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McMullan-Bell, Alexander (2019) The role of audiological support in the language development of deaf learners: Research and practise to inform outcomes. Hillary Place Papers (5).

https://doi.org/10.48785/100/237

The role of audiological support in the language development of deaf learners: Research and practise to inform outcomes

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ABSTRACT: This case study is written to illustrate to general and non-deaf specialist educators some of the most commonly occurring struggles that deaf learners, who use their supportive technology effectively, face in language development. Specifically, it addresses the impact of audiological support on the language development of a secondary age profoundly deaf learner. I will focus on the hierarchy of listening skills and assess the learner's abilities within the four main areas of detection, discrimination, identification, and comprehension. These assessments of his listening skills were conducted in two different educational environments and with different audiological support in place to provide points of comparison. I collected data in these areas so that I was able to examine the collection for challenges and opportunities within his learning and development of language. This paper concludes that case studies such as this allow educators and practitioners to pinpoint barriers in the listening process in order to place support strategies. This paper highlights the distinction between the role of audiology in supporting audiological access to language and cognitive development and understanding of language. The student used here stands as an example for non-deafness specialists as to the challenges deaf learners come across when trying to develop language.

Introduction:

With this case study, I focussed on the audiological support in place to support a particular student's listening skills and abilities that will then impact his spoken language. The student used within this case study is a secondary pupil currently in year 8 and 12 years old. He is educated in a mainstream school with a specialist Deaf Additional Resource Provision (ARP) attached for the education of deaf learners with severe to profound deafness, some with complex needs. My role within the school is that of a Teacher of the Deaf (ToD) and as such one of my principle roles is to continually monitor our deaf learner's progress and attempt to pinpoint barriers or successes in their development. One of the areas we need to continuously review is the current audiological technology and support in place so that ToDs have a clear understanding of audiological options that are to best support students, demonstrate that we can undertake the audiological management of a student and that we understand how the appropriate audiological support can potentially benefit a child's spoken language development. Language acquisition and development are likely to be a major barrier for deaf learners (Marschark and Hauser, 2012) because we learn our native language as we grow by listening to the language that surrounds us during childhood (Crystal, 2006). Even with audiological support from hearing aids and cochlear implants, deafness means some deaf learners struggle to access the spoken language of their native environments (Marschark and Hauser, 2012).

Before we go into the case study itself, it is important to clarify some key terms that some outside of deaf education may not be familiar with. **Figure 1** shows the range of human hearing; with the pitch being measured along the top from left (low pitch) to right (high pitch) and measured in hertz (Hz) while volume is measured in decibels (dB) from the top (soft sounds) to bottom (loud sounds). The student in question is classified as being profoundly deaf meaning that on average their hearing level falls below 90 decibels (dB) which is exceptionally low in comparison with normal hearing which falls into the average of around 0dBs. To put this into context, without the support of hearing aid technology the student can hear vehicles passing close by, however, would not be able to hear any speech sounds, human or animal movement or noises, or distant noises without the support of hearing aid technology. Hearing aids can support access to surrounding language in deaf learners who do have some amount of residual hearing, meaning the hearing they do have after their threshold of deafness, however it does not impact on the understanding of the language around them (Marschark and Hauser, 2012). The speech sounds we make fall between 20dB and 50dB as can be seen in **Figure 1** where we can see plotted the letter sounds and where they fall on the graph, this area where speech sounds fall is known as the "speech banana". This means that without audiological support a profoundly deaf learner who cannot hear about 90dB will struggle to access speech sounds.

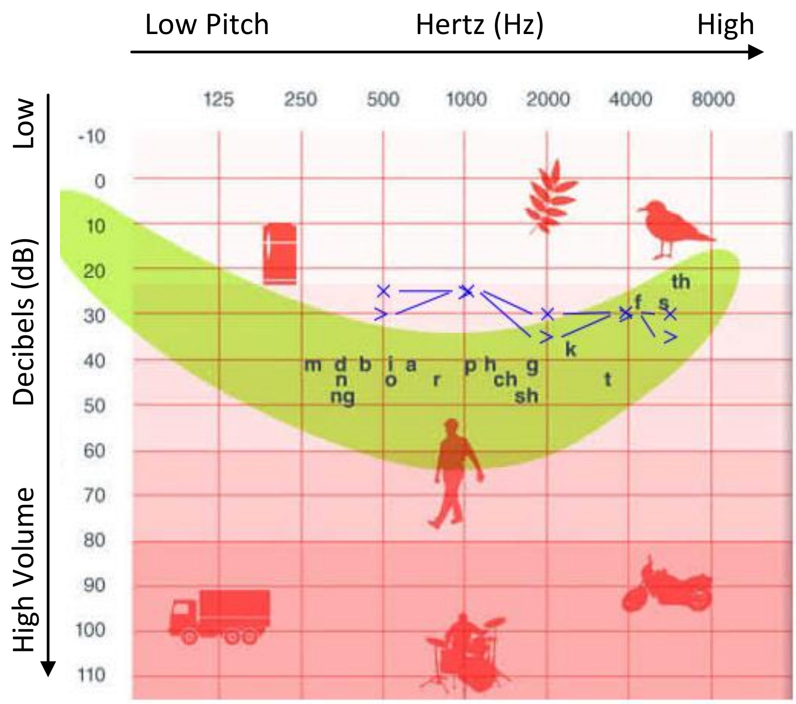

Figure 1: Left and Right Ear Audiograms (Aided) with Speech Banana

In this case study I aim to create a case study that can focus on two main points. Firstly, can a case study on a pupil's audiological support provide us as practitioners with an insight into barriers the learner may be facing within learning environments? Secondly, can the information provided from such a case study helps us pinpoint which listening skill (Madell, 2014) is a particular barrier for that individual pupil.

Baseline information:

The student whom I am writing about in this case study will be known as Simon.

Simon has an Education Health and Care Plan (EHCP), which details both his background and his needs when it comes to education. Simon has a bilateral profound sensorineural hearing loss and according to his EHCP began using hearing aids at 3 months and was implanted with two cochlear implants when he was 2 years and 2 months. Cochlear implants are "sophisticated" (Marschark and Hauser, 2012, p31) hearing aids which involves an implant in the head of a deaf individual and an external device which works like a hearing aid and sends electrical impulses to the implant which then sends them to the brain while the external device is secured to the individuals implant by a magnet (Marschark and Hauser, 2012). Being implanted at such a young age should, theoretically, have given Simon an appropriate amount of time to develop his speech perception. Gstoettner et al. (2000) found in their study that speech perception in congenital or prelingual deaf children improves steadily over time from the point of implantation which implies that now, at age 12 years and 6 months, Simon should have a fairly good perception of speech. However, the Gstoettner et al. (2000) study, although claiming to focus on all auditory skills from detection to comprehension, does few tests that do actually look at the comprehension of the language being heard and they themselves state that not all children completed all assessments. This could mean that although their data does show that prelingually deaf children do improve their auditory skills of detection and discrimination this may not mean that they comprehend the words and sounds that they are hearing.

Using the information provided to the school from Simon's Hospital reports we know that he has a profound hearing loss and that he has been implanted with two cochlear implants, and processors manufactured by the company Naida, which should provide him with access to all speech sounds as seen in **Figures 2** and **Figure 3** below which were made using the Audiogram creator by Hearing Aid Know (2006). These sound-field tests were done using warble tones, which is a sound played into the ear not being tested to ensure that the test sound is only picked up by the ear being tested, to measure the quietest sound Simon could hear and were done with one processor on at a time. When testing people hearing audiologists will usually test at 500Hz, 1000Hz, 2000Hz, 4000Hz, and 6000Hz, so keep the assessment in a range that is comfortable for the person being tested, as well as practical to listen to.

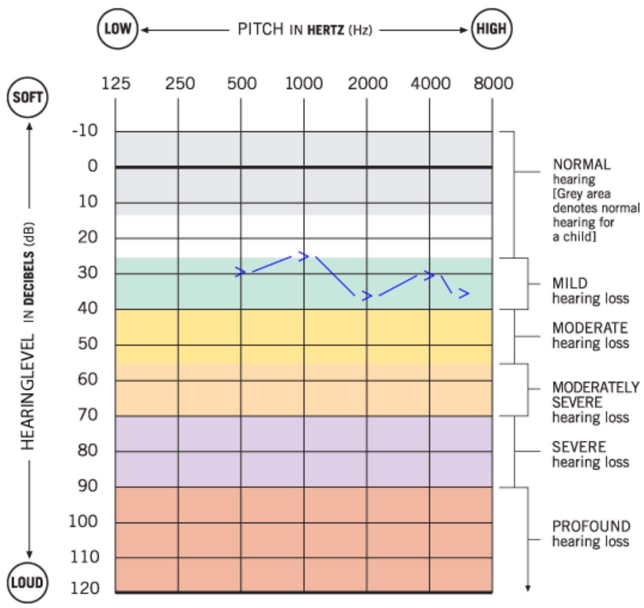

Figure 2: Right Ear Audiogram (Aided)

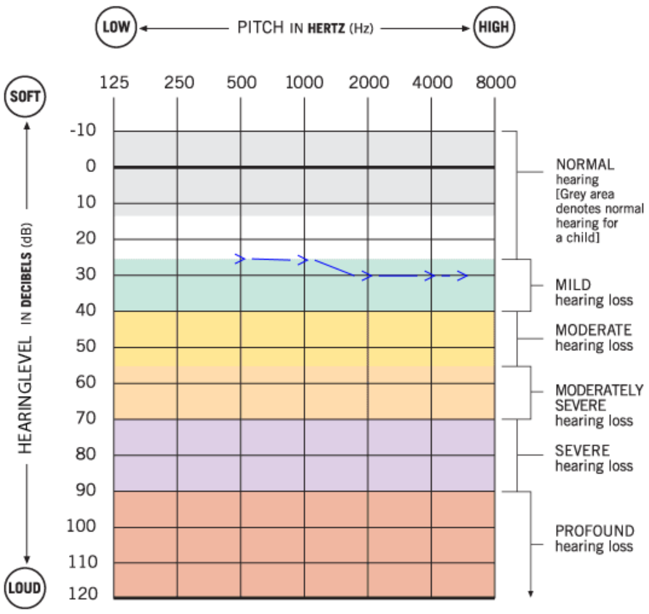

Figure 3: Left Ear Audiogram (Aided)

Frequency Hz	500	1000	2000	4000	6000
Right Processor (dB Hearing Level)	=30	=25	=35	=30	=35
Left Processor (dB Hearing Level)	=25	=25	=30	=30	=30

Figure 4: Data from Audiograms

The data from the Audiograms shows us that on average Simon's aided hearing is significantly higher than when he is unaided as his right ear averages 31dB and his left ear 28db. We also see when the audiograms are overlaid onto the "Speech Banana" (**Figure 1**), which is the banana-shaped area drawn out on audiograms which demonstrates where speech sounds occur due to their volume and pitch (Klangpornkun, Onsuwan, Tantibundhit, Pitathawatchai, 2013), that Simon should be able to detect the vast majority of the speech sounds. However these audiograms were conducted in a hospital under clinical conditions and therefore may not be reflective of Simon's hearing within School environments as even with such support from his implants providing him with increased access to sound, and particularly speech sounds, he is still delayed in his spoken language.

From Simon's current Assessment Tracker (AT), which contains assessment data, conducted by myself and the other TOD in the school, and from his Speech and Language Therapist (SaLT) report we have some starting knowledge about Simon's language levels. The SaLT for our particular student reports having completed Renfrew's (1988) Action Picture Test (RAPT) with Simon as this assessment is designed to explore his abilities to express ideas and concepts through spoken language through showing him picture scenes and asking specific questions and see how well Simon can express his understanding of what is happening in them (NDCS, 2017). From the table below (**Figure 5**) we can see the results of this assessment conducted by the SaLT.

Date of Assessment:	02/07/18
Chronological Age	11;11
Information Score **(Age Equivalent)**	Raw Score 35.5/40 (7;00-7;05)
Grammar Score **(Age Equivalent)**	Raw Score: 26/37 (6;00-6;05)

Figure 5

From these results, we can see that Simon's productive expressive language is significantly behind his chronological age. The results show that at the age of 11 years and 11 months he is expressing the information of an equivalent 7-year-old with the grammar and syntax of an equivalent 6-year-old. As a Teacher of the Deaf my job it to ask 'why is Simon's Language delayed like this?' and 'What can we do to help close this gap and support him?'.

For this case study I have explored what can be done from an audiological perspective to support Simon's productive spoken language, meaning the language he uses for verbal communication and for this we need to ask ourselves some questions about Simon that need to be explored. Our main question overall is 'How good are Simon's listening skills and how well is he able to use the skills he has in his school environments?' For us to be able to form any conclusions about this question we need to break it down into more individual components which are:

1. How well is Simon able to detect individual words within spoken language within school environments?
2. How well can he discriminate the variations in sounds within the words in these differing school environments and identify the words associated with these sounds?
3. How well does Simon comprehend the words spoken within these environments?

These three questions focus on the main aspects of our innate listening ability and cognitive listening skills: detection, discrimination, identification, and comprehension (Madell, 2014) meaning that the answering of these questions should give us a clear overview of Simon's sound and speech perception and, theoretically, give us an indication of where barriers to listening and spoken languages occur, if there are barriers. I have assessed each of the areas separately with their specific assessments, although discrimination and identification have been combined for the process of assessment, and then they are considered all together in the end of this paper.

Detection: Introduction

Knoors and Marschark (2014) believed that children develop their language through social interaction and communication, and that effective and efficient interactions and communication help promote effective and productive language development. Swanwick (2017) added that through conversing in a shared language children develop their understanding and gain meaning to words and concepts. However it is difficult for deaf learners to develop a spoken language if they are unable to hear it (Knoors and Marschark, 2014) and therefore we need to ensure that deaf learners within our learning environments have the best possible support in order for them to detect the words which make up the language happening around them. Now although hearing aids and cochlear implants don't in themselves support the understanding of language (Marschark and Hauser, 2012) they support deaf children with their awareness of language and sound around them and therefore provide them with the option of engaging in social interactions (Marschark, Hauser, 2012). With Simon's situation, I investigated how well Simon can detect the words being spoken around him within a school environment. There have been times at school where I and other staff have observed Simon either missing instructions or content, or being unsure about what is going on around him or why. Now this may be purely due to lack of attention on Simon's part. However we do need rule out that Simon is not missing things due to being unable to detect language due to his audiological support.

Detection: Method and results

Therefore to assess Simon's detection skills I used the Arthur Boothroyd (AB) Short Word List (Boothroyd, 1968) and is made up of "15 lists of 10 monosyllabic, consonant-vowel-consonant (CVC) words" (Myles, 2017, p.871) with words such as fish, heel, and dip. I assessed Simon using the lists in four different ways: The first assessment was done at the back of a mainstream classroom to simulate background noise Simon would experience in one of his mainstream classes; I then did it a second time in the mainstream but with an Assistive Listening Device (ALD) and the third and fourth tests were conducted at the back of a classroom within our Deaf Additional Resource Provision (ARP) with and without an ALD so we can see if there is a difference in his detection between him in a mainstream class environment and an ARP class environment. Myles (2017) states that in Australia the vast majority of Audiologists use this assessment and 96% of the Audiologists surveyed use this as a tool for detection because they use it as a way of cross checking the child's audiogram (Myles, 2017), such as **Figures 2** and **Figure 3**. This should imply that it is a sensible choice of assessment for me to use. However we should take into account that the practise of Australian Audiologists may not necessarily reflect the best practise of Audiologists here in the UK. It is also worth mentioning that the majority of these Australian Audiologists had issues with the scoring system used in this assessment as although the phonemes of these CVC words are supposedly individual they do change and are modified by the phonemes preceding and/or following them (Myles, 2017). However, with this in mind I still went ahead and used the AB Short Word List as it is an assessment which is practical in its delivery, engaging for the student, and, with the aid of video recording, means I can score phoneme by phoneme. This assessment also provides me an accurate idea of Simon's detection abilities and potentially data on sounds he is consistently not detecting.

The first assessments conducted were done within Simon's mainstream English classroom during a lesson, with the teacher's permission. In the classroom I sat myself in front of him and appropriate distance away to replicate where the teacher usually teaches from, in this case I was sat near the interactive screen at the front of the class with Simon in his usual seat on the front row. When reciting the word list I attempted to keep my voice around the 60 decibel (dB) mark throughout and I had my lips covered to prevent Simon from lip reading. While I conducted the assessments Simon's teacher continued her usual lesson with no adaptations or alterations to what she normally does. For list 6 and 8, as seen in **Figure 6**, I was wearing the ALD that Simon is usually issued with and wore it with the microphone in the appropriate place for maximum clarity. During the whole lesson I had a sound level meter monitoring the surrounding sound levels and within the mainstream classroom environment the average dB level was 70.3 dB with a highest maximum of 85.6dB. The results of these assessments are shown below (**Figure 6**). In both sets of tables (**Figure 6** and **Figure 7)** 'NR' stands for No Response, an 'X' means they did not produce the sound accurately, and an 'O' means they did produce the sound accurately.

From a glance at these results from the mainstream classroom environment we can see that Simon missed more than 50% of the CVC sounds when in the mainstream classroom without an ALD, but with the ALD this increased. So with a mean average result of 45.0% without an ALD and an average of 61.5% with an ALD we can see that there is a potential benefit of around 16.5% in CVC sounds heard when the student is using an ALD in a mainstream classroom environment. The next set of results (**Figure 7**) show how Simon scored within an ARP classroom environment, which is where deaf learners are educated outside of the mainstream environment.

The second group of assessments were conducted within a classroom within the ARP during a lesson of Simon's deaf peers. I attempted to keep conditions as similar to the first set of assessments as possible, therefore the person delivering the lesson did not alter anything from their usual style of teaching. I sat opposite Simon at a usual distance he would be from the teaching, which was similar to the distance he would be in a mainstream classroom anyway, and I endeavoured to keep my voice at a 60dB level and covered my lips to prevent Simon from lip reading. I also took dB readings for the environment during the lesson and found the ARP classroom had a sound level on average of 62.9dB with a maximum of 79.8dBs showing that the ARP classroom environment is significantly quieter than a mainstream environment by an average of 7.4dB.

Looking at the results of the AB word lists completed within the ARP classroom environment we can see that the results overall are significantly higher than they were in the mainstream classroom environment. Without an ALD Simon is detecting an average of 71.5% of spoken sounds as opposed to the 45% average, he was hearing in mainstream without an ALD and implies that, when not using an ALD, that Simon is detecting on average 26.5% more speech sounds in the ARP environment. With an ALD in the ARP Simon is detecting an average of 88% which is higher than when he used an ALD in the mainstream environment which averages out at 61.5%,

	List 2			List 5			List 6			List 8		
	Mainstream Classroom environment with no ALD.			Mainstream Classroom environment with no ALD.			Mainstream Classroom environment with an ALD.			Mainstream Classroom environment with an ALD.		
	Voice Level dB (Average)	60db		Voice Level dB (Average)	60db		Voice Level dB (Average)	60db		Voice Level dB (Average)	60db	
	Target	**Resp.**	**Score**	**Target**	**Resp**	**Score**	**Target**	**Resp**	**Score**	**Target**	**Resp**	**Score**
1	**Fish**	NR	XXX	**Fib**	NR	XXX	**Fill**	Feel	OXO	**Bath**	Bath	OOO
2	**Duck**	NR	XXX	**Thatch**	App	XOX	**Catch**	Crash	OXX	**Hum**	Hug	OOX
3	**Gap**	Gap	OOO	**Sum**	Sun	OOX	**Thumb**	Thumb	OOO	**Dip**	Dig	OOX
4	**Cheese**	Cheese	OOO	**Heel**	Hill	OXX	**Heap**	Hit	OXX	**Five**	Five	OOO
5	**Rail**	Play	XXX	**Wide**	Why	OXX	**Wise**	Wide	OXX	**Ways**	Waste	OXX
6	**Hive**	High	OOX	**Rake**	Brake	XOO	**Rave**	Gray	XOX	**Reach**	Meet	XXX
7	**Bone**	Bird	OXX	**Goes**	Go	OOX	**Goat**	Got	OXO	**Joke**	Joke	OOO
8	**Wedge**	NR	XXX	**Shop**	Shop	OOO	**Shone**	Shoe	OXX	**Noose**	Oops	XOX
9	**Moss**	Fox	XOX	**Vet**	Bet	XOO	**Bed**	Bed	OOO	**Got**	Got	OOO
10	**Tooth**	Tooth	OOO	**June**	NR	XXX	**Juice**	just	OXX	**Shell**	Shell	OOO
	Total		13	**Total**		14	**Total**		16	**Total**		21
	Score %		43%	**Score %**		47%	**Score %**		53%	**Score %**		70%

Figure 6

this is also lower than his 71.5% that he detects without the ALD in the ARP environment. Overall we can see that Simon's detection is greatest when learning within an ARP classroom environment and using an ALD to assist him with detection. This may be due to the lower background noise within in the ARP environments and the fact that the ALD cuts out some of the background noise and provides speech

	List 11			List 13			List 14			List 15		
	ARP Classroom environment with no ALD.			ARP Classroom environment with no ALD.			ARP Classroom environment with an ALD.			ARP Classroom environment with an ALD.		
	Voice Level dB(A)	60db		Voice Level dB(A)	60db		Voice Level dB(A)	60db		Voice Level dB(A)	60db	
	Target	Resp.	Score	Target	Resp.	Score	Target	Resp.	Score	Target	Resp.	Score
1	**Man**	Man	OOO	**Kiss**	Kiss	OOO	**Wish**	Wish	OOO	**Hug**	Hug	OOO
2	**Hip**	Hic	OOX	**Buzz**	Buzz	OOO	**Dutch**	Dutch	OOO	**Dish**	Dish	OOO
3	**Thug**	Dull	XOX	**Hash**	Cash	XOO	**Jam**	Jam	OOO	**Ban**	Ban	OOO
4	**Ride**	Wide	XOO	**Thieve**	Been	XXX	**Heath**	Heath	OOO	**Rage**	Rage	OOO
5	**Siege**	Sepge	OXO	**Gate**	Gate	OOO	**Laze**	Laze	OOO	**Chief**	Chief	OOO
6	**Veil**	Rail	XXO	**Wife**	Wife	OOO	**Bike**	Bike	OOO	**Pies**	Pies	OOO
7	**Chose**	Chose	OOO	**Pole**	Hole	XOO	**Rove**	Rose	OOX	**Wet**	Wet	OOO
8	**Shoot**	Shoot	OOO	**Wretch**	Wretch	OOO	**Pet**	Pet	OOO	**Cove**	Cole	OOX
9	**Web**	Web	OXX	**Dodge**	Dodge	OOO	**Fog**	Frog	XOO	**Loose**	Miss	XXX
10	**cough**	Cup	OXX	**Moon**	Moo	OOX	**Soon**	Soon	OOO	**Moth**	Mouth	OXO
	Total		19	Total		24	Total		28	Total		25
	Score %		63%	Score %		80%	Score %		93%	Score %		83%

Figure 7

directly to Simon's cochlear implants. As I will state in my targets later in this case study, I would recommend from this that for Simon to have the best chance of detecting speech sounds in lessons that he be taught within an ARP classroom environment wherever possible and in all lessons he use an ALD to assist further.

Discrimination and Identification: Introduction

Once I had an understanding of Simon's potential abilities to detect I needed to explore how well he can distinguish between sounds and then how well he can use this. It is important to understand what we mean when we use the terms discrimination and identification within this section of the study. Within the subject of speech perception we mean that they can hear contrasting sounds whereas identification asks them to then use their cognitive abilities to form connections between these sounds and the meaning behind them (Govaerts et al., 2006). The skills to discriminate sounds begins around the age of four weeks starting with certain vowels and consonants (Crystal, 2006) while the ability to identify develops alongside our cognitive abilities. Therefore at this point we see the assessments move from assessing skills that we have innately as new-borns, our detection and discrimination, into assessing abilities which require significantly more cognitive skill, our ability to identify and understand (Govaerts et al., 2006). Therefore in this section I conducted an assessment which tells me how well Simon can discriminate between similar sounds and identify the meaning of the spoken sounds.

Discrimination and Identification: Method and Results

To conclude Simon's abilities in these areas I conducted the McCormick Toy Test which was created in 1977 by Professor Barry McCormick OBE (Soundbyte Solutions, 2001) and is widely used by professionals with students aged two and above. This test is usually done to provide comparative data between situations as it can be done easily and quickly and is generally found to be engaging for the children (Lovett etal., 2013). The test involves the students being presented with up to 14 objects which are all set and paired; each pair are similar sounding words with variations in consonants but a similar diphthong (Soundbyte Solutions, 2001). For the test either the tester or a recorded voice will state the name of one of the objects and the child has to identify which object has been stated (Lovett, Summerfield, Vickers, 2013) and the child is marked on how many they correctly identify. This test asks the student to listen to the variations in sounds and identify which word was stated accurately. Although this assessment is widely used by professionals working with deaf children of all levels of deafness its reliability has only been measured with those with "normal" (Lovett etal., 2013, p378) hearing or with a mild deafness meaning that potentially the reliability may change for those who take part and have a greater degree of deafness (Lovett etal., 2013) like Simon. However with the support of his cochlear implants Simon's deafness does fit into this category of hearing loss and therefore I deemed it an appropriate assessment to be conducted with Simon.

To conduct these assessments I tried my best to make the environmental factors as similar to the first as possible. This involved conducting the assessments in the same mainstream classroom in which I did the AB short word lists during the same lesson and with both myself and Simon sat in the same place. The second set was also done in the same ARP classroom, I conducted them in the same place, during the same lesson and, Simon and I were sat in the same place. This should make the data from these assessments and the previous assessments comparable as they were conducted under the same conditions and mean any variations which affected the results affected both equally. The following tables (**Figure 8** and **Figure 9**) both show the results of the assessments. Words in bold and underlined represent the words said incorrectly.

We can see from the results collected from the mainstream environment (**Figure 8**) that Simon, like in the detection assessments, performs better with his ALD as he scored an average of 90% accuracy with it compared to his 60% average without it in the mainstream environment. This 30% variation between with ALD and without re-enforces my statement from previously that Simon's listening and auditory perception is bolstered and re-enforced with the support of his ALD and should be being used whenever Simon is being educated within a mainstream environment.

The results conducted within the ARP lesson, with and without ALD show improvements to performance during the assessment as it did with the AB word list.

Mainstream Classroom environment with no ALD.		**Mainstream Classroom environment with no ALD.**		**Mainstream Classroom environment with an ALD.**		**Mainstream Classroom environment with an ALD.**	
Speech Level (Average)	60dB	**Speech Level (Average)**	60dB	**Speech Level (Average)**	60dB	**Speech Level (Average)**	60dB
Target	**Response**	**Target**	**Response**	**Target**	**Response**	**Target**	**Response**
Horse	Horse	Plate	Plate	Cow	**Horse**	Horse	Horse
Plane	**Plate**	Horse	**Fork**	Spoon	Spoon	Plane	Plane
House	House	Spoon	Spoon	Fork	Fork	Man	Man
Tree	**Shoe**	Cow	Cow	Lamb	Lamb	Tree	Tree
Cup	Cup	Shoe	Shoe	Duck	Duck	Duck	Duck
Plate	Plate	Tree	**Shoe**	House	House	House	House
Key	**Shoe**	Duck	**Man**	Plate	Plate	Spoon	Spoon
Horse	**Fork**	Cup	Cup	Shoe	**Spoon**	Cow	Cow
Man	Man	Key	**Man**	Tree	Tree	Key	Key
Duck	Duck	Lamb	Lamb	Cup	Cup	Shoe	Shoe
Score %	60%	**Score %**	60%	**Score %**	80%	**Score %**	100%

Figure 8

Simon shows an average of 90% without an ALD and scored 100% both times when using an ALD in the ARP. Although this data is excellent and we can agree that his performance improves within the ARP and with an ALD, we should not believe that Simon can correctly discriminate and identify 100% of the time when in the ARP and with an ALD. This is due to the fact that this assessment does provide the student with multiple options and therefore unlike with the AB word list they have options to select from multiple options (Lovett, Summerfield, Vickers, 2013).

Therefore, we should consider that a limitation of this assessment is that the student does have the opportunity and likely hood to guess the word spoken and guess correctly. Simon also has more of a chance to get it correct than they do with the AB word list, and thus to believe that Simon will always perfectly discriminate and identify sounds in the ARP and with an ALD would be naïve.

ARP Classroom environment with no ALD.		**ARP Classroom environment with no ALD.**		**ARP Classroom environment with an ALD.**		**ARP Classroom environment with an ALD.**	
Speech Level (Average)	60dB	**Speech Level (Average)**	60dB	**Speech Level (Average)**	60dB	**Speech Level (Average)**	60dB
Target	**Response**	**Target**	**Response**	**Target**	**Response**	**Target**	**Response**
Cow	Cow	Plate	Plate	Fork	Fork	Plate	Plate
Man	Man	Duck	Duck	Duck	Duck	Lamb	Lamb
Key	Key	Spoon	**NR**	Spoon	Spoon	Tree	Tree
Cup	Cup	Lamb	Lamb	Cow	Cow	Key	Key
Fork	Fork	Horse	Horse	Show	Show	Cow	Cow
Plane	Plane	Cow	Cow	Tree	Tree	Plane	Plane
House	House	Man	Man	Man	Man	Fork	Fork
Duck	Duck	Show	Show	House	House	Spoon	Spoon
Lamb	Lamb	Tree	Tree	Key	Key	Man	Man
Horse	**Fork**	Plane	Plane	Cup	Cup	House	House
Score %	90%	**Score %**	90%	**Score %**	100%	**Score %**	100%

Figure 9

Comprehension: Introduction

A language is a tool through which students are able to construct meaning and therefore develop an understanding (Swanwick, 2017) so the student needs to have a comprehension of the language they are working in to be able to develop an understanding and meaning of the concepts they are studying. This idea of language being a medium in which we begin learning is working within the sociocultural theory of mind (Swanwick, 2017) which was pioneered by Vygostsky (1978) and supported by various other researchers since. Linell (2009) re-enforces this idea of learning and development through the exchange of ideas and thoughts and therefore our language and knowledge are constructed by our cultural context and environment (Swanwick, 2017). Hence, now that we have examined how well Simon is able to receive the language within his educational environments through his audiological access, I needed to see how well he understands the spoken language he is working in.

Comprehension: Method and Results

To do this I chose to use The British Picture Vocabulary Scale (BPVS) which is an assessment designed to test student's receptive skills of Standard English vocabulary and developed by Dunn and Dunn (2009). The test Dunn and Dunn (2009) developed involves showing the student four images and then the person administrating the test stating a word with links to one of the images; students are marked on their ability to correctly match the word spoken with the correct image from the four options. The limitations of this assessment are that it is one often used by professionals of all backgrounds and there is a risk that it is over-tested but to overcome this is co-ordinated with the other professionals that work with Simon to ensure that they hadn't used this within the past 6 months, which no one had. Secondly, this only focusses on a small aspect of linguistics and cognitive skills and therefore we should be careful to not make too much speculation using these results purely on their own and that this assessment should lead to further research (Dunn and Dunn, 2009).

As this assessment focusses purely on Simon's cognitive abilities I conducted this assessment differently to the ones done previously in this case study. Having established the optimum conditions for Simon's detection, discrimination and identification were within the ARP environment and with an ALD to support him I, therefore, conducted the BPVS in these conditions in an attempt to limit the audiological barriers to him accessing the assessment. This should mean Simon had the best opportunity to access the sound of the words being used in the assessment and makes the results more reliable as it focusses us more on Simon's cognitive understanding without us having to worry about audiological and phonological variables.

Record of scores:	Score:	Confidence bands:
Raw score:	60	
Standardised score:	70-	N/A to N/A
Percentile rank:	N/A	N/A to N/A
Age equivalent: (Years:Months)	4:6	N/A to 4:10

Figure 10

Looking at the results from the BPVS we can see that the results put Simon very low and in some areas he even falls before the standardised scores. We can see that from this particular assessment we can see that Simon's results standardise to an age equivalent of 4 years and 6 months which is a full 8 years below his current chronological age. These results strongly imply that Simon's main barrier to improving his spoken language lies in his understanding of the language being used around him. Marschark and Knoors (2012) state that it is still uncertain whether better access to speech, through Cochlear Implants particular, do actually provide benefits to a child's mental development as it doesn't fully capture the full emotional aspects of spoken language and that the connection between a child's spoken language and their cognitive functions are not as clear cut as they would appear to be. This may potentially link with why Simon, who with the right support has potentially very good access to spoken language, seems to be so behind with his own understanding of language.

Repercussions and outcomes of assessment:

Having assessed and established certain aspects of Simon's speech and audiological access we can begin constructing targets that can aid and improve Simon's rate of progress. As ToDs we regularly have to set and evaluate targets we have set to support the development of all our students. To do this the targets I would set would be written using the SMART format (Day and Tosey, 2011). This means that the targets are all "specific, measurable, achievable, realistic and time-based" (Day and Tosey, 2011, p517) which should mean that the targets set are more meaningful and should, therefore, help more with any progress Simon makes. These targets can then be given to staff that work closely with Simon so they know how he can improve and help contribute evidence to him meeting these targets and they can be given to Simon himself, in student-friendly language, so that he himself is aware of how he can improve and develop. These targets set for Simon could be based on his own audiological support and responsibilities for using them. For example; ensuring he is using his ALD for a specific amount of time across a fixed period in his educational settings. These targets could also be based on his spoken language use and development, such as ensuring that he uses the 's' and 'es' sounds on word endings when pluralising as we have seen that this sound is a barrier in both his listening and speaking. These targets would, of course, have clearly defined time boundaries, success criteria to establish the successful achievement of the targets, strategies to support and clearly rationale behind them based on assessments conducted.

Conclusion

Having conducted the assessments in this case study we are able to draw some conclusions about Simon's audiological access. Firstly, we know that overall Simon performs better when using an ALD in both mainstream and ARP environments compared to when he performs without (**Figures, 6, 7, 8, & 9**). We also saw that overall he performs better in the ARP environment with an ALD compared to all other variables (**Figures, 6, 7, 8, & 9**). Secondly, we found that Simon's main barrier to spoken language development and acquisition is his level of language understanding which we saw through his results in the BPVS (**Figure 10)**. When talking with Simon during this case study process he himself has identified the barriers he finds he faces he says "When I use radio I still don't understand" showing that Simon finds his level of understanding a barrier to his language. However, a downside to the research I have conducted is that it focusses purely on single-word testing, Simon's ability to detect, discriminate and identify (Madell, 2014) may be potentially weaker when involving sentences or more complex grammar and this is something that will need further testing. Last week, at the time of writing, the school was provided with portable Sound-field to use in school with our ARP students. A sound-field is an educational tool that uses amplification to provide educations with control over their classroom's acoustic environment (Massie and Dillon, 2006). Through the use of speakers, microphones, and receivers a teacher is able to ensure that their voice is spread evenly through the teaching environment to lessen the amount of sound lost from where the teacher is presenting to where the children are sat (Massie and Dhillon, 2006). Within this first week of a four-week trial, Simon has already commented that he finds the Sound-field beneficial within the ARP environment, stating "When I use that [Sound-field] I am really clearly and easier". Show that this could potentially reinforce Simon's audiological access when used in conjunction with his ALD both in the ARP but also when in the mainstream where we have seen that he does perform lower with detection, discrimination, and identification (**Figures, 6, 7, 8, & 9**). Schafer and Thibodeau (2004) found that with a Sound field deaf adults with cochlear implants had improved speech recognition and hypothesised that this should work equally as well with deaf children. Whitmer, Brennan-Jones, and Akeroyd (2011) also found that Sound fields speech intelligibility was also improved in deaf adults. Both these pieces of research have the potential to imply that Simon could access speech more effectively in mainstream classrooms when supported by both his ALD and the sound-field. Dockrell and Sheild (2012) also found that in rooms with poor acoustics, Sound-field systems boosted students understanding of spoken language which would certainly benefit Simon. With this potential of a Sound-field to support Simon, it is worth trialling this piece of audiological equipment over the following three weeks while we have the technology. Overall it is clear that Simon does have room to further support his audiological access but it is vital to prioritise support his understanding of spoken language. Simon has good listening skills with the support of the right audiological equipment but Simon struggles to process the cognitive aspects of language and it's important to now help Simon with these skills if we want his spoken and written language use to progress at an increased rate.

Finally, I believe that there are a number of things that we can take away from this case study and that, I hope, will be of benefit to practitioners and educators regardless of if they work as Teachers of the Deaf. If we begin by looking at the three questions we set regarding Simon and his development we wanted to see how well Simon was using his innate and cognitive listening skills within the categories of detection, discrimination, identification, and comprehension (Madell, 2014). Simon shows us a clear example of a pupil who uses his audiological equipment correctly and effectively to support his innate abilities, however still struggles with spoken language acquisition, a difficulty faced by the vast majority of deaf learners (Marschark and Hauser, 2012). This implies to us that overcoming the impact deafness has on language skills is not purely down to support of audiological technology, although as we have seen it does have a large beneficial role, but it cannot do it alone. The Consortium for Research into Deaf Education (CRIDE) found that 78% of school-age deaf learners are educated within mainstream school environments without specialist attached provisions (CRIDE, 2017). This means that these learners are primarily educated by mainstream teachers who may not have any relevant experience or knowledge on deafness and its impact on education and that the pupils are seen by peripatetic ToDs. This means it is important to give mainstream educators an insight into the barriers deaf learners face and case studies such as these, that can be created with the combined effort of peripatetic ToDs and SaLTs, can give mainstream educators an insight into difficulties their students face. This case study also stresses to those who are not deafness professionals that while audiological equipment is an important and vital tool in deaf learners' support it doesn't automatically fix a student's language struggles and that for many the problem lies in the cognitive comprehension of language. This is a barrier not overcome through technology but through careful planning and intervention by educators and professionals working with the student and if this is a barrier it needs to be identified as soon as possible.

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