



Position Statement

Auditory processing disorder (APD)

Date: 31st March 2011

Date for review: March 2013

General foreword

This Position Statement represents a brief synthesis of the current evidence-base and consensus on APD, as prepared and reviewed by national and international experts, and approved by the British Society of Audiology (BSA).

Although care has been taken in preparing this information, the BSA does not and cannot guarantee the interpretation and application of it. The BSA cannot be held responsible for any errors or omissions, and the BSA accepts no liability whatsoever for any loss or damage howsoever arising. This document supersedes any previous statement on APD by the BSA and stands until superseded or withdrawn by the BSA.

Comments on this 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

Published by the British Society of Audiology

© British Society of Audiology, 2011

All rights reserved. This document may be freely reproduced for educational and not-for-profit purposes. No other reproduction is allowed without the written permission of the British Society of Audiology. Please avoid paper wastage, e.g. by using double-sided ('duplex') printing.

1. Introduction

The purpose of this document is to inform audiologists and other interested parties of the latest evidence on auditory processing disorder (APD) and a consensus interpretation of that evidence. It is also intended to inform current clinical understanding and practice. The document was developed by the BSA APD Special Interest Group (see Appendix A) and supersedes the previous BSA 'definition' of APD (BSA, 2007).

2. Position Statement

- **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 can 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.

3. Background

Developments in the understanding of APD through new evidence and increased levels of debate over the last few years (Cacace and McFarland, 2009; Dawes and Bishop, 2009; Sharma et al., 2009; Moore et al., 2010; Rosen et al., 2010) suggest the timeliness of proposing a BSA position statement on APD. The purpose of this statement is to increase professional and public awareness and to guide research.

There are three categories of APD:

1. Developmental APD: Cases presenting in childhood with normal hearing (i.e. normal audiology) 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.

4. New developments

Over the last 10-15 years it has become increasingly recognised that cognitive factors play a central role in listening (Kiessling et al., 2003). These 'top-down' influences are not easily distinguished from 'bottom-up' sensory processing, but recent evidence shows that poor listening in children has an important cognitive component (Moore et al., 2010). At the same time, it is recognised that current practice in APD is not evidence led. APD diagnosis is based on a large number of tests, none of which have robust scientific validity, not least because there is no agreed 'gold standard' against which validity can be assessed. Management strategies are consequently and similarly under-informed.

For the field to move forward, some influential current claims need to be re-evaluated based on the available evidence:

- **Claim:** The clinical presentation of APD results primarily from impaired bottom-up processing in the auditory system.
Evidence: This claim has recently been specifically tested and no evidence was found to support it (Moore et al., 2010).

- **Claim:** Only tests shown to be useful in diagnosing frank neurological lesions of the auditory system will be useful in diagnosing APD in people lacking such lesions. This 'neurological model' (Musiek et al., 2005; AAA, 2010) was an attempt to establish a gold standard of APD.
Evidence: This model lacks (i) a clear relation to cases actually brought to clinics, especially of children, (ii) an adequate theoretical or experimental underpinning, and (iii) a consensus.
- **Claim:** Attention is something that needs to be 'controlled' for or eliminated (ASHA, 2005).
Evidence: In contrast to this view, evidence shows that attention is a key element of auditory processing and that poor attention may make a major contribution to APD (Dawes and Bishop, 2009; Moore et al., 2010).
- **Claim:** Children who appear to have APD have a particular difficulty hearing speech in a noisy background.
Evidence: Children referred for APD were recently found to perform normally identifying speech in both noise and quiet (Ferguson et al., 2010), but there is a shortage of good evidence on this important question.
- **Claim:** The symptoms of APD are all specific to the auditory modality.
Evidence: There has been little attempt to address the alternative: that the problem may be multi-modal, at least in part (Moore et al., 2008a,b; Cacace and McFarland, 2009).

5. Symptoms

APD is a collection of symptoms that typically co-occur with a range of other neurodevelopmental symptoms (e.g. poor reading, language difficulties, inattention, autistic spectrum disorder; Dawes and Bishop, 2009; Sharma et al., 2009; Ferguson et al., 2010). As argued elsewhere (BSA, 2011), retention of the term APD is, however, desirable to reduce further confusion. To define APD, it is necessary to agree upon the presenting symptom(s). Several recent studies have found that some children with Developmental APD have difficulty with speech perception. However, they appear to perform equally in quiet as in at least some forms of noise (Ferguson et al., 2010). Other studies (Keith, 1994, 2000; Bamiou et al., 2001) have highlighted aspects of auditory attention (focus, concentration, distraction) and memory (for complex or multi-step instructions). Still others have found problems in spatial hearing (Cameron and Dillon, 2008). Concerns have been consistently expressed about academic achievement, especially in relation to reading and language comprehension (Keith, 1994, 2000; Bamiou et al., 2001). However, there is no correlation between performance on auditory processing tasks and standardised measures of academic achievement (Watson and Kidd, 2009). There is clearly no consensus here but, rather, a list of

problems that may be due to one or several causes. The way through this may be to focus on a core symptom or symptoms; aspects of auditory perception that reflect and can be shown to contribute to the clinical presentation, and that help to add information to the overall evaluation of a child with listening difficulties.

6. Clinical presentation and a road to diagnosis

A major shortcoming in present research, diagnoses and interventions for APD is the lack of a 'gold standard': an agreed measure with which the sensitivity and specificity of other measures can be compared. Some candidate measures recur in the literature (e.g. dichotic listening, tone frequency discrimination, filtered words). Performance measures other than detection or discrimination thresholds (e.g. consistency of responses) should also be considered as these can shed light on central processing (Moore et al, 2010). However, none of these measures approach the level of experimental support that a 'gold standard' would require. Case-control research studies typically use clinical diagnosis as the inclusion criterion for APD, but this becomes circular if there is no agreed clinical diagnostic standard. Given the heterogeneity of the problem, one way forward is to ask why children were initially referred: the clinical presentation. Carefully constructed parent/caregiver evaluations have provided valuable and sensitive screening instruments in other developmental disorders (e.g. Connors Rating Scales for attention deficit disorder, Children's Communication Checklist for specific language impairment). The development of such an instrument for listening difficulties might also lead to a gold standard. The questionnaire, or some other candidate measures (e.g. functional neuroimaging; Schmithorst et al., 2011), could be used during an initial, transitional period of research, to validate direct tests, both behavioural and physiological.

7. Conclusions

APD consists of symptom(s) contributing to a neurodevelopmental disorder towards which other symptoms, including impaired language, also contribute. APD presents as impaired perception of both non-speech and speech sounds, and is closely associated with impaired top-down, cognitive function. There is no evidence that it is produced by a primary, sensory disability. APD impacts on everyday life through disordered listening and a consequent reduction in the ability to act on what is heard. Appropriate, objective tests of auditory function are urgently required to serve as a 'gold standard' for APD against which clinical test and candidate people with APD may be assessed.

8. References

American Academy of Audiology (AAA). 2010. Diagnosis, treatment and management of children and adults with central auditory processing disorder. Available from www.audiology.org/resources/documentlibrary/Documents/CAPD%20Guidelines%208-2010.pdf (accessed 1st October 2010).

American Speech-Language Hearing Association. 2005. (Central) auditory processing disorders, Technical report: Working group on auditory processing disorders. Available from www.asha.org/policy (accessed 6th October 2010).

Bamiou D.E., Musiek F.E., Luxon L.M. 2001. Aetiology and clinical presentations of auditory processing disorders--a review. *Arch Dis Child*, 85, 361-365.

British Society of Audiology APD Special Interest Group. 2011 What's in a name? APD by any other name would not smell so sweet. *Int J Audiol*, in press.

British Society of Audiology. 2007. Auditory Processing Disorder Steering Committee Interim Position Statement on APD. Reading: British Society of Audiology.

British Society of Audiology. 2003. Procedure for Processing Documents. Reading: British Society of Audiology.

Cacace A.T., McFarland D.J. 2009. Current Controversies in Central Auditory Processing Disorder (CAPD). San Diego: Plural Publishing Inc.

Cameron S., Dillon H. 2008. The listening in spatialized noise-sentences test (LISN-S): comparison to the prototype LISN and results from children with either a suspected (central) auditory processing disorder or a confirmed language disorder. *J Am Acad Audiol*, 19, 377-391.

Children's Communication Checklist: CCC -2. 2003. Pearson Assessment: The Psychological Corporation.

Conners Rating Scales-Revised (CRS-R). 1996. Pearson Assessment: The Psychological Corporation.

Dawes P., Bishop D.V.M. 2009. Auditory processing disorder in relation to developmental disorders of language, communication and attention: a review and critique. *Int J Lang Commun Disord*, 44, 440-465.

Ferguson M. A., Hall R. L., Riley A., Moore D.R. 2011. Communication, listening, speech and cognition in children diagnosed with auditory processing disorder (APD) or specific language impairment (SLI). *J Speech Lang Hear Res*, 54, 211-227.

Keith R.W. 1994. SCAN-A: A test for auditory processing disorders in adolescents and adults. San Antonio, TX: The Psychological Corporation.

Keith R.W. 2000. SCAN-C: Test for auditory processing disorders in children-revised. San Antonio, TX: The Psychological Corporation.

Kiessling J., Pichora-Fuller M.K., Gatehouse S., Stephens D., Arlinger S., Chisolm T., Davis A.C., Erber N.P., Hickson L., Holmes A., Rosenhall U., von Wedel H. 2003. Candidature for and delivery of audiological services: special needs of older people. *Int J Audiol*, 42, 2S92-2S101.

Moore D.R., Ferguson M.A., Halliday L.F., Riley A. 2008a. Frequency discrimination in children: perception, learning and attention. *Hear Res*, 238, 147-154.

Moore D.R., Ferguson M.A., Riley A. & Halliday L.F. 2008b. Auditory processing disorder (APD) in children. In: Dau T., Buchholz J.M., Harte J.M., Christiansen T.U. (eds) *Auditory Signal Processing in Hearing-Impaired Listeners*. 1st International Symposium on Auditory and Audiological Research (ISAAR 2007). Denmark, Centertryk A/S, pp. 281-290.

Moore D.R., Ferguson M.A., Edmondson-Jones A.M., Ratib S., Riley A. 2010. The nature of auditory processing disorder in children. *Pediatr*, 126, e382-e390.

Musiek F.E., Bellis T.J., Chermak G.D. 2005. Nonmodularity of the CANS: Implications for (central) auditory processing disorder. *Am J Audiol*, 14, 128-138.

Rosen S., Cohen M., Vanniasegaram I. 2010. Auditory and cognitive abilities of children suspected of auditory processing disorder (APD). *Int J Pediatr Otorhinolaryngol*, 74, 594-600.

Schmithorst VJ, Holland SK, Plante E. 2011 Diffusion tensor imaging reveals white matter microstructure correlations with auditory processing ability. *Ear Hear*, 32, 156-67.

Sharma M., Purdy S.C, Kelly A.S. 2009. Comorbidity of auditory processing, language, and reading disorders. *J Speech Lang Hear Res*, 52, 706-22.

Watson C.S., Kidd G.R. 2009. Associations Between Auditory Abilities, Reading and Other Language Skills, in Children and Adults. In Cacace, A.T. McFarland D.J. (eds) *Current Controversies in Central Auditory Processing Disorder (CAPD)*. San Diego: Plural Publishing Inc, pp. 217-242.

Appendix A. Authors and acknowledgments

This document was developed by the BSA 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, Lecturer, UCL Ear Institute, London.
- Dr Lesley Batchelor, Consultant Paediatrician (Audiology), East Cheshire.
- Dr Nicci Campbell (Vice Chair), Lecturer, Institute of Sound and Vibration Research, Southampton.
- Mr David Canning (Chair of Special Interest Group), Manager, Services for Deaf Children, Newham, London.
- Ms Pauline Grant, Lead Professional in Hearing Impairment, Harrow, London.
- Prof Linda Luxon, Consultant Audio-vestibular Physician, UCL Ear Institute, London.
- Prof. David Moore (Lead author), Scientific Researcher, MRC Institute of Hearing Research, Nottingham.
- Ms Pam Murray, Adult Audiology, RNTNE Hospital, London.
- Ms Sara Nairn, Educational Psychologist, Kent Educational Psychology Service, Maidstone.
- Prof Stuart Rosen, UCL Speech, Hearing and Phonetic 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, Devon and Exeter.

The authors thank two anonymous reviewers, members of the Professional Practice Committee and all those that took part in the consultation (19.11.2010 to 14.12.2010) for helpful comments on drafts of this document. An electronic copy of the anonymised comments (from 14 individuals) received during consultation, and the responses to these by the authors, is available from BSA on request.
