



Practice Guidance

An overview of current management of auditory processing disorder (APD)

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General foreword

This document presents Practice Guidance by the British Society of Audiology (BSA). This Practice Guidance represents, to the best knowledge of the BSA, the evidence-base and consensus on good practice, given the stated methodology and scope of the document and at the time of publication.

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Comments on this draft document are welcomed and should be sent to:

British Society of Audiology

80 Brighton Road, Reading

Berkshire, RG6 1PS, UK

info@thebsa.org.uk

www.thebsa.org

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2. Document development

This report, compiled by the Steering Committee of the BSA Auditory Processing Disorder (APD) Special Interest Group, provides an overview of current APD management, and highlights the level of research evidence for different management options. This is a working document, which will be updated as new research evidence emerges and resources become available. The aim of this report is to inform professionals and guide research.

The Steering Committee would like to acknowledge the advice received from a range of professionals (see Appendix A). The document was developed in accordance with BSA Procedure for Processing Documents (2003).

3. Executive summary

At this time there is no 'gold standard' for diagnosing APD. Without such a 'gold standard', the best methods for identifying and managing APD remain elusive. Data specifically addressing the efficacy of interventions for APD are lacking and many of the recommendations commonly made are based on theory or inferred from approaches validated in other populations, e.g. specific language impairment and dyslexia.

Researchers are demanding empirical evidence before endorsing diagnostic criteria and intervention strategies whilst clinicians, seeing individuals with 'suspected APD', are demanding guidelines for best practice at this time. The translation of evidence into practical recommendations is likely to take some time and it is important that researchers and clinicians collaborate in their efforts.

This report provides an overview of current management options, citing evidence levels, to inform clinicians of current best practice whilst simultaneously guiding further research. The purpose of the document is to provide information to enable professionals to make informed choices. Practical appendices and references are referred to in the text.

4. BSA Position Statement on APD

In their Position Statement on APD, the BSA APD Special Interest Group (2011) defines APD as follows:

- **APD is characterised by poor perception of both speech and non-speech sounds.** Auditory ‘perception’ is the awareness of acoustic stimuli, forming the basis for subsequent action. Perception results from both sensory activation (via the ear) and neural processing that integrates this ‘bottom-up’ information with activity in other brain systems (e.g. vision, attention, memory). Insofar as difficulties in perceiving and understanding speech sounds could arise from other causes (e.g. language impairment, non-native experience of a particular language), poor perception of speech alone is not sufficient evidence of APD.
- **APD has its origins in impaired neural function.** The mechanisms underlying APD include both afferent and efferent pathways in the auditory system, as well as higher level processing that provides ‘top-down’ modulation of such pathways.
- **APD impacts on everyday life primarily through a reduced ability to listen, and so respond appropriately to sounds.** The term ‘listening’ has been used to imply an active process while ‘hearing’ implies a more passive process; it is possible to hear without listening attentively.
- **APD should be assessed through standardized tests of auditory perception.** There are currently no generally agreed ‘gold standard’ methods to assess APD, but these are essential to move the field forward. Note that ‘testing’ may include both direct and indirect measures such as questionnaires.
- **APD does not result from failure to understand simple instructions.** Primary impairments for which auditory difficulties may be a ‘secondary’ or ‘trivial’ consequence include medical problems not affecting the ‘mechanisms underlying APD’ and generalised medical/psychological problems that render a label of APD impossible, inappropriate or irrelevant (e.g. severe mental impairment).
- **APD is a collection of symptoms that usually co-occurs with other neurodevelopmental disorders.** Like other such symptoms (poor language, literacy or attention, autism) APD is often found alongside other diagnoses.

There are three categories of APD:

1. Developmental APD: Cases presenting in childhood with normal hearing (i.e. normal audiometry) and no other known aetiology or potential risk factors. Some of these people may retain their APD into adulthood
2. Acquired APD: Cases associated with a known post-natal event (e.g. neurological trauma, infection) that could plausibly explain the APD.
3. Secondary APD: Cases where APD occurs in the presence, or as a result, of peripheral hearing impairment. This includes transient hearing impairment after its resolution (e.g. glue ear or surgically corrected otosclerosis).

There is an international focus on Developmental APD, primarily because of fears that it may lead to learning difficulties, especially affecting language and literacy, and hence to poor school performance. Individuals in the latter two categories are likely to require medical and audiological intervention in addition to the APD management strategies presented here.

5. Evidence-based practice and intervention efficacy

When considering evidence-based practice it is important to evaluate the quality of the evidence. This can range from anecdotal reports, case studies to peer reviewed randomised and controlled studies published in scientific journals. Table 1 provides a useful method for evaluating the evidence levels of different sources; with level I representing the highest ranking and level IV the lowest ranking. Currently most research on APD management is rated at level III and IV. Evidence at level IV is particularly weak and based on opinion rather than proper scientific evaluation.

It is important to differentiate between studies where interventions have been validated for other populations, e.g. language, specific language impairment and dyslexia and studies that have investigated the benefit of these interventions for the APD population. The benefit of many interventions for APD have been inferred from other populations rather than validated directly.

Bishop (2008) highlights the strict levels of scientific evidence required for introducing a new pharmacological intervention and argues that non-drug interventions should also be required to meet the same stringent levels of scientific evidence. Randomised control studies are the best way of determining educational and therapeutic intervention outcomes and differentiating between true and artefactual improvements (Torgerson and Torgerson, 2003). Bishop (2008) supports this view and proposes specific criteria for evaluating intervention studies, which should also serve as the benchmark for future studies, namely:

- Study participants selected by objective criteria
- Appropriate control group included
- Sample size with adequate power
- Study participants comparable to those for whom the intervention is intended
- Information provided on dropouts from the study and why
- Random allocation of participants to the treatment and control groups
- Reliable, sensitive and valid assessment methods, using age-standardised measures where possible
- Assessment blind to group status
- Pretest data (n), means and SD (or SE) for intervention and control groups clearly described
- All data reported
- Intervention effect assessed in terms of significant differences between the control and intervention groups
- Effect sizes reported with confidence intervals
- Interpretation of the results takes into account the hypotheses, potential sources of bias or imprecision

Table 1

Evidence levels of different sources (ASHA, 2004)

Level	Sources of Evidence
Ia	Meta-analysis including more than one randomised study
Ib	Randomised controlled study
II	Non-randomised controlled (quasi-experimental) study
III	Non-experimental study (e.g. case studies with controls, observational studies with controls, retrospective studies, cohort studies with controls)
IV	Expert reports (committees, consensus conference); clinical experience of respected authorities; case, observational, and cohort studies without controls

Literature published between 1995 and 2010 was reviewed in the compilation of this report. The following databases were searched: Cochrane Library, CRD database, Lilacs, Medline, PubMed, PsycARTICLES, and Web of Science. The key words used were: “auditory processing”, “auditory processing disorder”, “(central) auditory processing disorder”, “(central) auditory processing assessment”, “(central) auditory processing intervention” “(central) auditory processing management”, and “auditory training”. Key words were combined (and/or) so that all relevant papers would be identified. In addition to peer-reviewed articles, the position statements and practice guidelines of national and international professional associations, and references from textbooks of auditory processing disorder were searched by internet and hand. The search was confined to literature in English. The systematic review and classification of the evidence levels outlined in Table 1 was done by the lead author and 3 members of the APD Special Interest Group Steering Committee primarily involved in writing this document and then verified by the remaining ten members.

6. A multi-disciplinary approach

A multi-disciplinary approach should be considered but needs to be balanced with practical issues including timing and cost. In children APD may co-exist with other delays/disorders and differential diagnosis and appropriate management are essential (Witton, 2010). In adolescents and adults, a multi-disciplinary team may be helpful in academic/vocational modifications, psychological counselling, career counselling and transition planning and self-advocacy training (Baran, 2007). Thus, in broad terms, the minimum multidisciplinary assessment for APD should include (modified from the Interim Position Statement on APD, BSA 2007):

- Detailed audiometry (including puretone audiometry, word recognition testing, OAEs +/- suppression, tympanometry, acoustic reflexes and/or ABR). These are necessary to differentiate between APD and other disorders such as Auditory Neuropathy Spectrum Disorder (ANSD)
- Auditory processing tests (which should include at least 1 non-speech test procedure)
- A screening language and cognitive assessment (including tests for auditory memory and attention). In particular, children referred for suspected APD need to have, in addition to their audiometric assessment, a screening work-up, including assessments of nonverbal ability, language and literacy, because problems in these areas may contribute to problems experienced by the child (Rosen, 2009). Administering audiological APD tests in isolation, without considering these issues may result in misdiagnosis and delays in the appropriate management of individuals with co-existing disorders. Professionals or departments may choose to address this in different ways,

i.e. requesting this information prior to referral for APD testing or offer this as part of an 'in-house' service.

- Additional tests and assessments should be conducted on the basis of the patient/carer reported symptoms or if findings of the above mentioned assessments warrant further investigation.

At present, there is no universally accepted audiological APD test battery, nor any general consensus regarding the extent of the non-audiological assessments that need to be conducted. Currently recommended (ASHA, 2005; American Academy of Audiology, 2010) auditory processing tests are primarily behavioural, including non-speech psychoacoustic tests (e.g. frequency and duration discrimination, binaural interaction) and speech-based tests (e.g. dichotic listening, monaural low-redundancy syllables). ASHA (2005) recommends that the audiological APD test battery include tests representative of the following auditory processes: dichotic listening, temporal processing, binaural interaction, monaural low redundancy, auditory discrimination, sound localisation, performance in competing acoustic signals and performance with degraded acoustic signals. These may be followed up with further electrophysiologic testing, if required and available.

Substantial evidence regarding test performance (e.g. reliability, validity, sensitivity, and specificity) is lacking for most commonly used behavioural tests of auditory processing and this shortcoming needs to be addressed. Despite previous APD Consensus Statements (ASHA, 1996; Jerger and Musiek, 2000; Katz et al, 2002; ASHA, 2005), stressing the importance of well-standardised tests, only 'lip service' has been paid to recommendations (Keith, 2009). Keith (2009) highlights that popular tests such as the Dichotic Digits Test, the Frequency Pattern Test and the Duration Pattern Tests have no published norms, despite being developed more than 20 years ago. Clinicians are encouraged to collect their own normative data, but most do not and the methods of collection will inevitably vary across centres. At this time there is also no gold standard or agreed definition of APD and without these it is not possible to determine the specificity or sensitivity of tests (Keith, 2009).

Electrophysiologic tests include Auditory Brainstem Response (ABR), Middle Latency Response (MLR), P300 and Mismatch Negativity (MMN). There are no widely accepted criteria as to when electrophysiologic tests (except for ABR as discussed above) should be included in the clinical evaluation of APD. Some of the electrophysiologic tests requiring more complex multi-channel recording and elicitation using speech signals are generally not available in routine audiology clinics.

Electrophysiologic measures, together with measurements of OAE with contralateral suppression and functional imaging studies are advancing our

understanding of APD and the effects of auditory training. Schochat et al (2010) recognise the paucity of data on electrophysiologic measures in the field of APD and how auditory training may affect these potentials. In their study 30 children with APD, 8 to 14 years of age, were tested using MLR. These children were reported to have no speech or language problems (verbal) as reported by a speech language therapist but did suffer 'learning disabilities' as determined by the classroom teacher (this information is not provided). This group then underwent an 8-week auditory training programme (comprising both formal (frequency, intensity and temporal-training, dichotic interaural intensity training, localisation and speech perception training) and some informal training at home) and were then retested. A control group of 22 children without APD underwent the same testing at equal time intervals but were not exposed to the auditory training programme. Prior to the training the MLR amplitudes of the APD group were found to be significantly lower than for the control group. Following the training, no significant MLR amplitude differences were found between the 2 groups (Evidence level II). The functional outcomes with regards to performance in the classroom are not provided.

Age is a further consideration when compiling an APD test battery. Most diagnostic behavioural tests require a minimum age of 7 years and maturational effects in the central auditory pathway are noted in test scores until approximately the age of 12 years (Moore et al., 2010). A right ear advantage for dichotic materials is also evident up to the age of 12 years. Deterioration in APD tests scores is also evident as an effect of aging. Appropriate normative data should be compiled and used. Similarly, many electrophysiologic measures of central auditory function yield variable results in children under age 10 years secondary to the maturational time course of the central auditory nervous system (ASHA, 2005) and of the brain in general. The use of both behavioral and electrophysiologic assessment procedures requires a thorough understanding of the effects of maturation on test results (Hall and Johnston, 2007).

Behavioural tests of APD are available from Auditec (www.auditec.com), Audiology Illustrated (www.audiologyillustrated.org) and the Department of Veterans Affairs (richard.wilson@med.va.gov). Auditec (www.auditec.com) provides an overview of test materials, in addition to purchasing information.

7. Linking test results and needs to specific management strategies

Linking an individual's test results and needs to specific management strategies can be:

- Functionally driven, i.e. the individual's difficulties in everyday life and at school/work are matched with corresponding management strategies (Appendix B),
- Test driven, i.e. management strategies are selected on the basis of test findings (see Appendix C) (Evidence level: IV), and/or
- Profile driven, i.e. the individual is classified into an APD subtype, based on patterns in test results and proposed audiological or neurological underpinnings, and management is decided accordingly, e.g. the Bellis/Ferre Model (see Appendix D) (Evidence level: IV).

Appendix B: Functional difficulties associated with APD
Appendix C: Test-driven auditory training
Appendix D: Summary of Bellis/Ferre APD subtypes

Management programmes should consider the primary presenting complaint/s, case history and multi-disciplinary assessment results. Comprehensive management cannot be designed on the basis of audiological APD test results alone.

8. Identifying specific needs in children and support in schools

Schools may receive information about a child's APD from different sources - parents, specialist clinic, speech and language therapist or teacher of the deaf - and must take responsibility for the management of APD in the classroom. The special needs co-ordinator (SENCO) should take the lead, working in partnership with and taking advice from parents, school staff and outside professionals.

The 2003 Green Paper 'Every Child Matters' recommended a national standard format for early and integrated intervention through multi-disciplinary assessment. The Common Assessment Framework (CAF) is now in wide use and aims to reduce bureaucracy and provide any service involved with children, whether they are health, education, voluntary or social services, with a format to facilitate joint working with other services.

A child with APD should be placed at 'School Action' or 'School Action Plus' and will require an Individual Education Plan (IEP) to be put in place. An IEP is required if a child needs support additional to that provided through the differentiated curriculum provided for all children. The IEP is the route to

intervention and will identify need, set clear targets (no more than four or five) detailing how these targets will be achieved. Teaching and learning strategies and any 'programmes' of intervention will also be included with the IEP and progress (or lack of it) must be recorded and evaluated on a regular basis. The time scale will be set by the school, but meetings should take place at least half termly and the IEP targets re-written or modified as necessary. Parents receive a copy and, where appropriate, the child should be actively involved in his or her IEP, with a thorough understanding about the particular implications of his/her APD and how the strategies and/or programmes may help to minimise the effects at school. The IEP should be an easily accessible working document, referred to frequently by the class teacher and other professionals involved with the child, so that the aims and targets become part of the child's every day learning, not separate from it.

Local Education Authorities have devolved the Special Educational Needs budget to schools and provision for the majority of children with special educational needs, including those with a Statutory Statement of SEN, are met within a school's budget. The initiation of a Statutory Assessment may be requested during the course of intervention if indicated from the evidence of existing multi-professional assessment. The Special Educational Needs and Disability (SEND) Review and Green Paper (2010) to be updated 2011, is expected to have a focus on increasing the rigour in school and statutory processes and on providing an alternative to the current adversarial system for resolving disputes.

9. APD management in children

APD will often co-exist with attention, language and learning impairments as well as autism spectrum disorder (Bellis, 2008; Dawes and Bishop, 2010, Witton, 2010). A multi-disciplinary approach is recommended, particularly when co-existing disorders are present. Ideally, expert APD clinics including professionals such as a psychologist, speech and language therapist, educational audiologist/teacher of the deaf and a paediatrician, in addition to audiological professionals working together would best serve this group. Ascertaining whether APD is the primary disorder may be useful in determining the focus of the intervention and help to prioritise the different components and order of implementation thereof. Intervention focussed entirely on auditory processing might not be all that is needed and intervention should be based on an integrated multi-disciplinary approach (Witton, 2010). On the other hand, it may be that a common developmental disorder (e.g. impaired attention) underlies several co-existing problems, in which case a single intervention may be indicated.

Management should be individualised, with the ultimate target to improve the individual's primary complaints and everyday functioning. Management should be

both cost- and time effective and not cause the child to fall behind in other areas (e.g. reading or other schoolwork) due to time constraints.

Management programmes should consider the primary presenting complaint/s, case history and multi-disciplinary assessment results. Comprehensive management cannot be designed on the basis of audiological APD test results alone. The strategies presented here give an overview of current thinking and strategies. Management needs to be tailored according to each child's needs.

9.1 Modifying the listening environment

9.1.1 Acoustic changes to the environment (reduce of noise and reverberation)

The synergistic effect of noise and reverberation in a less than ideal acoustic environment will result in degradation of the speech signal. Where possible, architectural interventions to reduce reverberation and improve the signal while reducing or removing competing noise should be implemented. The Building Bulletin 93 document (Acoustic Design of Schools, Building Bulletin 93, 2003) provides a comprehensive guide for architects, building control bodies, building services engineers, clients, and others involved in the design of new school buildings.

The acoustic environment can be improved by acoustic treatments such as carpets, curtains, doors (and closing doors), putting seals on doors, rubber shoes on furniture legs, double-glazed windows to reduce outside noise and soft covers on display tables as well as by more sophisticated means, such as installation of noise absorbent partitions or screens within the classrooms (Appendices E and F). Covering hard reflective surfaces with absorptive material such as acoustic panelling and cork boards can reduce reverberation time (Bamiou et al, 2006).

In addition to the above, preferential sitting may also be of benefit for children with APD. This varies between classrooms and recommendations should be based on knowledge of the specific classroom and the teacher's style of teaching (Appendix G).

Appendix E: Classroom audit
Appendix F: Making your classroom a better place to listen and learn
Appendix G: Suggestions for teachers

9.1.2 Assisted listening FM systems

Assistive listening FM devices, such as personal ear level or desk top (which benefit the individual) and/or classroom sound-field (which benefit everyone in the room). These are wireless devices that receive distant auditory input, amplify and transmit the signal to the ear of the listener. A microphone worn by the speaker and connected to a transmitter picks up the speech signal of the speaker and converts this to an electrical signal, which is transmitted via FM band waves to the receiver. These systems help counteract the problem of distance between teacher and student, as loss of critical speech elements is overcome since the distance travelled by the speech signals is reduced, while masking of the speech signals by ambient noise is minimized and overall audibility is increased (Bamiou et al, 2006). Sound-field systems are helpful in rooms that are not too reverberant; however personal FMs are better in reducing the effects of reverberation.

Most children with APD have normal audiometric thresholds and it is therefore important to use a system designed for use with normal hearing. However, the FM system will be effective only if problems caused by poor classroom acoustics have been addressed and are part of the individual management process. FM systems may not be appropriate for all children with APD.

The fitting of an FM system should be preceded by careful audiological evaluation of the child and evaluation and modification of classroom acoustics. The age of the child and his/her motivation should be considered as well as the support for a FM system from the school. Progress with an FM system should also be closely monitored (using checklists that are completed by the child and teacher independently are useful). DeConde Johnson et al (1997) provide useful checklists for monitoring FM use and benefit. Where possible a trial period is recommended before a final decision is made.

A systematic review of the literature up to April 2008, using data found in electronic databases (Medline, Lilacs and Cochrane library) as well as the internet (Lemos et al 2009) investigated the scientific evidence confirming the effectiveness of personal FM systems in the treatment of APD. The search resulted in 1589 references out of which only 19 met the inclusion criteria ('randomised controlled clinical attempts' and individuals with normal peripheral hearing). All of the studies analysed employed a low level of evidence (Evidence level IV: expert opinions or case studies) and strong evidence supporting the use of personal FM systems for APD intervention was not found.

A more recent search of Medline yielded an additional two studies on FM systems as well as a study on personal amplification. Johnson et al (2009) reported on children with APD fitted with Phonak Edulink FM devices. Baseline measures of the children with APD, prior to FM use, documented significantly

lower speech-perception scores, evidence of decreased academic performance, and psychosocial problems in comparison to an age- and gender-matched control group (who only wore the FM for the speech perception testing). Repeated measures during the school year demonstrated speech-perception improvement in noisy classroom environments as well as significant academic and psychosocial benefits. Compared with the control group, the children with APD showed greater speech-perception advantage with FM technology. Notably, after prolonged FM use, even unaided (no FM device) speech-perception performance was improved in the children with APD, suggesting the possibility of fundamentally enhanced auditory system function (Evidence level: III).

In the second study, Hanschmann et al (2010) tested sentence in noise perception (Oldenburg sentence test in noise OLSA) in 66 children aged 6-11 years with and without an FM system (evidence level – III). Children were grouped into a control group (normal results in OLSA), and two test groups (abnormal OLSA results), viz. 2a, who gave normal results on retest, and 2b, who gave abnormal results on retest. All children achieved improved speech intelligibility using the FM system, and the greatest improvement with vs. without FM system was observed in group 2b (9.53 dB S/N). However, there was no significant difference in the improvements observed in the 3 different groups. Group 1 achieved an improvement of 8.86 dB S/N and group 2a 7.89 dB S/N.

In a further study, Kuk et al (2008) conducted a before-after study on 14 children with APD, fitted with bilateral, mild-gain, behind-the-ear, wide dynamic range compression hearing aids fitted in an open-ear mode (evidence level- IV). The hearing aids provided approximate insertion gain of 10 dB for conversational input. The children were encouraged to wear the hearing aids as much as possible during all their activities, and were assessed on the Northwestern University word-list (NU-6) and the Auditory Continuous Performance Test (ACPT) in noise during an initial visit to fit the hearing aids, and at 2 weeks, 3 months, and 6 months after the initial fitting. The children's parents and teachers completed the Children's Auditory Processing Performance Scale (CHAPS) questionnaire both before and at the end of the study. The fitting of hearing aids with directional microphones with a noise reduction algorithm improved speech understanding in noise. Amplification showed a (non-significant) trend for reduction of errors on the ACPT and improvement of the CHAPS. The BSA APD Special Interest Group does not endorse the fitting of hearing aids in the APD population in the absence of a peripheral hearing loss. The Edulink and more recently the iSense by Phonak (www.phonak.com) are examples of personal FM systems designed specifically for children with normal hearing.

9.1.3 Teacher/speaker adaptations

Teachers are advised to use clear speech and alter the pacing, emphasis and segmentation of their speech in order to highlight the key points. These changes slow down the teacher's speech. The teacher may also use repetition or re-phrasing of the message, using additional visual or other cues, keeping the message short, showing something rather than describing it, and frequently checking for understanding. Appendices H, I and J outline activities that can be used to minimise the effects of APD.

Appendix H: Activities to minimise the effects of auditory processing difficulties (School and Home)
Appendix I: Activities to minimise the effects of auditory processing difficulties (Primary School)
Appendix J: Activities to minimise the effects of auditory processing difficulties (High School)

9.2 Auditory training

Neuroplasticity underpins auditory training and requires that activities are sufficiently challenging (i.e. at the 'Edge of competence') and repeated over extended periods of time to be likely to be effective (for example, 30 minutes, 3-4 times a week for 6 weeks). As detailed below, the application of auditory training to APD and language-based learning problems is controversial. However, there is strong evidence (Level I/II) from studies of musical training (Kraus and Chandrasekaran, 2010) that auditory training can be beneficial for a wide range of perceptual and cognitive abilities, and result in neuroplasticity.

There are formal and informal auditory training methods. At this time there is no evidence to suggest that the formal training programmes are more beneficial than informal training methods, or that more expensive programmes are superior to less expensive ones.

9.2.1 Formal training methods: computer-based auditory training (e.g. Earobics, Fast ForWord, Phonomena)

Computer technology has made possible the presentation of auditory training tasks through computer programmes with an adaptive procedure ensuring an appropriate level of difficulty. Although auditory training tasks are used, the focus is more on language than fundamental auditory processing training. Interesting computer graphics also help engage the child. The tasks are typically reported to improve phonological awareness, phonics, auditory attention and language. Fast

ForWord also claims to improve the discrimination of brief sounds. Earobics and Fast ForWord have both been developed in the USA, and Phonomena has been developed in the UK. See Table 2 for a brief description of Earobics, Fast ForWord and Phonomena and the relevant websites. Further information and costs are available from the websites. Fast ForWord is significantly more expensive and professionals are required to complete a ‘Certified Practitioner’ training course before being able to purchase and use the software.

Table 2

Brief description of Earobics, Fast ForWord, Phonomena

<p>Earobics www.earobics.com</p>	<p>Fast ForWord www.scilearn.com or www.innovative-therapies.com (UK)</p>	<p>Phonomena www.mindweavers.co.uk</p>
<p>Earobics is underpinned by adaptive training technology to adjust the level of instruction to the child's level and progress, and primarily uses recorded but real speech. It is recommended that the child use Earobics for 15 to 20 minutes per day, three times a week. Earobics Step 1 is designed for developmental ages 4-7 and features six interactive games with over 300 levels of play. It purports to teach phonological awareness and introductory phonics skills required for learning to read and spell, and to develop general cognitive skills that support learning, such as attention and memory. Earobics Step 2 is designed for developmental ages 7-10 and features five interactive games with nearly 600 levels of play. Step 2 targets the same skills targeted in Earobics Step 1, but at more advanced levels, as well as language processing skills for extracting meaning from spoken language and written text. Earobics Adolescents & Adults provides sophisticated, game-style, multimedia instruction, designed to appeal to adolescents and adults who are struggling to</p>	<p>Fast ForWord is a series of computer based exercises (games) designed to improve auditory, language processing and reading abilities with the view to “train the brain to process at faster rates and help to create or modify the neural pathways”. It uses both speech and non-speech stimuli that have been acoustically modified to slow and amplify transient sounds. Fast ForWord Language Basics is a program aimed at 4-6 year olds and consists of 3 exercises that help to develop visual attention and auditory discrimination skills and sustained auditory attention, and aims to prepare for Fast ForWord Language. There are a number of products available such as: Fast ForWord Language v.2 (ages 5-12), Fast ForWord Middle & High School (adolescents and older learners), Fast ForWord Language to Reading v.2 (which targets the skills that require to make the link between spoken and written language). Fast ForWord Reading is a curriculum-based reading program. The child will usually work on these intensive computer based exercises 30 minutes a day, 5 days a week for 3-4 months (or more intensively for a</p>	<p>Phonomena is an interactive game, designed to improve auditory discrimination and phonemic awareness, and to build language skills. It consists of game-play and graphics designed to appeal especially to 6-12 year olds, while administrator controls give language professionals additional tools. “Phonomena” uses ‘phoneme contrasts’ which are selected from over 1,000 possible in English. At the start of the game, these 'sounds of words' are set as normally found in spoken language. Phonomena’s adaptive learning algorithms change the sounds in response to each player’s performance, making the choice more or less difficult, in order for the client to train at the ‘Edge of Competence’ therefore keeping the training at</p>

<p>read faster, spell better and improve their comprehension. There are two versions: one for home use (allows three users and 1 guest) and the other for professional use (allows 12 users).</p>	<p>shorter period of time). Fast Forward Literacy Advanced was launched in August 2006 for adolescents and older learners. Professionals are required to do a 'Certified Practitioner' training course before being able to purchase and use the software.</p>	<p>the point at which learning is most effective. Prices are available on the website with different options depending on whether a single or multiple computers are used.</p>
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Computer-based auditory training programmes were originally developed and marketed for children with language, learning and reading difficulties. More recently, these programmes have also been recommended for children with a specific diagnosis of APD, despite limited research evidence to support this. To date, only two studies (Deppeler et al, 2004; Miller et al, 2005) have investigated the outcomes of Fast ForWord and Earobics on children with APD and both had limitations in that neither study included a control group, the testers were not blind to the treatment options and subjects were not randomly assigned (Evidence level: IV). Deppeler et al (2004) reported that 6 of the 8 children diagnosed with APD (age 6-9 years) showed significant improvement following Fast ForWord on either or both the Staggered Spondaic Word Test and AB words in noise test (Boothroyd, 1968), but only one child maintained the improvement when assessed again after 1 year. Miller et al (2005) reported on a series of case studies involving 7 children (aged 7-9 years) who participated in 20 day intensive treatments designed to improve auditory processing. Three of the children participated in Fast ForWord, 2 in Earobics and 2 in 'traditional' intervention games, using worksheets and hand-on activities. Tests of auditory processing and spoken and written language were administered before and after treatment. All children showed evidence of improvement on auditory processing measures but no consistent improvement in spoken or written language measures was observed.

More recently Loo et al (2010) reviewed the existing evidence for computer-based auditory training in children with language, learning and reading difficulties, and evaluated the extent to which it can benefit children with auditory processing deficits. Searches, using 4 data bases, were confined to studies published between 2000 and 2008, and were rated according to the level of evidence hierarchy proposed by ASHA (2004). Sixteen studies (with evidence levels ranging from I to IV) were identified: thirteen studies of Fast ForWord and three studies of Earobics. The results suggest that, apart from the phonological awareness skills, FFW and Earobics programmes do not seem to have much effect on the language, spelling and reading skills of children beyond that observed using non computer-based speech and language therapy. Loo et al (2010) reported that there is some limited evidence to support remediation of auditory processing deficits, but emphasised that randomised control studies are

necessary. Thibodeau (2007) has also underscored the need for well-designed studies to determine the efficacy of this training for children with APD.

In a systematic review, Fey et al (2010) searched 28 data bases and evaluated peer-reviewed literature on the efficacy of APD training and auditory/language interventions for children, aged 6 to 12, with APD. The search yielded 25 studies for analysis but only six of these studies reported the outcomes for children diagnosed with APD while the remainder reported the outcomes for children with spoken language disorders. The authors concluded that the evidence base was too weak to provide clear guidance for treating children with APD.

Interestingly, Loeb et al (2009), Gillam et al (2008), Given et al (2008), Cohen et al (2005), and Pokorni et al (2004) reported that Earobics and Fast ForWord do not offer any significant benefit over other computer-assisted or therapist-centred language interventions in children with language, learning and reading difficulties. Furthermore, Loeb et al (2009) and Pokorni et al (2004) reported improvements in phonemic awareness but not reading. See section on 'Shared reading' for suggestions to generalise improvements in phonemic awareness to reading.

In adults, Mahncke et al (2006) conducted a randomised controlled study on 182 adults aged over 60 (evidence level II) to evaluate effects of a computer based auditory training programme, the Brain Fitness Program (Posit Science) which has six adaptive exercises. The test subjects performed 5-day weekly, hour-long training sessions for 8 weeks while the controls were watching educational videos over the same period of time. The authors reported significant improvement in the trained tasks, in auditory processing and auditory memory vs. no improvement of the control groups, while improvement was sustained 3 months after the end of training.

9.2.2 Formal training methods: programmes for improving phonological awareness and auditory discrimination

These are non-computer based programmes, which have traditionally been used by Speech-Language Therapists to improve phonological awareness and reading. There are a large number of commercially available programmes for children of different ages, e.g.:

- Just for Me! Phonological Awareness
- The Lindamood Program (LIPS Clinical Version) - Phoneme Sequencing Program for Reading, Spelling, and Speech
- Winget (2007). Differential Processing Training - 3 workbooks: Acoustic Tasks, Acoustic-Linguistic Tasks, and Linguistic tasks

The above and other materials are available from companies such as Linguisystems (www.linguisystems.com). Many of these resources are already available in schools.

Otaiba et al (2009) examined the efficacy of early phonological interventions for young children with speech and language impairments. Eighteen studies were included (based on electronic databases searched for peer-reviewed journal articles from 1990-2006 and manual searches of speech-language therapy journals). The 18 studies (ranging in Evidence level from II-IV) included nearly 500 children and the results showed improvements in phonological awareness, but that the gains decreased with an increase in age and large individual differences were reported. The importance of linking phoneme training and graphemes (written symbols) to facilitate reading acquisition is underscored. Ukrainetz (2009) recommends that phonological awareness training be delivered in combination with classroom lessons to facilitate generalisation to reading and spelling.

Phonological awareness training is widely used as an intervention for children with reading disability and there are programmes that have been developed and evaluated using randomised controlled studies (Bowyer-Crane et al, 2008; Torgesen, 2001). However, APD status has not been considered in these studies and there are no studies to date that have focussed specifically on children diagnosed with APD.

Informal auditory training of phonological processing is discussed later in this document.

9.2.3 Formal training methods: non-computer based auditory training programmes using headphones or speakers

These are programmes that typically use headphones and an audio CD. For example the Dichotic Interaural Intensity Difference training or DIID (Musiek et al, 2007) which can be used for children with poor dichotic listening. Dichotic listening is when two different stimuli are presented simultaneously to the two ears, i.e. the stimulus in the right ear differs from the left ear but is presented at the same time. There are two different processes that can be used, the first is binaural integration where the child is asked to repeat everything that they hear and the second is binaural separation where the child is asked to repeat only what is heard in one ear. Dichotic listening also trains interhemispheric transfer, which is discussed later in this document.

In children, a right ear advantage is seen until around the age of 12 years. Should this advantage continue to exist beyond this age or be greater than expected at a given age, then DIID training could be considered. DIID training utilises a variety of dichotic tasks (e.g. digits, consonant vowel combinations and

dichotic sentences) and essentially trains the two ears to function equally. Typically, the intensity of the stimuli presented in the better ear is reduced to avoid possible acoustic cross-over to the other side. The training is done at an intensity level where the poor ear performance exceeds the stronger ear. Gradually the level in the better ear is increased over an extended period of time (15-30 minutes; 3-4 times a week, usually over 2-3 months in an audiology clinic using headphone) until the functioning of the ears is balanced. Details of the procedure are described by Weihing and Musiek (2007).

Moncrieff and Wertz (2008) reported improvements in 13 children with a larger than normal interaural asymmetry on dichotic listening tasks following training. Dichotic verbal material was presented in the sound-field (rather than through headphones) with intensity adjusted separately for each speaker. Output from the right-sided speaker was initially 20–30 db HL lower than for the left-sided speaker, resulting in excellent performance in the left ear. Intensities were adaptively adjusted throughout training in 1, 2, and 5-dB steps in order to keep performance high across dichotic tasks. The evidence level of this study is IV as there was no control group and the children were not randomly assigned.

English et al (2003) recruited 10 children with reduced left ear dichotic listening scores and delivered left ear only stimulation (age appropriate story) for 8 minutes once a week, for 10-13 weeks in addition to 'addressing other processing problems' (not specified) for the remaining time in the one hour sessions. There was no control group and the methodology is not replicable as the other methods used in 'addressing other processing problems' are not described (Evidence level: IV).

The workbooks of Winget (2007) include audio CDs and some dichotic training activities (but no supporting evidence). Informal training methods, as discussed in the next section, can also be used.

9.2.4 Informal auditory training methods: overview

As for formal auditory training these activities need to be sufficiently challenging and repeated over extended periods of time to be likely to be effective. Informal auditory training can be implemented at home and school. Used together with formal auditory training they may be helpful in generalizing specific auditory skills to real-world experiences and school curriculum demands. The source of evidence is expert reports and the clinical experience of respected authorities (Evidence level IV). There are no studies evaluating the efficacy of informal auditory training for children with a diagnosis of APD.

Commercially available programmes such as Winget's (2007) 'Differential Processing Training' - 3 workbooks: Acoustic Tasks, Acoustic-Linguistic Tasks,

and Linguistic tasks (www.linguisystems) provide activities and are useful in generating ideas for further worksheets.

Recently, the Educational Audiologist Association (www.edaud.org) have launched the book, 'Therapy for APD: Simple, Effective Procedures', written by Jack Katz. It is a book published in binder format with techniques that can be used by audiologists and other professional to remediate the various aspects of APD.

DeConde Johnson et al's (1997) CD (www.edaud.org) contains forms, handouts, instruction sheets and protocols which that can be customized and downloaded.

Informal training can be divided into the areas described in the following sections.

9.2.4.1 Informal training: dichotic listening and binaural interaction training (based on Bellis, 2003; Bamiou et al, 2006; Bellis, 2008)

- Binaural integration/separation activities (e.g. listening to a story using headphones and adjusting volume in a similar method as described in the section on formal training (the main difference being that exact intensity levels cannot be determined accurately).
- Speech-in-noise training (adding noise while listening to a story or being given instructions (the louder the noise and the more similar the 'competing message the more difficult the task, e.g. noise from a radio set off station is less challenging then ignoring a speech signal or a song that we like).
- Sound localisation (where a sound is coming from; is it nearby or far away) and 'tracking' (locating a moving sound) training (in quiet and noise) and games like 'Blind Man's Bluff' and 'Marco Polo'. When we play sport we need to be able to follow moving sounds (other players calling to us and also the sound of a tennis ball being hit by a racket or hitting the ground. We also use this skill when tracking an ambulance siren.

9.2.4.2 Informal training: auditory closure training (based on Bellis, 2003; Bamiou et al, 2006; Bellis, 2008)

- Missing word, syllable, phoneme (e.g. te/phone = telephone, _able = table/stable)
- Speech- in-noise (as described above). When there is noise we don't always hear all of the speech sounds and our brains need to fill in the parts that we miss

- Different accents (listening to someone with a different accent is more challenging as you need to work out what the parts are that are not clear or that sound different)
- Telephone training (telephones do not offer an exact replica of the original speech stimulus and using a telephone is more difficult with there is poor reception (distortion of the signal) or when there is background noise).

9.2.4.3 Informal training: music training

- Music activates a widespread bilateral network of brain regions (frontal, temporal, parietal and sub-cortical) and taxes timing skills, i.e. temporal processing which is necessary for the resolution of prosodic detail.
- Prosody (i.e. intonation contours of voice, stress patterns and rhythm) relies on the same neural systems as melodic pitch perception (order of music notes) (Schon et al, 2004)
- Chermak (2010) suggests that music can be used in basic auditory discrimination training using tones and tone glides, as well as contour, rhythm, meter and timbre. Different instruments and chords can be used for auditory discrimination training, and keyboard cadences can be used for pattern, contour and rhythm discrimination, recognition and identification and also nursery rhymes and poetry. Games such as 'musical chairs' may help with vigilance and temporal resolution. Interhemispheric transfer may be enhanced by games such as 'name the tune' or dichotic melodies, singing extracting lyrics from songs and playing a musical instrument which requires bimanual coordination. Chermak (2010) recognises that evidence based research is necessary to determine the efficacy of music training for the APD population.
- Musical training has been shown to enhance the brain's ability to detect temporal novelty in sounds, as shown by enhanced brain activation on functional MRI in professional musicians vs. laypersons, and enhanced fMRI activation in musicians after a period of musical training, indicating that it is the musical training rather than genetic predisposition that is responsible for this difference (Herdener et al., 2010). Another recent study suggested that musicians show enhanced working memory task performance for music sounds vs. non- musicians, underpinned by enhanced neural activation of neural networks that indicated an enhanced ability of musicians for sustained cognitive control (Pallesen et al, 2010).
- Kraus and Chandrasekaran (2010) report that music training leads to changes throughout the auditory system that prime musicians for listening challenges beyond music processing. This effect of music training suggests

that, akin to physical exercise and its impact on body fitness, music is a resource that tones the brain for auditory fitness. Therefore, the role of music in shaping individual development, and in particular auditory processing, deserves consideration.

9.2.4.4 Informal training: temporal patterning and prosody training (based on Bellis, 2003; Bamiou et al, 2006; Bellis, 2008)

- Non-speech sounds: pitch, loudness, rhythm
- Syllabic stress (convict vs. convict, permit vs. permit, record vs. record)
- Stress and pauses between words and within sentences (“don’t touch that book” vs. “don’t touch that book”, “Out standing in his field” (a farmer) vs. “Outstanding in his field” (Nobel Prize winner) and “I am a light housekeeper” versus “I am a lighthouse keeper”). Queen Margaret University College in Edinburgh has developed the Profiling Elements of Prosodic Systems in Children (PEPS-C) to assess prosody using computer-based tasks (www.qmu.ac.uk/ssrc/prosodyinasd/PEPS-C.htm).
- Keyword extraction (keywords are typically read with more stress and intonation)
- Reading aloud with intonation
- Understanding intent: tone of voice, sarcasm, jokes

9.2.4.5 Informal training: auditory discrimination training (based on Bellis, 2003; Bamiou et al, 2006; Bellis, 2008)

- Non-speech sounds (long versus short, loud versus quiet, high versus low)
- Speech sound discrimination: sounds in isolation (‘f’ versus ‘v’), syllables (‘chi’ versus ‘cha’, words (boots/boost, shoulder/soldier, position/possession, peace/beast)
- Coarticulation: sounds can change depending on where they occur in relation to other sounds (e.g. say cat and ban and feel how differently the ‘a’ sound is produced)

9.2.4.6 Informal training: phonological and phonemic awareness training:

Phonological awareness is the awareness of the underlying sound structures of spoken language, and the ability to manipulate these sound structures. Phonemic awareness is the highest level of phonological awareness and is the

ability to manipulate sounds. Phonics refers to connecting sounds to letters and speech to print skills.

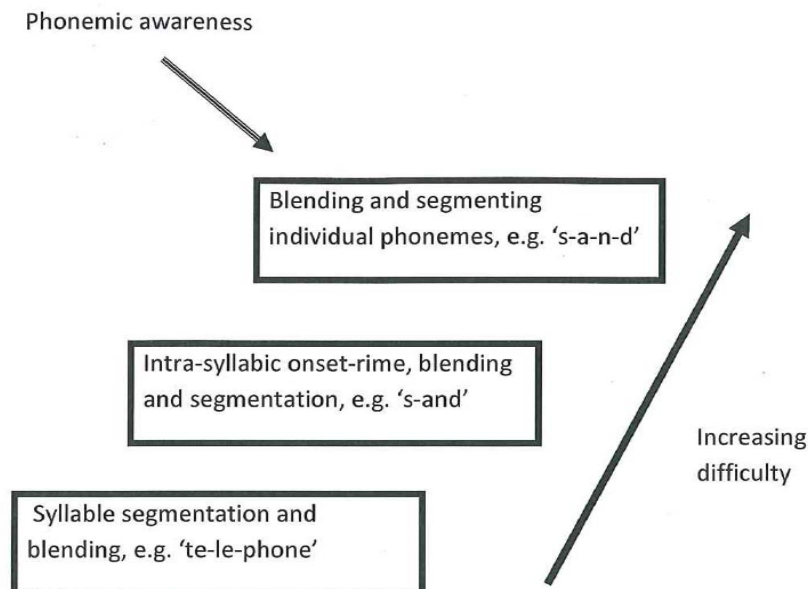
Phonological awareness training is widely used as an intervention for children with phonological and reading disability. In addition to computer-based and non-computer based programmes (discussed earlier) it is also possible to do informal training, i.e. develop specific activities for a given child. This does however require a knowledge and understanding of phonological and phonemic awareness, age appropriate development and also a progression from easier to more challenging tasks (Appendices K and L).

Appendix K: Components of phonological and phonemic awareness
Appendix L: Practical tips and guidelines for improving phonological awareness.

Phonological awareness can be viewed in a continuum, as shown in Figure 1.

Figure 1

Phonological awareness on a continuum (based on Correa, 2000)



9.2.4.7 Informal training: interhemispheric transfer activities

Exercises that require rapid interhemispheric transfer via the corpus callosum may be indicated for children with binaural integration and/or separation deficits. These activities can include any skill that requires interaction between the two hemispheres, e.g. symbol-sound associations and dictation, verbal-to-(left handed) motor transfers, left handed motor-to-verbal transfers, music linked to language (piano and saying notes at the same time, singing, listening to music with attention to lyrics), sport and dance activities (Bellis, 2008). To date, there is no research evidence indicating the efficacy of these methods and recommendations are based on expert reports and clinical experience (Evidence level: IV).

9.3 Shared reading

In order to generalise phonological awareness training to reading it is important that reading be encouraged. Many commercially available computer software and programmes focus on phonological and phonemic awareness but it is important that these skills are 'carried over' to everyday reading and spelling. Shared reading refers to a child reading aloud with an adult every day; with the adult and child taking turns to read. This encourages reading and helps a child get 'into' a story/book, and aids reading speed and comprehension. Shared reading also provides the opportunity to encourage reading with intonation (see section on temporal patterning and prosody training), retelling of the story to ensure comprehension and talking about new and similar sounding words (Appendix M).

This can be done with any age group and even slower readers in secondary school will benefit from this as it will help them to keep up with the reading of prescribed texts, while improving their reading abilities, speed and comprehension.

Appendix M: Shared reading

9.4 Compensatory , metacognitive and metalinguistic strategies:

9.4.1 Enhancing auditory attention (listening skills)

Listening is an active process involving self-regulation and monitoring whilst hearing is a passive process. Address these differences and the different types of auditory attention listed below, highlighting the behaviour of a good listener (whole body listening skills), identifying a good listener/s, the advantages of being a good listener and the penalties of not listening, more challenging listening conditions (including noise and different accents), experiencing not being listened to, evaluating own listening behaviour, implementing and evaluating practical strategies for improving listening (Appendix N).

Different types of auditory attention (Medwetsky, 2006):

- preparatory attention choosing what to attend to
- selective attention attending to target & blocking out competing stimuli
- divided attention attending to two or more targets (attention shifting)
- vigilance attending to an intermittent target
- sustained attention maintaining attention to a target over time

9.4.2 Enhancing auditory working memory

Identify key areas where auditory memory is impaired (e.g. for children this could be remembering single or more complex instructions, a story read, alphabetic principle (alphabet and whether a letter comes before or after another letter), days of week, months of year, timetables, homework, etc. For older children this could include remembering names, directions, telephone numbers, instructions, etc).

Van Kleeck et al (2006) report that that early reading achievement relies on both phonological awareness and phonological working memory. In their study of 16 preschool children with language impairment they found improvements in phonological working memory following training in phonological awareness (Evidence level: IV).

Jaeggi et al (2008) report that computer training programmes can be used to enhance working memory which generalises to other skills such as fluid intelligence (the ability to adapt our thinking to a new cognitive problem or situation). The study included 35 adult subjects and 35 controls who underwent 4

individual experiments (Evidence level: II). Also see Mahncke et al (2010) study, referred to above in the discussion of music training. Further research using children with APD is necessary.

Memory can also be enhanced by using metacognitive strategies, such as self-regulation, organization skills (including writing things down and using a diary), problem solving, metamemory strategies (including mnemonics and mindmapping), chunking, analogies and acronyms, pictorial representation, and verbal rehearsal / reauditorization.

9.4.3 Linguistic and metalinguistic strategies

Training in the rules of language, e.g. tag words (before, after, first), adversative terms (but, however, although), terms implying relationships and causal terms (therefore, because) and examination terms (list, compare) and formal schema induction, e.g. predict relationships among elements in a message such as “The first point I would like to make ..” implies that the speaker plans to convey more than one point.

9.4.4 Metacognitive strategies

Training in self-regulation, problem solving, metamemory strategies, chunking, use of analogies and acronyms, pictorial representation and verbal rehearsal / reauditorization may also be helpful.

9.5 Games to enhance auditory processing in children (including young children) (Musiek et al., 2007)

- ‘Musical chairs or statues’ (vigilance)
- ‘Simon says’ (vigilance, auditory discrimination, following directions)
- ‘Marco Polo/ Blind Man’s Bluff’ (localization and tracking)
- ‘Same and different’ (auditory discrimination)
- Exposure to rhymes and songs (phonological awareness, auditory discrimination)
- Following directions (auditory memory and sequencing)

The evidence level for the above games is IV; based on expert opinion.

The BBC website (www.bbc.co.uk/cbeebies/games/shows/tuvwxy) also provides games.

9.6 Other auditory training programmes and methods:

Auditory Integration Therapy (AIT) is marketed as addressing APD, as well as ADHD, learning disabilities, autism and a host of behavioural symptoms. It is a technique designed to expose individuals to electronically modulated sound by filtering out certain frequencies to reduce hypersensitive reactions to auditory stimuli. One of the most well-known AIT programmes was developed by Guy Berard (an otolaryngologist in France) using equipment known as the Audiokinetron. Prior to this the French Physician Alfred Tomatis also developed an AIT programme, known as the Tomatis Audio-Psycho-Phonology Approach. Another AIT programme, the Johansen Individualised Auditory Stimulation (formerly known as Johansen Sound Therapy) was developed in Denmark by Kjeld Johansen, (who has been developing the programme since the 1970s).

Ethical, safety and efficacy issues have been raised in the USA with regard to AIT methodologies by both the American Academy of Audiology (1993) (www.audiology.org/resources/documentlibrary/Pages/AuditoryIntegrationTraining.aspx) and the American Speech-Language-Hearing Association resulting in both presenting position statement about the use of AIT (American Speech-Language-Hearing Association, 2004; www.asha.org/docs/html/TR2004-00260.html).

Other auditory training programs have emerged over the past several years, e.g. Samonas Sound Therapy (www.samonas.com) and The Listening Program (www.thelisteningprogram.com & www.advancedbrain.com). Several anecdotal reports have appeared in support of these approaches and are available on the above websites.

'Otto's World of Sound' (www.otikids.com) was originally compiled for children with hearing impairment to improve recognition of environmental sounds. It may be helpful in some children with APD and entails the 'discovery, recognition and memory' of non-speech noise in 10 different sound environments e.g. house, street, seaside.

'Brain Boy' is a game which purports to improve general listening. It is produced by Medi-Tech a German firm (www.meditech.de) and is available in the UK from Learning Solutions (www.learning-solutions.co.uk)

As highlighted in the Introduction of the report, when considering evidence-based practice and treatment efficacy, it is important to evaluate the quality of the evidence. The above programmes and methods have a no or a very low level of evidence or conflicting expert opinion. Ethical, safety and efficacy issues have been raised in the USA with regard to AIT methodologies, leading to position statements which do not endorse these methods for the APD population.

10. APD management in adolescents and adults

APD in young adolescents and adults may be due to:

- A developmental disorder, which was identified and possibly treated in childhood, or which surfaced at a later age due to increasing and more complex communication demands (e.g. upon entering sixth form, university or a new job)
- Age related degeneration of the brain
- A neurological disorder such as brain tumour, head injuries, multiple sclerosis or stroke (Bamiou et al, 2006)

Management programmes for adolescents and adults should be individualised and address the specific deficit areas. The demands placed on adolescents and adults increase in terms of the number of different contexts in which they function, e.g. an individual may work in an open plan office during the day; attending meetings with large groups of people and then attend evening classes as a student, whilst juggling this with family life. A functional approach, where difficulties are matched with solutions and compensatory strategies, is often the most helpful when dealing with this group.

Management options such as academic or vocational modification, psychological counselling, career counselling and transition planning and self-advocacy training should be considered. A multi-disciplinary approach should be considered (Baran, 2007) but this needs to be balanced against practical issues including timing and cost.

Other management options (evidence level III and IV), already discussed in this report, are briefly summarised here for the convenience of those professionals working only with adults.

10.1 Modifying the listening environment

- Acoustic changes to the environment (reduce noise and reverberation)
- Assisted listening FM systems
- Speaker adaptations

10.2 Auditory training

- Computer-based auditory training: e.g. Earobics and Fast ForWord both have a section for older children and adults. This software provides sophisticated, game-style, multimedia instruction, to improve aspects such as reading speed, spelling and comprehension.
- Non-computer based auditory training programmes using headphones: These are programmes that typically use headphones and an audio CD. For example, the Dichotic Interaural Intensity Difference training or DIID (Musiek, Chermak and Weihing, 2007) which can be used for individuals with poor dichotic listening.
- Informal auditory training methods: The training methods discussed under Section A can be considered and in particular binaural integration/separation activities, speech-in-noise training, sound tracking, different accents, music training and telephone training (consider telephone amplifier).
- Music training: Music activates a widespread bilateral network of brain regions (frontal, temporal, parietal and sub-cortical) and taxes timing skills, i.e. temporal processing which is necessary for the resolution of prosodic detail. Prosody (i.e. intonation contours of voice, stress patterns and rhythm) relies on the same neural systems as melodic pitch perception (order of music notes) (Schon et al, 2004). Chermak (2010) suggests that music can be used in basic auditory discrimination training using tones and tone glides, as well as contour, rhythm, meter and timbre. Different instruments and chords can be used for auditory discrimination training, and keyboard cadences can be used for pattern, contour and rhythm discrimination, recognition and identification. Chermak (2010) recognises that evidence based research is necessary to determine the efficacy of music training for the APD population.

10.3 Compensatory, metacognitive and metalinguistic strategies

10.3.1 Enhancing auditory attention (listening skills)

Discuss the different types of auditory attention listed below, more challenging listening conditions (including noise and different accents), and finally focus on implementing and evaluating practical strategies for improving listening.

Different types of auditory attention (Medwetsky, 2006):

- Preparatory attention choosing what to attend to
- Selective attention attending to target & blocking out competing stimuli
- Divided attention attending to two or more targets (attention shifting)
- Vigilance attending to an intermittent target
- Sustained attention maintaining attention to a target over time

10.3.2 Enhancing auditory working memory

Identify key areas where auditory memory is impaired, e.g. remembering names, directions, telephone numbers, instructions, etc). As mentioned earlier, there is some evidence (Jaeggi et al, 2008) (Evidence level: II) that computer training programmes can be used to enhance working memory which generalises to other skills such as fluid intelligence (the ability to adapt our thinking to a new cognitive problem or situation). Further research using adults with APD is necessary.

Memory can also be enhanced by using metacognitive strategies, such as self-regulation, organization skills (including writing things down and using a diary, mobile phone, 'ipod' and other technology), problem solving, metamemory strategies (including mnemonics and mindmapping), chunking, analogies and acronyms, pictorial representation, and verbal rehearsal / reauditorization.

10.3.3 Linguistic and Metalinguistic strategies

Training in the rules of language e.g. examination terms (list, compare, describe, analyse, contrast) as well as tag words (before, after, first), adversative terms (but, however, although), terms implying relationships and causal terms (therefore, because). Discuss formal schema induction, e.g. predict relationships among elements in a message such as "The first point I would like to make ..." implies that the speaker plans to convey more than one point.

10.3.4 Metacognitive strategies

Training in self-regulation, problem solving, metamemory strategies, chunking, use of analogies and acronyms, pictorial representation, verbal rehearsal/reauditorization, note-taking, learning strategies and assertiveness training may also be helpful. Appendix O provides practical suggestions for individuals with APD who are making the adjustment to university/college after leaving school.

Appendix O: University and beyond! A few practical strategies

11. Concluding comments

As highlighted early in the report there is no 'gold standard' at this time for defining, diagnosing or managing APD. Data specifically addressing the efficacy of interventions for APD are lacking and many of the recommendations commonly made are based on theory or inferred from approaches validated in other populations, e.g. specific language impairment and dyslexia.

Clinicians, seeing individuals with 'suspected APD', are thus placed in a challenging position and have voiced the need for clear guidelines outlining best practice at this time. At the same time researchers are demanding empirical evidence before endorsing diagnostic criteria and intervention strategies. The translation of evidence into practical recommendations is likely to take some time and it is important that researchers and clinicians collaborate in their efforts.

This report provides an overview of current management options, citing evidence levels, to inform clinicians of best practice at this time whilst simultaneously guiding further research. This is a working document, which will be updated as new research evidence emerges and resources become available.

Key Points

- The British Society of Audiology (BSA) APD Special Interest Group provides an updated definition of APD in this document, cited from the BSA APD Position Statement.
- The BSA APD Special Interest Group recognises three categories of APD, namely *developmental* (presenting in childhood), *acquired* (due to post-natal event) and *secondary* (occurring in the presence or as a result of hearing impairment which may be transient, e.g. glue ear).
- There is currently no universal 'gold standard' for diagnosing or managing APD. This document provides an overview of current management options, citing evidence levels, to inform clinicians of current best practice whilst simultaneously guiding further research. The purpose of the document is to provide information to enable professionals to make informed choices. Practical appendices, resources and websites are provided.
- A thorough case history and detailed audiometry (including puretone audiometry, word recognition testing, OAEs +/- suppression, tympanometry, acoustic reflexes and/or ABR) should precede any APD testing. These are necessary to identify hearing impairment and differentiate between APD and other disorders such as Auditory Neuropathy Spectrum Disorder (ANSD).
- A screening language and cognitive assessment (including tests for auditory memory and attention) should be done prior to APD testing in children. In particular, children referred for suspected APD need to have, in addition to their audiometric assessment, a screening work-up, including assessments of nonverbal ability, language and literacy, because problems in these areas may contribute to problems experienced by the child. Professionals or departments may choose to address this in different ways, i.e. requesting this information prior to referral for APD testing or offer this as part of an 'in-house' service. Administering audiological APD tests in isolation, without considering these issues may result in misdiagnosis and delays in the appropriate management of individuals with co-existing disorders.
- At present there is no universally accepted audiological APD test battery. Substantial evidence regarding test performance (e.g. reliability, validity, sensitivity and specificity) is required. There are behavioural tests for assessing the following auditory processes: dichotic listening, temporal processing, binaural interaction, monaural low redundancy, auditory discrimination, sound localisation, performance in competing acoustic signals and performance with degraded acoustic signals, as well as electro-physiologic tests.
- Clinicians choosing to do APD testing should ensure that they have a thorough understanding of these tests, their value and limitations, the effects of ageing, normative data and the functioning of the central auditory nervous system.

- Currently most published research on APD management is based on expert report and non-experimental studies (e.g. case studies with controls, observational studies with controls, retrospective studies, cohort studies with controls). Randomised control studies are necessary.
- Management programmes should consider the primary presenting complaint(s), case history and multidisciplinary assessment results. Management cannot be designed on the basis of audiological APD test results alone. Management should be individualized, with the ultimate target to improve the individual's primary complaints and everyday functioning.
- Management strategies can be divided into three main categories, namely:
 - Modification of the listening environment: This includes acoustic changes to the environment to reduce noise and reverberation, consideration of assisted listening FM systems, and recommendations for adaptations that the teacher/speaker can make to improve access to auditory information
 - Auditory training: There are both formal and informal auditory training methods available. At this time there is no evidence to suggest that the formal training programmes are more beneficial than informal training methods, or that more expensive programmes are superior to less expensive ones. Neuroplasticity underpins auditory training and requires that activities are sufficiently challenging (i.e. at the 'edge of competence') and repeated over extended periods of time (for example, 30 minutes, 3–4 times a week for 6 weeks) to be likely to be effective. It is important to recognise that many of the training programmes available are based on theory or inferred from approaches validated in other populations, e.g. specific language impairment and dyslexia.
 - Compensatory strategies: These strategies are used to overcome residual dysfunction and maximize the use of auditory information. This includes aspects such as improving listening skills, working memory, metacognitive and metalinguistic strategies and shared reading.
- This is a working document and will be updated as new research evidence emerges and resources become available

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13. Resources and websites

- APD questionnaires and checklists www.edaud.org
- Behavioural tests of APD:
- Auditec of St Louis* www.auditec.com
- Audiology Illustrated* www.audiologyillustrated.org
- Department of Veterans Affairs* richard.wilson@med.va.gov
- 'Brain Boy' game www.meditech.de or www.learning-solutions.co.uk (UK)
- BBC website games www.bbc.co.uk
- Earobics www.earobics.com
- Edulink and iSense FM systems www.phonak.com
- Educational Audiology Handbook and CD with management materials (CD only can be purchased separately) www.edaud.org
- FastForWord www.scilearn.com or www.innovative-therapies.com (UK)
- Profiling Elements of Prosodic Systems in Children (PEPS-C) (Queen Margaret University College in Edinburgh) www.qmu.ac.uk/ssrc/prosodyinasd/PEPS-C.htm
- Just for Me! Phonological Awareness www.linguissystems
- Otto's World of Sound www.otikids.com
- Phonomena www.mindweavers.co.uk
- Samonas Sound Therapy www.samonas.com
- The Lindamood Program (LIPS Clinical Version) www.linguissystems
- The Listening Program www.thelisteningprogram.com & www.advancedbrain.com
- Therapy for APD: Simple, Effective Procedures, written by Jack Katz www.edaud.org
- Winget, K. 2007. Differential Processing Training - 3 workbooks www.linguissystems.com

Appendix A. Authors and stakeholder involvement

This document was developed by the APD Special Interest Group in accordance with BSA Procedure for Processing Documents (2003) which was overseen by the BSA Professional Practice Committee.

Membership of APD Special Interest Group Steering Committee:

- Dr Roshini Alles, Consultant Audiological Physician, Royal Free Hampstead NHS Trust, London.
- Dr Doris Bamiou, Consultant Audio-vestibular Physician, Senior Lecturer, UCL Ear Institute, London.
- Dr Lesley Batchelor, Consultant Paediatrician (Audiology), East Cheshire NHS Trust.
- Dr Nicci Campbell (Lead Author and Vice Chair), Lecturer & Audiological Scientist, Institute of Sound and Vibration Research, University of Southampton.
- Mr David Canning (Vice Chair), Ear Institute School of Audiology, London
- Ms Pauline Grant, Professional Lead for Children with Hearing Impairments Children's Sensory Team, Teachers' Centre, Harrow.
- Prof Linda Luxon, Consultant Audio-vestibular Physician, UCL Ear Institute, London.
- Prof. David Moore, Scientific Researcher, Director, MRC Institute of Hearing Research, Nottingham.
- Ms Pam Murray, Adult Audiology, RNTNE Hospital, London.
- Ms Sara Nairn, Educational Psychologist, Kent Educational Psychology Service..
- Prof Stuart Rosen, UCL Psychology and Language Sciences, London.
- Dr Tony Sirimanna, Consultant Audiological Physician, Great Ormond Street Hospital for Children NHS Trust, London.
- Dr Dilys Treharne, Senior Lecturer, Department of Human Communication Sciences, Sheffield University, Sheffield.
- Dr Kelvin Wakeham, Consultant Audiological Scientist, Royal Devon and Exeter NHS Trust.

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Appendix B. Functional difficulties often associated with APD

This appendix provides a list of the functional difficulties associated with APD. An individual with APD will typically present with some but not all the difficulties listed here.

- Difficulty localising and 'tracking' sounds
- Hearing when signal is not clear or 'degraded' (e.g. accents, telephone)
- 'Mishears' auditory information (e.g. lethal/legal)
- Takes longer to respond to and process auditory information
- Poor listening skills and auditory attention
- Poor auditory memory
- Music perception difficulties
- Above difficulties may be exacerbated in noisy or reverberant environments

Additionally, in children there may also be reports of:

- Delayed auditory milestones
- Difficulty with learning songs and nursery rhymes
- Difficulty with multiple auditory commands
- Possible speech & language delay/disorder
- Phonological and phonemic awareness, reading, spelling, and academic difficulties

Appendix C. Test-driven auditory training (Bamiou et al, 2006)

This appendix provides an example of how tests and their underlying processes are linked to auditory training, using the 'test-driven auditory training method'.

Tests used to assess process	Process	Suggested guidelines for auditory training
Dichotic speech tests	<ul style="list-style-type: none"> • Binaural separation (directed attention) • Binaural integration 	<ul style="list-style-type: none"> • Dichotic listening training (binaural integration / separation activities, localisation training in quiet and noise at varying azimuths) • Environmental modifications
Temporal processing / patterning tests	<ul style="list-style-type: none"> • Temporal resolution • Frequency discrimination • Duration discrimination • Intensity discrimination • Temporal ordering 	<ul style="list-style-type: none"> • Prosody training • Temporal patterning training • Auditory discrimination • Phoneme training • Interhemispheric exercises • Key word extraction • Reading with intonation
Monaural low redundancy speech tests	<ul style="list-style-type: none"> • Auditory closure • Auditory discrimination 	<ul style="list-style-type: none"> • Auditory closure activities • Phoneme training • Auditory discrimination • Environmental modifications
Binaural interaction tests	<ul style="list-style-type: none"> • Binaural interaction 	<ul style="list-style-type: none"> • Localisation and 'tracking' training in quiet and noise at various azimuths • Detection of signals in noise (speech-in-noise training) • Auditory closure • Binaural fusion activities • Environmental adaptations

Appendix D. Summary of Bellis/Ferre APD subtypes (Bellis, 2003)

This appendix shows how the Bellis/Ferre Model classifies and individual into an APD subtype, based on patterns in test results, associated region of dysfunction and sequelae which are linked to management strategies. This model is not widely accepted as discussed in the text.

Profile	Region of dysfunction	Audiological APD test results	Associated sequelae	Management strategies
Auditory Decoding Deficit	Primary (left) Auditory Cortex	Bilateral deficit on dichotic speech tests; bilateral deficit on monaural low-redundancy speech tasks	Difficulties with spelling (word attack), hearing in noise, sound blending; poor analytic skills; mimics hearing loss	Improve acoustic clarity, speech sound training, auditory closure activities, speech-to-print skills training
Prosodic Deficit	Nonprimary (right) Auditory Cortex and associated areas	Left-ear deficit on dichotic speech tasks; deficit on temporal patterning tasks in both labelling and humming conditions	Difficulties with spelling (sight word), judging communicative intent, perception and use of prosody; monotonic speech; visuospatial and mathematics calculation difficulties; socio-emotional concerns	Placement with animated teacher; prosody training; key word extraction; psychological intervention
Integration Deficit	Corpus Callosum	Left-ear deficit on dichotic speech tasks; deficit on temporal patterning tasks in linguistic labelling condition only	Difficulty linking prosody and linguistic content; poor speech-in-noise skills; phonological deficits; auditory language and memory deficits; poor bimanual coordination; difficulty with any task requiring interhemispheric integration	Limit or discontinue use of multimodality cues; provision of notetaker, sensory integration therapy; interhemispheric exercises; specific academic intervention

Appendix E. Classroom audit

This appendix provides a practical method for assessing the acoustic features of a classroom.

School _____ Room _____
Date _____

Circle the relevant statements – How good are the acoustics in your classroom?

Describe your room

OPEN PLAN	LOW CEILING	HIGH CEILING	WELL FITTING DOORS WITH ACOUSTIC SEALS/FIRE SEALS	POORLY FITTING DOORS. DOORS LEFT OPEN	DOUBLE GLAZING
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What is in place to enhance the listening environment?

SOFT FURNISHINGS IN READING CORNER	DISPLAY BOARDS THAT HAVE SPACE BEHIND THEM AND ARE TILTED	ACOUSTIC TILES ON THE CEILING THAT HAVE BEEN PAINTED	DRAPED FABRIC OVER DISPLAY TABLES	NO BLINDS, CURTAINS OR DRAPES ON WINDOWS
CARPETS	'SOFT' DISPLAY BOARDS	HARD FLOORS	CURTAINS	BLINDS

Noises that YOU are aware of inside your room. Close your eyes and take a 'snap shot'

COMPUTERS MONITORS & PRINTERS	FLUORESCENT STRIP LIGHTS	WELL MANAGED 'BUSY' NOISE FROM STUDENTS	DIGITAL PROJECTOR	LAVATORIES NEARBY & CORRIDOR NOISE	PUPILS TALKING (INSIDE & OUTSIDE ROOM)
D & T WORKSHOP NOISE	SCRAPING CHAIRS & TABLES	CLATTERING PENCILS ETC	HEATERS	CENTRAL HEATING	AIR CONDITIONING OR FANS

Outside your room

NOISE FROM PE OR GAMES	TRAFFIC OR GRASS CUTTING	OTHER CLASSROOMS	EMPTY OR QUIET ROOMS	DINING ROOM	I AM IN A QUIET LOCATION
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Distance between you and child with a hearing loss, a listening or attention difficulty or other sen.

1 metre	2 metres	4 metres
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Room Technology or personal listening aids for pupils to enhance the listening environment

EduLink	Hearing aid	Cochlear implant	FM (radio aid)	Direct input leads	Soundfield system
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SCORE!

NUMBER OF GREEN ANSWERS	NUMBER OF RED ANSWERS	MORE GREEN THAN RED? NOT BAD, BUT CONSIDER SOME MINOR IMPROVEMENTS!
		MORE RED THAN GREEN? OOPS! BIG IMPROVEMENTS NEEDED!

Appendix F. Making your classroom a better place to listen and learn

This appendix provides suggestions for improving classroom acoustics, which range from inexpensive to expensive.

Problem	Free or won't break the bank	Creative accounting	How many wealthy benefactors do you know?
Background (ambient) noise	<ul style="list-style-type: none"> • Close doors to corridors/hall etc • Get heating systems checked so that they don't make unnecessary noise • Plastic trays/pencil boxes etc? Pad with foam or felt. Put soft pads on the base • Everyone wear indoor shoes • Teach your pupils how to value quiet • Turn off computers/printers when not in use • Close windows to outdoor noise • Position bookshelves and display boards against thin partition walls 	<ul style="list-style-type: none"> • Build acoustic partition walls or add doors in open plan buildings • Replace poorly fitting or light weight internal doors • Line partition curtains with acoustic fabric • Consider a classroom sound-field system (but remember, acoustics must be reasonable in the first place!) 	<ul style="list-style-type: none"> • Replacement windows – double or triple glazed depending on how intrusive outside environmental noise is. Remember, we become used to background noise and, as adults, we can shut it out. Children can't. We only realize how intrusive noise is once it stops!
Reverberation	<ul style="list-style-type: none"> • Use display drapes on walls • Angle display boards downwards by allowing a gap from the wall at the top of up to 10cm • Create a quiet area with bean bags and cushions 	<ul style="list-style-type: none"> • Fit vertical blinds to windows (better than curtains that are rarely drawn) • Carpet the floors! • Fit acoustic panels above display boards in rooms with high ceilings • Fit thick acoustic ceiling tiles over plaster ceilings. Thin ones are almost useless! 	<ul style="list-style-type: none"> • Lower the ceilings and fit thick acoustic tiles
Distance	<ul style="list-style-type: none"> • Make sure children with hearing or listening problems are appropriately seated – near the front to the side of the room so that they can see you and swivel easily to see classmates during discussions 	<ul style="list-style-type: none"> • If FM (radio aid) has been provided, make sure it is used properly, consistently and is well maintained 	<ul style="list-style-type: none"> • Rebuild classrooms!

P. Grant, Harrow Advisory Teachers of the Deaf, 2009

Appendix G. Suggestions for teachers

This appendix provides practical suggestions for teachers in managing children with APD in the classroom.

- Provide preferential seating. Seat the student near the primary sound source. Allow flexibility in seating to achieve the preferential seating advantage. The middle of the class towards the front is a possibility or at the front and to the side favoured by the teacher for main instruction giving. This enables the student to access both visual and auditory information more easily and turn to see peers during discussions.
- Avoid seating near noise sources. Place the student away from competing or distracting noise sources such as outside noise or equipment in the classroom.
- Acoustical modifications may be considered to create a good acoustical listening and learning environment (e.g., carpeting, curtains, and other sound absorbing materials).
- Speak in a clear, well modulated voice. Be careful not to over-articulate.
- Discuss the difference between listening (active process) and hearing (a more passive process) – ‘I can hear but that doesn’t mean I’m listening’. Explain how to be a good listener.
- Try not to talk when your face is not visible to the class or your back is to the class, i.e. when writing on a board or looking down.
- Reduce distractions, both auditory and visual.
- If using a personal or sound-field FM system make sure that it is working before starting the lesson and position the microphone appropriately. Remember to ‘mute’ the system when speaking individually to another child or teacher
- Gain attention before giving instructions and regularly check for attention.
- Encourage the student to ask for clarification.
- Frequently paraphrase or summarise key points.
- Encourage self-monitoring and self-regulation.
- Give positive feedback.

Appendix H. Activities to minimise the effects of APD (at home and school)

This appendix provides practical activities to minimise the effects of APD. These activities are easily integrated into daily activities and interactions. These activities and games should be enjoyable! There are many more that you will know! Do them 1:1 or in small groups at school or as family games at home. These games can be adapted to suit different age groups. I have, for example, adapted the “silly sentences” game for use with high school students by using set texts from Shakespeare.

- Listening for “same” or “different” sounds – such auditory training games may already be in school.
- Listening for “Silly Sentences” and missed words in familiar rhymes or stories
- Auditory sequencing / memory games such as “ I went to the shops”
- “Simon Says ...” But give more complex 3 or 4 element instructions. If she finds this difficult, reduce the number of elements
- Gradually increase the number of elements in an instruction; “go upstairs, look in the airing cupboard and bring down the red bath towel and a white hand towel
- Auditory discrimination activities
- Play mime games such as “charades” to develop attention and the ability to read visual clues
- Pass on the message – first in quiet, then introduce background noise and other distractions. Increase the complexity of the “message” gradually.
- Copy that tune! Repeat a simple tapped rhythm or riff (musical phrase), if the child plays a musical instrument.
- Find that noise! Sound location games with eyes closed
- Listen to audio books and follow the words
- Make colourful mind maps for revision
- Easier to remember own voice! Suggest they make their own “Teach Yourself” audio/visual aids. For example, learn a topic, then “teach it to yourself” by explaining the topic onto a CD or tape. Some older students have enjoyed filming themselves delivering a lesson on their mobile phones. They then listen/watch back and note anything they have missed.

Appendix I. Strategies to minimise the effects of APD (primary schools)

This appendix provides practical suggestions for teachers to minimise the effects of APD in primary school-age children.

- Acknowledge the problem! Reassure the child that listening is difficult, but there are things you are going to try that will help
- Consider a trial of an assisted listening device
- Seek advice on improving existing listening conditions
- Seat child close to the teacher so that distance and “noise” do not interfere with his/her ability to listen to speech effectively.
- Encourage child to watch and listen so that he/she has visual as well as auditory clues, so provide visual aids and prompts.
- When addressing the child use name first so that you gain attention before speaking an instruction.
- The child’s auditory memory is probably weak. The first part of an instruction may be heard, but not the rest. “Chunk” information/instructions. Give written directions to which the child can refer. Praise each completed stage.
- Give time to process what is heard (thinking time) without prompting straight away.
- Consider delivering spoken tests – particularly mental maths - at a slower pace – i.e. 10 seconds instead of 5 seconds per question. Perhaps the child could be part of a small group with a teaching assistant out of the main classroom to minimise feelings of isolation and being “different”.
- Give child the opportunity to work in a quiet environment where possible – perhaps with a small group and an assistant.
- Consider implementing a “listening programme” of 10 minutes a day, delivered by a teacher’s assistant. See suggested resources on presentation.
- The level of concentration needed to keep up in order to listen effectively will be high and it will need to be sustained. Greater than average effort is required. This is exhausting and the child may “switch off” and day dream. Give “time out” in a quiet place if necessary/possible.
- Written instructions to support the verbal – but staff should also check the child’s understanding of tasks.

- As the curriculum becomes more complex and demanding, guided use of a lap top computer will help organise and order thoughts and ideas more easily.
- Ask child discreetly to repeat back what he/she has been asked to do. This will build comprehension skills and ensure messages have been understood correctly.
- Give written instructions in clear bullet pointed steps.
- Some older students find it helpful to record the lesson for review later – teacher instruction parts only! This is especially useful when new information is being given.
- Teachers help by making it physically, visually and audibly clear when they are about to begin something important.
- Revision – Some children find it easier to remember if they record their own voice as they revise, then listen back on headphones.
- Teachers work in partnership with parents to prepare child for lessons – pre-teach new vocabulary, remind him/her what has been learned before. This will help the child to feel more secure and confident.

Appendix J. Strategies to minimise the effects of APD (high school and beyond)

This appendix provides practical suggestions for teachers to minimise the effects of APD in high school children and could also be adapted for university students.

- Acknowledge the problem! Reassure the student that listening is difficult, but there are things you are going to try that will help
- Consider a trial of an assisted listening device
- Seek advice on improving existing listening conditions
- Written instructions to support the verbal – but staff should also check student’s understanding – this will be particularly important in examinations and tests.
- If possible, a written lesson outline and glossaries of terms in advance of the lesson so that the student knows what to expect and is “cued in” to the topic. If in-class learning support is available, then note taking by a learning assistant will enable him/her to check the accuracy of his own notes and also allow him/her to concentrate on what the teacher is saying, rather than split attention from listening to writing. If this is not possible, perhaps photocopies of notes taken by a reliable fellow student could be organised.
- Consider specific training to develop note-taking skills. Picking out the salient points is often difficult.
- Use of a lap top computer to help with organising work, memory and planning
- Encourage effective use of a diary and “To Do” lists to organise and remember life!
- Use memo facility on mobile phone
- Encourage student to sit in the best possible place – this could be at the front and to the side so that it is easier to swivel from teacher to class and focus on speakers during discussions.
- Ask student discreetly to repeat back what he has been asked to do. This will build comprehension skills and ensure messages have been understood correctly.
- Give student the opportunity work in a quiet space if this helps
- Give written instructions in clear bullet pointed steps.
- Some students find it helpful to record the lesson/lecture for review later. This is especially useful when new information is being given.
- Provide visual aids and prompts
- Consider fitting acoustic screens (also worth considering in offices – particularly if open plan)

Appendix K. Components of phonological and phonemic awareness

This appendix provides examples of some of the main components of phonological and phonemic awareness. Tasks within each component move from less to more challenging (also see Appendix L).

Components	Examples
<i>Rhyming</i> Nursery rhymes and songs Discrimination Production	"Twinkle, twinkle, little star" Do "hat" and "cat" rhyme? Tell me a word that rhymes with "star"
Onset-rime and phonograms	"H-and", "s-and", "l-and", "st-and", etc. The initial consonant/s that changes the meaning of the word is called an onset, and the syllable consisting of a vowel and consonant/s is called a rime. Phonograms are the common elements in word families.
Alliteration	Rhyme in which words start/end with the same sound, e.g.: "sh" - shell, she, shoe, or "wish" "dish", "wish", etc
Assonance	Rhyme in words in which the same vowel sounds are used with different consonants, e.g.: "In the <u>park</u> after <u>dark</u> , if you <u>care</u> to go, in the <u>grass</u> , as you <u>pass</u> , you will see <u>lamps</u> glow...."
<i>Segmentation</i> Sentences Compound words Syllables Phonemes	"The cat is cross" (Clap for each word) "Rainbow" (Clap for each part of the word) "Table" (Clap for each syllable) "Dog" (Clap for each phoneme)
<i>Isolation</i> Initial Final Medial	What sound is at the beginning of "cat"? What sound is at the end of "cat"? What sound is in the middle of "cat"?
<i>Deletion</i> Compounds/Syllables Phonemes	Say "pancake", say it again but don't say "pan" Say "snake", say it again but don't say "n"
<i>Substitution</i> With manipulatives (i.e. blocks)	Using blocks of different colours for each phoneme in a word such as "cat". Show me how to change "cat" to "mat"
Without manipulatives	Say "mouse". Change the "s" to "th"
<i>Blending</i> Compounds/Syllables Phonemes	Put the sounds together - "te..le..vi..sion" Put the sounds together - "b..e..d"

N. Campbell, ISVR, University of Southampton, 2010

Appendix L. Practical tips and guidelines for improving phonological awareness

This appendix shows the how the difficulty level of phonological awareness tasks are graded. When working on phonological processing start with easier and work towards more challenging tasks.

Start with easier tasks before tackling harder ones!

Remember the following guidelines:

1. The **size of the phonological unit** (e.g.: it is easier to break sentences into words and words into syllables, than to break syllables into phonemes)
2. The **number of phonemes in the word** (it is easier to break phonemically shorter words such as "man" than "sleep")
3. **Phoneme position in words** (initial consonants are easier than final consonants and middle consonants are most difficult)
4. **Phonological properties of words** (continuants such as /s/ and /m/ are easier than very brief sounds such as /t/)
5. **Phonological awareness challenges** (rhyming and initial phoneme identification are easier than blending and segmenting)

Appendix M. Shared reading

This appendix shows how phonological awareness training can be 'carried over' to reading. Shared reading needs to be done regularly for it to be effective.

- Many commercially available computer software and programmes focus on phonological and phonemic awareness but it is important that these skills are 'carried over' to reading.
- Shared reading refers to a child reading aloud with an adult every day, with the adult and child taking turns to read, e.g. child reads for 5 minutes, adult for 5 minutes, etc.
- This should be a relaxed and enjoyable time.
- Shared reading can be done with any age group and even slower readers in secondary school will benefit from this as it will help them to keep up with the reading of prescribed texts, while improving their reading abilities, speed and comprehension.
- Shared reading needs to be done regularly, e.g. 5 times a week for 15-30 minutes (depending on the age of the child) for it to be effective.
- Shared reading encourages reading and helps a child get 'into' a story/book, and aids reading speed and comprehension.
- Select reading material that is at child's level to slightly above (should not be too easy as there is no benefit, but not too hard otherwise motivation is lost).
- Read with intonation – this helps to understand the story but also helps children learn to identify the key words, which speeds up reading and understanding.
- Retell the story: In the beginning this might be challenging, so adult could start, have child tell the next part or talk about another ending for the story or what would have made it a better story.
- Talk about interesting use of language, words that sound similar, etc.

Appendix N. Developing good listening skills

This appendix explains the difference between hearing and listening and shows how good listening skills can be taught.

Why develop good listening skills?

Listening is an important skill. We are required to process auditory information in most situations throughout the day. Most of the time we do this without thinking as grown ups but children acquire these skills over time.

Children with listening difficulties (and indeed all children) find it helpful to talk about listening really is and how they can become better at listening.

Things to discuss and do....

- **There is a difference between listening and hearing.** Listening is an active process which requires attention and understanding. Hearing is a more passive process. I can hear but that does not mean I am listening.
Activity: Think of times when you have heard but not really listened to something. Think of times that you have listened well. What did you do?
- **What do we do when we listen?** What do we do with our eyes, hands feet and our bodies? When we listen our bodies focus on listening – not only our ears. We sit still (relaxed position rather than stiff and uncomfortable), we look at the speaker, our hands and feet are still (we don't fidget or kick the table or play with our fingers). We actually listen with our whole bodies rather than just our ears. This is called 'whole-body' listening.
- **Discuss the different types of listening** (if the child is old enough to understand this):
 - preparatory attention choosing what to attend to
 - selective attention attending to target & blocking out competing stimuli
 - divided attention attending to two or more targets (attention shifting)
 - vigilance attending to an intermittent target
 - sustained attention maintaining attention to a target over time
- **Identify a good listener/s.** What makes him/her a good listener? You can be a good listener too – it just takes a bit of practice.

- **Advantages of listening versus penalties of not listening.** Advantages of listening: know what is happening, feel part of things. Penalties of not listening: don't know what is happening, miss important information and don't feel part of things.
- **Identify more challenging listening conditions** (including noise and different accents). What can you do in these situations?
- **Experiencing not being listened to and evaluating others' and own listening behaviour.** If you have established a good relationship and trust with a child, you can 'not listen' to something important they say and then discuss how this made him/her feel. Have the child evaluate your listening behaviour in this situation and in general. Have them evaluate their own listening behaviour.
- **A good practical tip:** When working with a child it is helpful to have a picture of an owl (with big interesting eyes). Use a post-it with the child's name and another with your name. Instead of saying 'Okay, I need you to listen and sit still and remember good listening skills' you can simply cover the owl's eyes with the post-it with the child's name. This alerts them to their listening in a positive way. When listening improves remove the post-it. Similarly should the child feel you are not listening they can place the post-it with your name over the owl's eyes. This can also be done with a class where a blank post-it is used when the teacher feels someone is not listening. This engages the specific child and makes the others check their listening too.
- **Reward good listening behaviour.** The most effective reward is not a star or token but positive verbal feedback, highlighting the advantages of good listening.

Appendix O. University and beyond! A few practical suggestions

This appendix provides some practical suggestions for individuals with APD who are making the adjustment to university/college after leaving school.

You will soon be beginning your course at university. Congratulations! You have already worked hard to overcome the problems caused by your APD at school. Most of these strategies will be equally helpful at college but here is a list to consider. At college, listening will be a prime source of information so use whatever helps and give your tutor/lecturers a copy so that they can support you.

- Determine why what the speaker is saying is important to you. This may be obvious, but if you don't have an immediate reason for listening, you'll be unmotivated and less likely to listen effectively.
- Take responsibility for what is being said. The responsibility for interest and understanding lies with you, not the lecturer. Learning will be up to you, so continue to be an active listener, not a passive one. Then you'll be a successful student.
- If you can't hear, arrange things so you can. Move away from whatever noise is distracting you – anything that is mechanical or human! Sit where you can see the lecturer clearly so that you can use your lip reading skills and distractions are reduced.
- Continue to listen to what the speaker (could be another student) is saying. Don't tune out because you don't think it is relevant. Be sure you understand before you reject.
- Become familiar with a lecturer's style and organisation of lectures. In a lecture, the speaker is usually referring to notes or a presentation. You'll be able to understand much better if you are aware of the ultimate goals of the topic/lecture and how the lecturer will get there! Don't be afraid to ask for a brief order/synopsis of the lecture in advance. Try to familiarise yourself with new vocabulary/terminology in advance.
- Look for the main idea/s of a presentation. Facts are important only as they support the speaker's points. If you have a problem distinguishing between trivial 'throw-away' remarks and the salient points, seek advice from your tutor or support centre.
- Try not to let your mind wander! It's easy to allow your thoughts to stray – especially if you have a lot on, so try to make a deliberate effort to stay on track and your concentration span will increase. This is a REALLY valuable skill so practice the skill of ATTENTION and you'll soon find it (and the work) much easier.
- Take notes while you listen. This is active listening (see second point). If you are given lecture notes scribble your own notes on them as you listen. Use different colours to categorise – anything that will jog your memory when you refer to the notes later on.

P. Grant, Harrow Advisory Teachers of the Deaf, 2009