - he loves animals and believes they are sent from God for us to enjoy and not to eat! He hopes one day to work with pets. He is such a curious boy and very sociable. He's growing at a really fast rate and has all of the normal teenage demands; the mobile phone, the iPad and a bedroom littered with car or pet magazines. He is currently rehearsing for his school play – he tells me he has a central part and is practising his lines every day. And he's learning German too, scoring 9 out of 10 in his German test today! We are so proud of him."

kurran's father, Avy

4.3.1 Improved quality of life

There is a significant body of literature on the relationship between hearing loss, quality of life and disability. The percentage of the Deaf community who say their health is poor is 10% compared to the national average of 6% and deaf people are nearly five times more likely to have a visual impairment, 9% compared to 2%.[87] A 2007 study into the health status of children with bilateral cochlear implants provided rigorous evidence of an association between bilateral permanent childhood hearing impairment and diminished health-related quality of life preference-based outcomes during mid-childhood.[88] This literature clearly indicates that any intervention which improves hearing and enables more effective communication will improve quality of life and/or reduce disability.

Cost effectiveness studies often report costs per quality adjusted life year (QALY) based on a variety of methodologies measuring health-related quality of life (HRQoL). A quality-adjusted life year (QALYS) is a measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life.[89] The measurement of, and assumptions about, health states continues to be an active field of research.

This CBA will use the method for valuing changes in QALY with the concept of the value of a life year (VOLY). The Interdepartmental Group on Costs and Benefits (IGCB, 2004) has recommended the estimated VOLY to be valued at £27,000.[90] This value is consistent with the value of a QALY currently used in recommendations by NICE which is in the region of £30,000. This would mean, for example, that a 10% reduction in disability (or improvement in quality of life) sustained over the course of a year would be valued at £2,700.

Table 15 lists disability weights from the WHO's Global Burden of Disease (GBD) study. The figures presented in Table 15 indicate that if an intervention were to completely 'remove' disability from hearing loss, this would be equivalent to a 2% reduction in disability for those with mild hearing loss, a 10-12% reduction for those

[87] Deaf Wellbeing Action Group in Nottinghamshire (2001) A survey of deaf people's experiences of local health and social support.
[88] Petrou, S., et al. (2007) Health status and health related quality of life preference-based outcomes of children who are aged 7 to 9 years and have bilateral permanent childhood hearing impairment, 120(5).
[89] The National Institute for Health and Care Excellence, NICE Glossary [https://www.nice.org.uk/glossary?letter=q]
[90] Health and Safety Executive, Human Costs of a Nuclear Accident: Final Report (2007) [http://www.hse.gov.uk/economics/research/humancost.pdf]

with moderate hearing loss, and a 32-37% reduction for those severe hearing loss.

As has been mentioned, such a reduction could not, in most cases, be achieved without a hearing device, but at the same time it could also not be achieved without appropriate language development services. According to Anthony Hogan and colleagues:

> The literature indicates that on average, the use of hearing aids and devices is associated with a 50% improvement in health related quality of life, but significant residual disability remains.[91]

This suggests that one should take care not to overestimate the impact of technology and early language training on quality of life.

Table 15: Disability Weights

Site	Disability Weight	Notes
From Mathers (1999)[92]		
Mild hearing loss	0.018 to 0.020	
Moderate hearing loss	0.104 to 0.020	
Severe hearing loss	0.324 to 0.370	
Global Burden of Disease study as shown in Mathers (2004)[93]		
Deafness	0.224 (0.229)	At least moderate impairment resulting from meningitis
Hearing loss, adult onset (moderate or severe)	0.121	Cases of adult onset hearing loss due to ageing or noise exposure. Excludes hearing loss due to congenital causes, infectious diseases, other diseases or injury.

4.3.1.1 Hearing loss and mental health

The paper by Hogan and colleagues also notes an important finding about mental health outcomes from another study, namely that they appear to be independent of the degree of hearing loss:

> This insight is consistent with the hearing literature which observes that it is the degree of communicative difficulty experienced, rather than the measured

[91] Hogan A, Shipley, M, Strazdins L, et al (2011) Risks to mental health among children with hearing loss – a preliminary study, Final Draft, submitted for publication in the A&NZ Journal of Public Health.
[92] Mathers C, Vos T, Stevenson C, (1999) The burden of disease and injury in Australia, *Australian Institute of Health and Welfare,* AIHW Cat. No PHE 17.
[93] Mathers C, Bernard C, Iburg K.M., et al (2004) Global Burden of Disease in 2002: data sources, methods and results, Global Programme on Evidence for Health Policy Discussion Paper No. 54.

> degree of loss, which is most predictive of any restriction in social participation.[94]

According to the NDCS, over 40% of deaf children with permanent hearing loss are estimated to have mental health difficulties at some point in childhood and early adulthood, compared to 10% of hearing children.[95] In a 2014 study, Harris reported that:

> Children and youth with hearing loss frequently experience difficulty with peer relationships and are at a greater risk of social isolation and loneliness. Early social competence influences later peer and adult relationships, as well as academic success, school adjustment and social-emotional development.[96]

In a 2011 study of 27 children with cochlear implants, 56 children with hearing aids and 117 hearing children, the authors found that:

> Hearing-impaired children reliably reported more symptoms of depression than their normally hearing peers. Degree of hearing loss, socio-economic status, gender, and age were unrelated to the level of depressive symptoms. But attending mainstream schools or using exclusively speech for communication were related to fewer depressive symptoms.[97]

The benefits of an overall improved quality of life includes mental health outcomes within Mathers' disability weights. However, as evidence of improved self-confidence and reduced isolation for graduates of Auditory Verbal[UK] develops further over time, it will be possible to quantify mental health outcomes separately.

4.3.1.2 Change in health related quality of life assumptions for this CBA

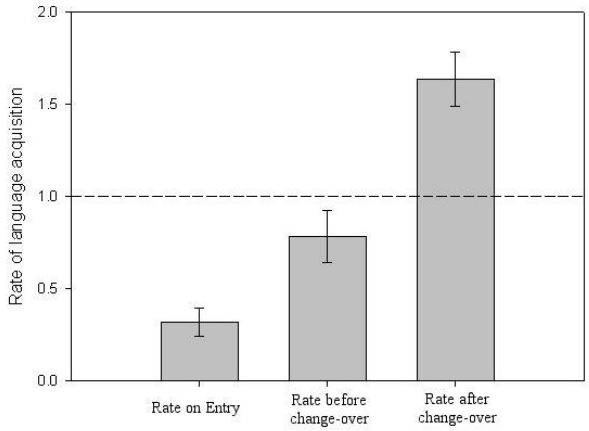
This CBA assumes that with the use of modern technology and attendance at auditory verbal therapy, on average, a 50% change in the HRQoL – some will do better and some will do worse.

For the purpose of this CBA, half of this improvement is attributed to AVT and the other half to technology. Figure 16 shows the average rate of language development for children who enrolled on an AV programme using hearing aids and received cochlear implant(s) during the therapy programme.[98] The graph shows that even

[94] Hogan A, Shipley, M, Strazdins L, et al (2011) Risks to mental health among children with hearing loss – a preliminary study, Final Draft, submitted for publication in the A&NZ Journal of Public Health.
[95] National Deaf Children's Society (2011) A Practitioner's Guide Social care for deaf children and young people: A guide to assessment and child protection investigations for social care practitioners.
[96] Harris, L. G. (2014) Social-Emotional Development in Children with Hearing Loss, *Thesis and Dissertations-Communication Sciences and Disorders* (4).
[97] Theunissen S.C., Rieffe C., Kouwenberg M., Soede W., Briaire J.J., Frijns J.H. (2011), Depression in Hearing-Impaired Children *Int J Pediatr Otorhinolaryngol* 74(10):1313-7.
[98] Hogan S., Stokes J., White C., Tyszkiewicz E., Woolgar A. (2008). An evaluation of Auditory Verbal Therapy using rate of early language development as an outcome measure. *Deafness & Education International.* 10,143–1

before having their optimal technology, the intervention was able to support children in increasing their rate of language development. This increased yet further with a change in hearing technology.

Figure 16: Average Rate of Language Development for children who transferred from Hearing Aids to Cochlear Implant whilst on the programme



The mid-point of the disability weights listed by Mathers (1999) are used for mild, moderate and severe hearing loss, and the improvement in the HRQoL attributable to Auditory Verbal[UK] is weighted by the proportions of the Auditory Verbal[UK] cohort with corresponding levels of hearing loss.

The result is that, on average, a 7% improvement in the HRQoL is attributed per child in the AV[UK] cohort. This is a conservative assumption – a figure 2 to 3 times as high would still be within the plausible range. It is assumed that this benefit flows from the date of enrolment with AV[UK].

Table 17: Change in HRQoL attributable to AVT

	Disability weight	50% change	Attribution to AVT	Proportion of cohort
Mild	0.02	1%	0.5%	5%
Moderate	0.11	6%	2.8%	20%
Severe and Profound	0.35	17%	8.6%	75%
Change in health state (weighted average)	7%			
Annual value using VOSLY of £27,000	£1,890			

A 15% optimism bias correction is allocated as these figures have been based on national analysis. With a 3.5% discount rate for Years 1-3 and a 3% discount rate for Year 31-50, the total benefit over 50 years of a child's life is £39,669.

4.3.2 Increased educational attainment and employment

There is now a significant body of literature which indicates that children with untreated hearing loss do not achieve as well academically and may have a worse long-term employment and income outlook than other children.

In January 2014, the Department for Education published data to show that 36.3% of deaf children achieve five A*-C GCSEs, compared to 65.3% of their hearing peers.[99] This gap widens in post-16 education, with 33.6% of deaf young people taking a level three qualification (A level, AS level or equivalent) compared to more than 80% of 16-18 year olds in the wider population. Of this 33.6%, fewer than 4% of deaf children attain their qualification.[100]

Adults with hearing loss earn on average significantly less income than adults without hearing loss and are more likely to be unemployed.[101] Those that do graduate from post-secondary education, however, experience significant earning benefits.[102] There is therefore a clear link between academic attainment and a child's long-term employment and earnings outlook in the future.

4.3.2.1 Impact on employment

The potential benefit of early intervention on long term employment opportunities will only accumulate over time as the number of Auditory Verbal[UK] graduates reach employable ages and the data pool becomes large enough to be statistically robust. However, the findings reported in Section 3.7 strongly indicate that those who have attended early intervention programmes will have significantly better prospects of being in paid work that those who were not enrolled in early intervention programmes.

The Office for National Statistics found that in 2015:

> People with hearing loss are less likely to be employed (65% are in employment)

[99] NDCS note on Department for Education figures on attainment for deaf children in 2014 (England), January 2015

[100] University of Manchester (2015) [http://www.ndcs.org.uk/professional_support/external_research/#contentblock1]

[101] Jung, D., (2012) Association of hearing loss with decreased employment and income among adults in the United States, *Ann Otol Rhionol Laryngol* 121(12):771-5.

[102] Schley, S., (2010) Effect of post-secondary education on the economic status of persons who are deaf or hard of hearing, *Journal of Deaf Studies and Deaf Education* 10.1093.

when compared with people with no long-term health issue or disability (79%).[103]

The question for this CBA relates to how much of the 14% gap one can expect participation in auditory verbal therapy to close. Statistics currently available from AV[UK] indicate that at least 80% of graduates have language and communication skills that are equivalent to their hearing peers. Data also shows that more than 30% of the Auditory Verbal[UK] children have additional needs.[104] Whilst a number of these children may not reach age-appropriate language, many of these children make huge progress through auditory verbal therapy, fulfilling their language potential.

On balance, it is conservatively assumed that only half of the 14% gap identified by the ONS is closed in the AV[UK] cohort.

For this CBA, this means from the age of 18 onwards, a gain of £1,323 per year is applied per child. This is based on the latest available ONS estimate of average wages for those in full time paid employment (£27,000).

A 15% optimism bias correction is allocated as these figures have been based on national analysis. With a 3.5% discount rate for Years 18-30 and a 3% discount rate for Years 31-50, the total benefit over 50 years of a child's life is £22,283.

4.3.2.2 Impact on earnings

The literature also identifies a link between hearing loss and earnings outlook. In 2014, The Ear Foundation calculated that, on average, people with hearing loss are paid on average £2,000 less per year than the general population.[105] This amounts to £4 billion in lost income across the UK.

A key benefit expected from early intervention is, of course, that educational outcomes improve and consequently in the long term, that enrolment in further education and acquisition of more advanced qualifications does occur. Certainly, the early case studies of children who have followed the auditory verbal approach in the UK has indicated that their hearing loss did not present a barrier to pursuing further studies and aiming for managerial and professional positions.

The economic literature on the returns of higher education is vast. A PwC 2005 report into the economic benefits of higher education qualifications found that over a working life, the average graduate will earn around 23% more than his/her equivalent

[103] Labour Force Survey/Action of Hearing Loss Scotland (2015) Consultation Response: Creating a Fairer Scotland, Employability Support: A Discussion Paper.
[104] Hogan, S (2016) TO BE PUBLISHED.
[105] Archbold, S., Lamb, B., O'Neill, C., Atkins, J., (2014), The Real Cost of Adult Hearing Loss, *The Ear Foundation*.

holding two or more A Levels.[106] Furthermore the average monetary value in 2005 of completing a degree over and above 2 or more A Levels is approximately £129,000.[107] Similarly, an Australian report found that:

> At the university level, Bachelor degrees and post-graduate qualifications are associated with significantly higher earnings, with each year of a Bachelor degree raising annual earnings by about 15 percent.[108]

The important question for this CBA is how many years of additional schooling/education one might expect to result from an early intervention programme at Auditory Verbal[UK]. Drop-out rates at all stages of the education pathway are currently higher for those suffering hearing loss than for others. The British Association of the Teachers of the Deaf (BATOD) reported in 2004 that 86% of deaf and hearing impaired students leave school by age 16 years.[109]

In 2001, Goldberg and Flexer completed a survey of AVT graduates in the US who were 18 years or older and had participated in an AV programme for at least 3 years.[110] Their survey reported that more than 98% of the AVT graduates obtained a university education. Current anecdotal evidence of children who followed an auditory verbal approach in the UK suggests that the majority of children continue in higher education beyond the age of 18.

In the absence of long term data at Auditory Verbal[UK], however, it will be assumed for this CBA, that on average, participation in an auditory verbal programme yields just one additional year of education. This is based on similar calculations made in First Voice's 2011 Cost Benefit Analysis, using long-term Australian data.[111] This, once again, implies a highly conservative approach to valuation and we can expect this to increase to two, if not three, additional years of education in the future.

Using the same ONS estimate of an average wage (£27,000), a 15% increase is the equivalent to £4,050.This is applied from Years 18-50.

A 15% optimism bias correction is again allocated as these figures have been based on national analysis. With a 3.5% discount rate for Years 18-30 and a 3% discount rate

[106] PwC, RSC, Institute of Physics (2005) The Economic Benefits of Higher Education Qualifications
[107] PwC, RSC, Institute of Physics (2005) The Economic Benefits of Higher Education Qualifications
[108] Leigh A, Ryan C (2006) Estimating Returns to Education Using Difference Experiment Techniques, *Economics of Education Review* 27:149-160.
[109] British Association of Teachers of the Deaf (2004) Deaf children and teachers of the deaf: Survey Report 2003.
[110] Goldberg D., and Flexer, C, Auditory-Verbal Graduates: Outcome Survey of Clinical Efficacy, J AM Acad Audiol 12:406-414.
[111] First Voice (2011). A Social Cost-Benefit: Early intervention programs to assist children with hearing loss develop spoken language.

for Years 31-50, the total benefit over 50 years of a child's life is £68,215.

4.3.3 Lower costs of schooling

Improved language development and communication skills lead to more active participation in the classroom and an expectation that a child is more likely to attend a mainstream school and less likely to require extra assistance in the classroom.

In the Australian, Listen Hear! Report, the total 'extra' cost of education for 20,918 children with hearing loss aged 5-16 years was estimated at £117.2 million in 2005.[112] This equates to $5,603 per child or £2,679 per child per annum.

Again, the question for this CBA is the extent to which one can expect these costs to be avoided as a result of a child enrolling with Auditory Verbal[UK] . It is assumed conservatively that children with additional needs in the Auditory Verbal[UK] cohort will continue to require that additional support. For the remaining 70% of the children, this CBA assumes that a reduction of 50% is possible.

On this basis, a benefit saving of £938 per year is applied from the age of 6 to 16.

With a 15% optimism bias correction and a 3.5% discount rate, the total benefit from ages 6 to 16 is £7,716.

To mirror the CBA published by First Voice, the education costs have been calculated for a child over the period from 6 – 16 years. In the UK mandatory schooling is from 5-18 years. Given the conservative costings used in this CBA, a small increase could be expected in the return on investment when considering this longer education period.

4.3.4 Lower dependence on government support e.g. Access to Work

Access to Work is a government funded scheme in the UK that helps people with disabilities have equal access to workplaces. It provides individuals and their employers with advice and support with extra work-related costs which arise because of an individual's disability or health condition. The type of support Access to Work provides is tailored to individual needs and can include travel to work, support workers and specialist aids and equipment. For people who are deaf or have a hearing loss, this support can range from a conversation amplifier to palantypists to British Sign Language (BSL) interpreters.

[112]Access Economics Pty Ltd (2006), Listen Hear! The Economic Impact and Cost of Hearing Loss in Australia.

The most recent data on Access to Work is from 2013/14. During this year, Access to Work supported 35,540 disabled people in work, spending £108 million at an average cost per person of just over £3,000.[113] Within this, Access to Work supports 5,750 deaf and hearing impaired clients and 3,084 of these rely on BSL interpretation awards, where the average spend is £9,582.[114] This averages out at a £6,530 spend per person to access work.

The Office for National Statistics found that 65% of people with hearing loss are in employment.[115] If this group had had the benefit of AV intervention coupled with appropriate hearing devices the cost would be reduced by 50% and, if as previously assumed, half of this is attributed to the influence of the AV approach, then the expected benefit per child is £9 per year. This is applied from Years 18-50.

With a 15% optimism bias correction and a 3.5% discount rate for Years 18-30 and a 3% discount rate for Years 31-50, the total benefit over 50 years of a child's life is £157.

4.3.5 Injuries avoided

There has been comparatively little research into the link between hearing loss and an increased risk of injury. A Canadian cross-sectional study, conducted by Statistics Canada, with a total of 131,535 respondents concluded that:

> Respondents classified as having a hearing problem, whether hearing loss or deafness, were more likely to have achieved less education, less likely to be working and experience higher rates of injury and work-relation injury compared with hearing respondents.[116]

A 2007 study from the US found that:

> Rates of injury treatment in children with hearing loss were more than twice that of the control group (17.72 vs 8.58 per 100, respectively). The relative rate (RR) remained significantly higher (RR = 1.51, 95% confidence interval, 1.30-1.75) after adjusting for age, race, sex, and the number of hospital or emergency department encounters for treatment of non-injury-related conditions. Children with hearing loss had significantly higher treatment rates for every injury type, bodily location,

[113] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/426416/future-of-access-to-work-equality-analysis.pdf [accessed 26th February,2016)

[114] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/426416/future-of-access-to-work-equality-analysis.pdf [accessed 26th February,2016)

[115] Labour Force Survey/Action of Hearing Loss Scotland (2015) Consultation Response: Creating a Fairer Scotland, Employability Support: A Discussion Paper.

[116] Woodcock K.R., Pole J. D., (2008) Education Attainment, labour force status and injury: a comparison of Canadians with and without deafness and hearing loss, *Int J Rehabil Res* 31:297-304

and external cause, with a cell size sufficient for valid comparison.[117]

There is no reason to believe that the situation would be different in the UK. In 2010/11, the annual number of hospital admissions in England was 46,771 for children between the ages of 0-5 (approximately 423 in every 100,000 children).[118] The short-term average cost per hospitalisation for individual injury (all types) is £2,494.[119] This cost can therefore be estimated at £10.54 per year per child.

Using the relative risk of 1.51 reported in the American study above, on average one would expect 2,718 cases per 100,000 in the sub-group that is affected by hearing loss. For this sub-group the estimated cost per child per year rises to £67.79, a difference of £57.25 compared to hearing children.

If AVT, coupled with appropriate hearing devices can reduce this excess cost by 50% and, if as previously assumed, half of this is attributed to the influence of AVT, then the expected benefit per child is £14 per year. This benefit, though very small, has been recognised in this CBA.

The number of cases and the age-specific rate of hospitalisation rises to an initial peak in the 15-24 years old age group.[120] Both cases and the rate drop off with age, before rising sharply for over-75s. For this CBA, this benefit will be applied for the 50 year project horizon.

With a 15% optimism bias correction and a 3.5% discount rate for Years 18-30 and a 3% discount rate for Years 31-50, the total benefit over 50 years of a child's life is £300.

4.3.5 Unquantifiable Benefits

A number of additional benefits flowing from Auditory Verbal[UK]'s EIP have been identified but could not be quantified at this stage:

4.3.5.1 Benefits to carers over the long-term

While this CBA emphasised the costs to parents who forgo income to attend appointments, it must also be recognised that there is a long-term return to carers. Parents undoubtedly value seeing their child benefit from intensive support and attaining better educational outcomes. Stress and anxiety levels may reduce over the

[117] Mann JR, Shou L, McKee M, McDermott S (2007), Children with hearing loss and increased risk of injury, *Ann Farm Med* 5(6):528-533.
[118] Public Health England, Children under 5 hospital admissions die to injury 2010/11 [ww.apho.co.uk]
[119] Polinder S, et al (2008) APOLLO: The economic consequences of injury – Final report. (Consumer Safety Institute, 2008)
[120] Australian Institute of Health and Welfare, Chapter 8 – Injuries
[http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=6442459239]

long term as parents see their child integrated and succeed in mainstream school and beyond. No proxy could be readily identified to place a monetary value on this benefit of emotional well-being for the parents.

The ability to participate in fundraising and lobbying on behalf of Auditory Verbal[UK] is seen by many parents as an empowering way to bring positive influence to bear and to give something back to the wider community. Again, this benefit has not been quantified.

Another benefit which has been noted anecdotally in families at Auditory Verbal[UK] is that the attachment bond between parent and child strengthens. This not only benefits the parent-child relationship, but also other siblings as the techniques learnt by parents at Auditory Verbal[UK] can be used to support the language development of other children and improve their family relationships. Interestingly, First Voice in Australia reported that the rate of marriage breakdown in families attending their programmes was lower than might be expected in families with children with a disability.[121] Due to the absence of specific information on the differential in divorce rates between AV families and other families with children with hearing loss, this benefit has not been quantified for this CBA.

4.3.5.2 Further Social Return

As previously highlighted, children with hearing loss frequently experience difficulties with peer relationships and are at a greater risk of social isolation and loneliness, with over 40% of deaf children experiencing mental health difficulties during childhood or early adulthood.[122] Whilst benefits to overall quality of life has been included in this CBA, evidence of improved self-confidence and reduced isolation for children in the Auditory Verbal[UK] cohort remains anecdotal and will develop further over time.

4.3.5.3 Demonstration and research value

The research produced by Auditory Verbal[UK] demonstrates the value of AVT to policymakers in the UK and worldwide who require information on new approaches to treatment and rehabilitation. Building best practice and national standards are valuable in their own right. It is difficult to put a value on all the items summarised under the heading of demonstration here, but it could certainly be substantial.

[121] First Voice (2011) A Social Cost Benefit Analysis: Early intervention programs to assist children with hearing loss develop spoken language.
[122] Department of Health (2005) Mental Health and Deafness: Towards Equity and Access

4.3.6 Summary of Benefits

Table 18 summarises the flow of benefits over time. The key finding of this analysis is that, even after discounting the future flow of benefits, the net present value (NPV) of benefits is £137,799.

Table 18: Summary of benefits per child over 50 year project horizon

Benefit	Value	Years	Net Present Value
Improved quality of life	£1,607	1-50	£39,669
Increased employment	£1,125	18-50	£22,283
Increased earnings	£3,444	18-50	£68,215
Lower cost of schooling	£797	6-16	£7,176
Lower dependence on government support	£8	18-50	£157
Injuries Avoided	£12	1-50	£300
Total NPV			£137,799

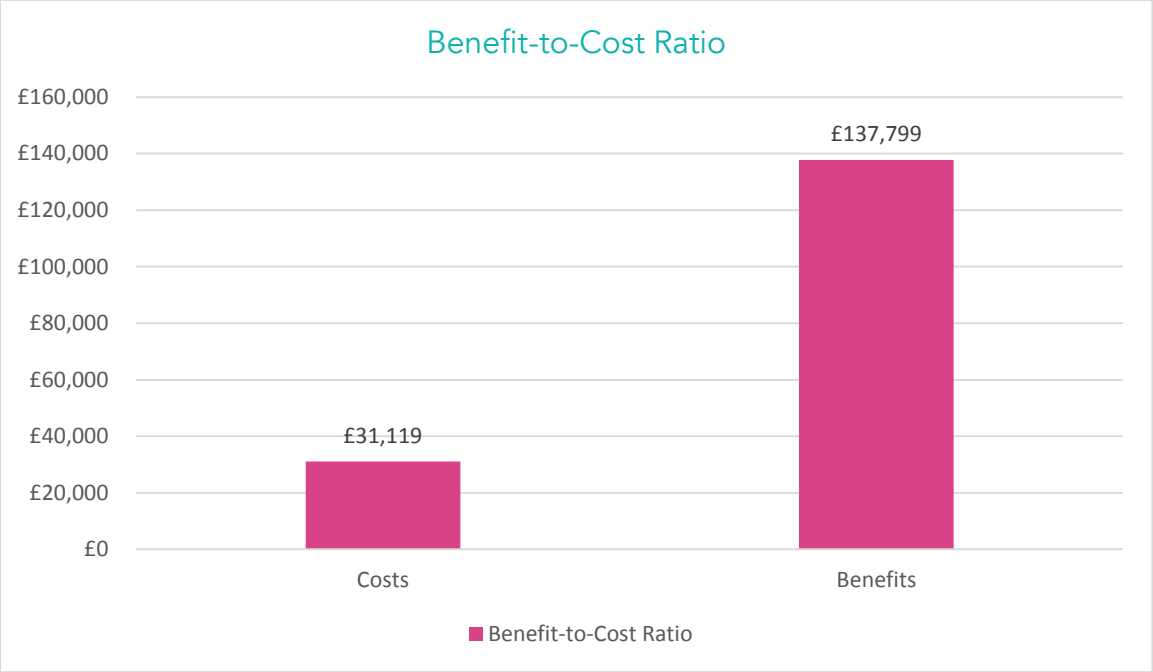
5. Comparing Costs and Benefits

5.1 The benefit-to-cost ratio (BCR)

The quantified costs and benefits can now be compared. As Figure 19 shows, the costs are estimated at £31,119 in present value terms, and the benefits are valued at £137,799. The BCR is therefore positive at 4:1.

On average, it is estimated that for every £1 invested in AV intervention, £4 is returned. In this case, the BCR is positive, despite a conservative approach to valuation.

Figure 19: The costs and benefits of early intervention



5.2 How does this BCR compare with other early intervention programmes in the UK?

Cost benefit analyses have been written for a number of early intervention programmes in the UK. AV[UK]'s BCR at £1:£4 compares favourably to the majority of these reports – a number of which are government-funded:

- Parent-child interaction therapy is a government-funded parent-child intervention designed to improve the quality of the parent-child relationship and change interaction patterns with children aged 2-7 years. The benefits included improved child behaviour, reduced parental stress and reduced abuse and neglect. This early intervention programme produced a BCR of £1:£3.5.[123]
- Multisystemic therapy (MST) is a government-funded youth intervention programme that focuses on improving the family's capacity to overcome the known causes of delinquency, with children aged 12-17. The benefits include a 25-70% reduction in long-term rates of re-arrest, a reduction of 47-64% in

[123] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284086/early-intervention-next-steps2.pdf [accessed 26th February 2016]

out-of-home placements, improvements in family functioning and decreased mental health problems for serious juvenile offenders. This intervention programme produced a BCR of £1:£2.50.[124]

- Triple P parenting programme is government-funded to provide additional support to parents to manage their child's behaviour. The benefits include improved parental confidence and knowledge of parenting, improved social networks, improved family relationships and improved child behaviour. This early intervention programme produced a BCR of £1:£2.50.[125]
- Nurse Family Partnership (NFP) is a government-funded intensive home visiting programme administered by health professionals and delivered to first-time mothers. This programme has consistently delivered positive benefits including fewer subsequent pregnancies, fewer months on welfare, fewer arrests and fewer reports of child abuse. The BCR is estimated to be between £1:£3 and £1:£5.[126]
- Stay and Play is provided by Barnado's children centres and offers safe and secure play environments for families with children under the age of 2. The benefits include improved confidence of parents, improved knowledge of parenting strategies, improved English language skills for children with English as an additional language, improved diet and access to physical activities, improved progress in a child's learning and reduced obesity. This early intervention programme produced a BCR of £1:£2.[127]
- Barnado's also runs a service which provides intensive support to expectant teenage and young mothers called Tiny Toes. The benefits of this programme include improved parenting skills and parenting confidence, reduced social isolation, improved family health and reduced levels of risk and harm to children. This early intervention programme produced a BCR of £1:£3.50.[128]
- A Family Support Workers is a service provided by Barnado's which provides intensive one-to-one support to families with children under 5 years old who have additional needs. The benefits include improved parenting skills and parent confidence, safer home environment and reductions in the level of risk and harm, improved access to information on housing, health, benefits, rights and support needs, reduced numbers of families accessing high level services,

[124] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284086/early-intervention-next-steps2.pdf [accessed 26th February 2016]
[125] https://www.barnardos.org.uk/the_value_of_early_intervention.pdf [accessed 26th February 2016]
[126] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284086/early-intervention-next-steps2.pdf [accessed 26th February 2016]
[127] https://www.barnardos.org.uk/the_value_of_early_intervention.pdf [accessed 26th February 2016]
[128] https://www.barnardos.org.uk/the_value_of_early_intervention.pdf [accessed 26th February 2016]

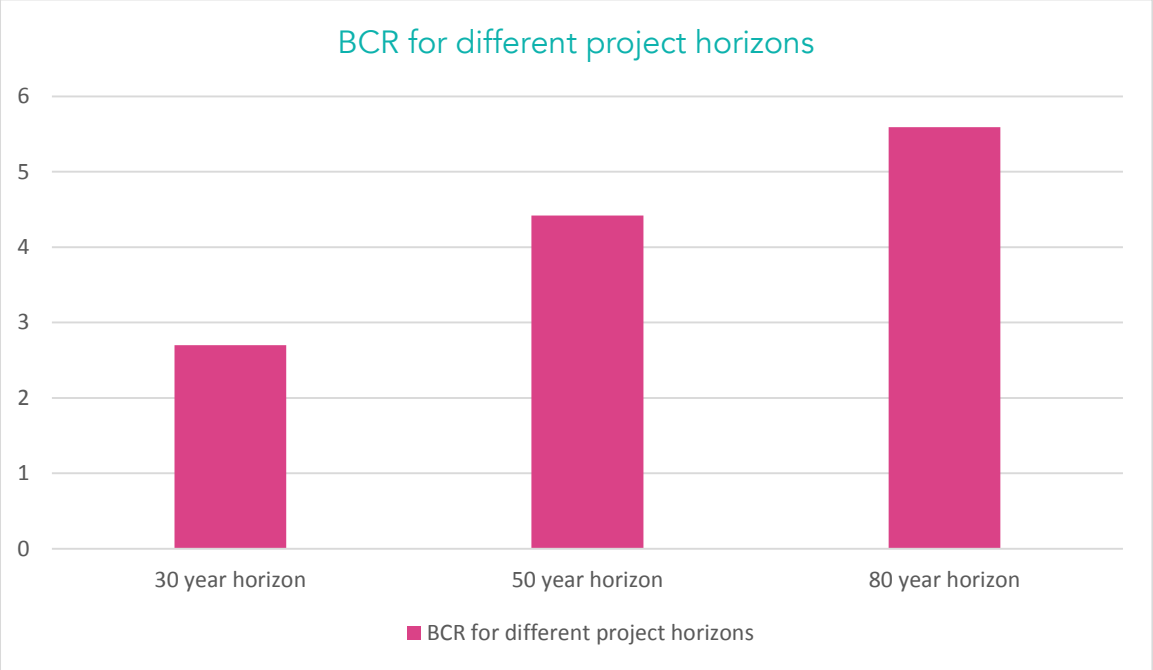
reduced social isolation and improved family relationships. This early intervention programme produced a BCR of £1:£3.50.[129]

Reading Recovery – part of the Every Child a Reader campaign – is a government-funded school-based short-term intervention designed for children who are the lowest literacy achievers after their first year of school, aged 5-6. The BCR has estimate to be around £1:£15 over the period 2006-2039. This estimate is based on a range of outcomes, including special education needs provision, crime and health costs.[130]

5.3 Sensitivity Analysis

5.3.1 Project horizon

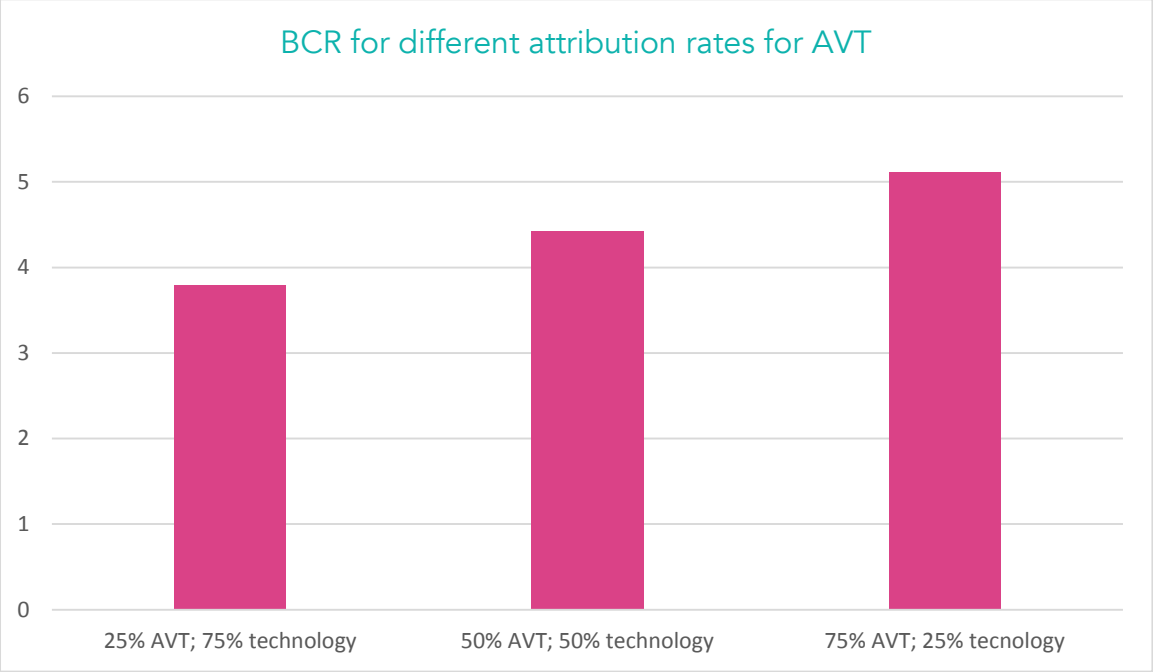
Figure 20: The BCR of AV intervention for different project horizons



[129] https://www.barnardos.org.uk/the_value_of_early_intervention.pdf [accessed 26th February 2016]
[130] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284086/early-intervention-next-steps2.pdf [accessed 26th February 2016]

5.3.2 Attribution between AVT and technology

Figure 21: The BCR for different attribution rates for AVT



Conclusion & Recommendations

This CBA of auditory verbal therapy undertaken at Auditory Verbal[UK] has indicated that, on a highly conservative basis, the social investment made by supporting deaf children and their families in the auditory verbal approach affords at least a four-fold return on that investment. From a social cost-benefit perspective, early intervention is clearly a worthwhile investment even under stringent assumptions about the flow of future benefits. This investment may come from private or public sources. The argument for government funding is however strengthened by the findings of this CBA.

This is the first CBA of an early intervention for deaf children in the UK. It is also a call to action from all EIPs and education providers to publish costs of the funding necessary to ensure that all deaf children have full access to the curriculum and the social learning environment of school. With further information of this sort all EIPs can develop their own robust analysis of the benefits to society of effective early intervention for all deaf children.

Other conclusions and recommendations include:

- There is a need for more research and consistent collection of statistics, including a longitudinal study of the outcomes resulting from auditory verbal early intervention. Auditory Verbal[UK] is well placed to take a national leadership role in this space.
- Auditory Verbal[UK] needs to be able to further promote its outreach activities in the NHS and Local Authorities to engage professionals supporting families of children who would otherwise miss out on effective services.
- There needs to be greater information published by organisations supporting deaf children on the costs, benefits and outcomes of interventions and analysis undertaken on the areas where there is currently no data to assist long term investment in effective interventions for children with hearing loss.

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