AUDITORY PROCESSING DISORDERS
AND THE ROLE OF THE SLP

ASHA Ad Hoc Committee 2007-2009
Background Information

- 2005 – position statement on (Central) Auditory Processing Disorders generated by ASHA Working Group on Auditory Processing Disorders
- Audiologist primary professional for assessing (C)APD
- SLP important in assessment and management, but role of SLP beyond scope of that document
- 2007- Ad Hoc Committee on the Role of the Speech-Language Pathologist in Identifying and Treating Children with Auditory Processing Disorders formed
Ad Hoc Committee Members

- Gail J. Richard, Chair
- Marc E. Fey
- Donna Geffner
- Alan G. Kamhi
- Larry Medwetsky
- Deborah Ross-Swain
- Sally Shawitz
- Lynn Snyder (2007)
- Geraldine Wallach (2008-2009)
- Diane R. Paul, ex officio
- Brian B. Shulman (2007-2008); Julie Noel (2009) – monitoring ASHA Vice President
Considerable controversy surrounding topic of (C)APD

Definition of 2005 Working Group

“the perceptual processing of auditory information in the CNS and the neurobiological activity that underlies that processing and gives rise to electrophysiological auditory potentials. (C)APD includes the auditory mechanisms that underlie the following abilities or skills:

- sound localization and lateralization;
- auditory discrimination;
- auditory pattern recognition;
- temporal aspects of audition, including temporal discrimination, temporal ordering, and temporal masking;
- auditory performance in competing acoustic signals
- and auditory performance with degraded acoustic signals”

ASHA position statement: (Central) auditory processing disorders-The role of the audiologist, p.2 (2005)
Some Unfinished Business

- 2005 Working Group acknowledged children with (C)APD experience variety of learning and speech-language problems
- Complicates research efforts to identify and characterize the relationship between discrete auditory abilities and higher-order language skills (e.g., reading, spelling)
- “although abilities such as phonological awareness, attention to and memory for auditory information, auditory synthesis, comprehension and interpretation of auditorily presented information, and similar skills may be reliant on or associated with intact auditory function, they are considered higher-order cognitive communicative and/or language-related functions and, thus are not included in the definition of (C)APD” (p. 2)
First Step for Ad Hoc Committee

- Conduct evidence-based systematic review on efficacy of auditory interventions for children with (C)APD to facilitate addressing role of SLP with this population
- Continuing uncertainty regarding role of SLP
  - ASHA, 1992 & 1996 – committee reports
  - DeBonis & Moncrieff, 2008
- ASHA’s National Center on Evidence-Based practice in Communication Disorders (N-CEP) to conduct appraisal of literature regarding treatment efficacy with this disorder population
Parameters for Systematic Review

- Committee accepted definition for (C)APD from 2005 Working Group
  - Distinction between auditory processing and higher-level language skills
  - Distinction not uniformly shared by researchers who study children with (C)APD

- Systematic review considered all treatment studies involving school-age children diagnosed with APD regardless of criteria used for diagnosis
  - Also included auditory treatment studies involving children with language disorders – interest in auditory treatments
  - Beyond scope of this review to include auditory interventions for reading, learning disabilities, autism, or other developmental disability diagnoses
Evaluate treatment programs- direct intervention of an auditory nature

- Auditory intervention distinguished from language intervention – progressive manipulation of auditory components of speech and non-speech stimuli
  - e.g., rate, interstimulus interval, frequency, intensity presence of background noise
  - Contrasted with language intervention that manipulates form, content, use
  - FastForWord considered auditory intervention – manipulates rate and intensity of speech segments
  - Earobics considered primarily language intervention – manipulates consonants, vowels, syllables, written analogues as parts of words rather than the auditory features (Diehl, 1999)
  - FM systems excluded – passive frequency modulation rather than active direct treatment
Fifteen Clinical Questions Developed
Patient, Intervention, Comparison, Outcome (PICO)

- Questions 1-6: effects / efficacy of auditory interventions on auditory, language, and academic outcomes in school-aged children with APD alone or with co-morbid language disorders
  - For school-age children with diagnosis of APD, what is effect of
    - auditory intervention on auditory outcomes?
    - auditory intervention on language outcomes?
    - auditory intervention on academic outcomes?
  - For school-age children with diagnosis of APD and co-morbid LD, what is effect of
    - auditory intervention on auditory outcomes?
    - auditory intervention on language outcomes?
    - auditory intervention on academic outcomes?
Clinical Questions (con’t)

- Questions 7-12: effects / efficacy of language interventions on auditory, language, and academic outcomes in school-aged children with APD alone or with co-morbid language disorders
  - For school-age children with diagnosis of APD, what is effect of
    - language intervention on auditory outcomes?
    - language intervention on language outcomes?
    - language intervention on academic outcomes?
  - For school-age children with diagnosis of APD and co-morbid spoken LD, what is effect of
    - language intervention on auditory outcomes?
    - language intervention on language outcomes?
    - language intervention on academic outcomes?
Clinical Questions (con’t)

- Questions 13-15: effects /efficacy of auditory interventions on auditory, language, and academic outcomes in children with spoken language disorders
  - For school-age children with diagnosis of spoken LD, what is effect of
    - Auditory interventions on auditory outcomes
    - Auditory interventions on language outcomes
    - Auditory interventions on academic outcomes
Methods

- Systematic search of 28 electronic data bases from March 2008 to June 2008
- Key words related to central auditory processing or auditory processing interventions
- Published in peer reviewed journal from 1978-2008; written in English, original data, pertinent to one of 15 questions
- Inclusion criteria: school-age children, ages 6-12; diagnosis of auditory processing disorder and/or spoken language disorder
- Exclusion
  - Written language disorders
  - Learning disabilities (without co-morbid language)
  - Reading disabilities/ dyslexia
  - Autism spectrum disorders
  - Hearing loss
  - Cognitive disability (IQ lower than 70)
Results of Systematic Review

- 192 article citations; 32 preliminarily accepted; 9 additional articles rejected; accepted 23 articles that addressed 25 studies

- Articles categorized evaluated in critical appraisal
  - clinical research stage: Exploratory, efficacy, effectiveness, or cost-benefit/public policy
  - Seven quality indicators
    - Study protocol
    - Blinding
    - Sampling/allocation
    - Treatment fidelity
    - Significance
    - Precision
    - Intention to treat (when applicable)
Evidence-Based Systematic Review

Marc Fey
Auditory Processing Disorders and Its Treatment: An Evidence-Based Systematic Review

Marc E. Fey, Ph.D.
University of Kansas Medical Center
Intercampus Program in Communicative Disorders
Email: mfey@kumc.edu

2009 ASHA Convention
New Orleans
November 21
Question Set 1: The Effects of Auditory Interventions on Auditory, Language, and Academic Outcomes in School-age Children with APD
Question Set 2: The Effects of Language Interventions on Auditory, Language, and Academic Outcomes in School-age Children with APD
Results of Our Search for Articles on TX for Children with Dx of APD

- A total of only 6 articles
- Articles included 8 studies
- APD dx typically based on SSW, SCAN-C, and tests of speech in noise
- Interventions represented
  - Traditional auditory training (N = 4)
  - Auditory Integration Training (N = 1)
  - Fast ForWord (N = 2)
  - Earobics (N = 1)
Number of Studies for Each Study Phase

<table>
<thead>
<tr>
<th>Phase</th>
<th># Articles</th>
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<tr>
<td>Exploratory</td>
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Number of Treated and Control Subjects Participating Per Study

![Bar graph showing the number of subjects participating in different intervention types.](chart.png)
Study Quality Points Awarded

- Exploratory – x/6
- Efficacy – x/7

Quality Points

Intervention Type
Most Common Problems with Quality Indicators

• Testers and analysts were not kept blind to the participants’ treatment protocols.
• The treatment was not adequately described and/or treatment fidelity was not reported.
• Participants were not assigned randomly to treatment group or schedule.
Significant Auditory Outcomes?

![Bar Chart]

- **Quality Points**
- **Intervention Type**
  - 1
  - “Traditional”
  - 4
  - AIT
  - 6
  - Fast ForWord
  - 7
  - Earobics

**Exploratory**

**Efficacy**
Significant Spoken Language Outcomes?
Significant Written Language Outcomes?

![Bar chart showing intervention types and quality points.]

- Intervention Type: 1, 2, 3 ("Traditional"), 4, 5 (AIT), 6 (Fast ForWord), 7, 8 (Earobics)
- Quality Points: Exploratory (blue) and Efficacy (red)
- Intervention Type 3 has +0.0 quality points in both categories.
- Intervention Type 5 (AIT) has the highest quality points with 4.0 in Exploratory and 0.0 in Efficacy.
- Intervention Type 7 (Fast ForWord) has the highest quality points with 7.0 in Exploratory and 0.0 in Efficacy.
- Intervention Type 8 (Earobics) has +0.0 quality points in both categories.
Summary of Findings from Articles on TX for Children with APD

- A total of only 6 articles
- Articles included 8 studies, none of which earned more than 4 quality points.
- There is weak, inconclusive evidence that intensive short term interventions *may* improve some aspects of auditory function in children with primary APD.
Summary of Findings from Articles on TX for Children with APD

• Evidence to support use of auditory interventions designed to affect spoken or written language is especially limited.

• Earobics, an intervention we classified as language, had mixed effects on auditory and written language tasks.

• There is no evidence to support the use of AIT with children with APD.
Question Set 3: The Effects of Auditory Interventions on Auditory and Spoken and Written Language Outcomes in School-age Children with Primary Language Disorder
Results of Our Search for Articles on Auditory TX for Children Primary LD

- A total of 17 articles
- Articles included 19 studies
- LD dx typically based on standardized tests with varying criteria (e.g., below -1 SD)
  - Two studies required comprehension delays
- Most studies included only English-speaking American children
  - England, Scotland, Australia also included
  - One study included Dutch speakers
Results of Our Search for Articles on Auditory TX for Children Primary LD

- Interventions
  - Fast ForWord (N = 16)
  - Language interventions with FFW-like acoustic modifications (N = 2)
  - Traditional auditory training (N = 1)
Number of Studies for Each Study Phase

- **Exploratory**: 12 studies
- **Efficacy**: 6 studies
- **Effectiveness**: No studies
Number of Treated and Control Subjects Participating Per Study
Study Quality Points Awarded

![Bar chart showing quality points awarded for different intervention types.](chart.png)
Most Common Problems with Quality Indicators

- Testers and analysts were not kept blind to the participants’ treatment protocols.
- The treatment was not adequately described and/or treatment fidelity was not reported.
- Participants were not assigned randomly to treatment group or schedule.
- Study design did not include an “intention to treat” analysis.
Significant Auditory Outcomes?

<table>
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<tr>
<th>Intervention Type</th>
<th>Quality Points</th>
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Legend:
- **Blue** represents Exploratory.
- **Red** represents Efficacy.
Special Considerations Regarding the Efficacy Studies of FFW

- Alexander & Frost (1982) found that temporal processing of speech-like sounds improved as a result of a FFW prototype.
  - The improvement was significant only at the .15 level.
Gillam et al. (2008) hypothesized that children who received FFW would improve more on a backward masking measure than would children who received language intervention or attention control procedures.

- All groups made significant improvements in backward masking over time.
- There were no differences between groups, however.
Significant Spoken Language Outcomes?

Quality Points

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<th>Intervention Type</th>
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Both Gillam et al. (2008) and Cohen et al. (2005) observed significant gains in spoken language following FFW. Observed gains were no greater than observed for the language interventions or for the attention control group, however. For Gillam et al., children in the FFW group outperformed controls on a sound blending test.
Special Considerations Regarding the Findings of the 7-point Efficacy Studies

- Gillam et al. (2008) predicted that children with low backward masking scores would make greater language gains if they received FFW than if they received the language interventions or the attention control procedures.
  - Children with low backward masking scores were at no advantage if they had FFW compared to either language intervention or the attention control procedures.
Summary of Findings from Articles on Tx for Children with Primary LD

• A total of 19 studies in 17 articles
  – All but three evaluated Fast ForWord
• In general, quality was better than studies of children with APD, with two efficacy studies receiving scores of 7.
Summary of Findings from Articles on TX for Children with Primary LD

- Exploratory and efficacy studies provide weak evidence to indicate that children with PLD *may* improve their auditory function following FFW and traditional auditory processing treatments.
- There is no evidence that FFW’s acoustic modifications of speech and non-speech stimuli are responsible for these improvements.
Summary of Findings from Articles on TX for Children with Primary LD

- The largest and most rigorous efficacy studies of FFW with children with LD have found either no improvements on language measures or gains similar to other, equally intensive language interventions and control conditions with no auditory or language manipulations.
  - There is no evidence that children with PLD who have weak auditory processing skills respond especially well to FFW.
Summary of Findings from Articles on TX for Children with Primary LD

- At present, there is no support for applying graded acoustic modifications, such as those found in FFW, to language interventions in an effort to enhance their efficacy.
To fill gaps in our understanding of children with APD and its treatment, we need research programs that:

- more adequately identify APD and APD subgroups using more rigorous test batteries.
- carefully measure language as well as auditory skills both before and as an outcome of tx.
Research Directions

To fill gaps in our understanding of children with APD and its treatment, we need research programs that:

- based on evidence from high quality exploratory studies, develop specific hypotheses about which auditory and language treatments should affect specific APD conditions.
- test these specific hypotheses in high-quality efficacy and effectiveness studies.
Some Clinical Guidelines

- There is little evidence available to guide clinicians working with children with APD.
- A few recommendations are warranted.
  - Always carefully and comprehensively evaluate the children’s language skills.
  - When language problems exist, they should be treated with language interventions.
Some Clinical Guidelines

- If auditory interventions are planned as sole or adjuvant treatments, clinicians should carefully describe the nature of the auditory problems and select an intervention plan designed to target those specific deficits.
- Clinicians must keep careful records of auditory, language, and academic progress to evaluate the effects of the intervention choices.
Personal Perspectives

- Despite committee’s strong commitment, not able to reach consensus regarding professional practice guidelines—minimal evidence in systematic review
- SLP faced with dilemma regarding intervention
- Use existing evidence and expert opinion to present variety of professional perspectives
  - Is auditory processing a unique and identifiable clinical entity?
  - Do auditory intervention have an academic outcomes?
  - Can auditory processing skills be separated from language, phonology, and literacy?
  - Why is it so difficulty to reach professional consensus on a definition for identifying and treating APD?
  - What guidance can be offered to practicing professional responsible for identifying and treating APD?
The Problem with Processing-Based Disorders
The Appeal of Processing Disorders

- It is human nature to look for the easier ways to do things.

- Watching videos (Baby Einstein) can make babies smarter.

- Processing explanations provide easy solutions to complex learning problems like learning to talk, understand, read, write, spell, and reason.
Examples of Simple Solutions to Complex Problems

- Give me the pill
- Pay attention
- Just try
- Listen
- Think
- Remember
- Listen better
- Think harder
- Try harder
If Only Learning Were So Simple

- The pill—I don’t do drugs.
- Attention---What do I attend to? I hear birds.
- Just try---Why? When I try, I still don’t do well.
- Listen—I am listening. I don’t understand what you’re saying.
- Think—Think about what? I think you don’t know how to teach.
- Remember—I remember the ugly shirt you wore yesterday.
Learning is Hard Work

- Learning the specific language, conceptual knowledge, and reasoning skills required to talk, understand, read, write, spell well is hard even for typical learners.

- It is incredibly challenging for students with language and learning disabilities.

- There are no shortcuts.
Processing Limitations

- Working memory and speed of processing limitations account for 62% of the variance in composite language scores (Leonard et al., 2007).

- Phonological processing limitations account for > 60% of the variance in word recognition ability (Wagner, Torgesen, et al. 1987, 1994).
The Disconnect Between Causation and Treatment

- Processing limitations may contribute to language and reading problems, but attempting to improve these abilities has not led to significant changes in language and reading abilities (Our evidence-based review,, Fletcher, 2007).

- It is often difficult to improve basic processing abilities like phonological memory, working memory, and speed of processing.
Processing-Based Treatments are Ineffective

When processing interventions are effective (e.g., Fast Foreword), it is often because they target knowledge or improve selective attention to speech and language.

Improvements in language knowledge often improves processing abilities (e.g., Alison in Germany).
Processing Assessments Have Little Predictive Value

- **Assumption**: Knowledge about processing strengths or weaknesses predicts treatment outcomes.

- **Reality**: No evidence that knowledge of processing strengths or weaknesses predicts treatment outcomes (Fletcher, 2007).
Predicting Treatment Outcomes

- Processing measures provide no additional information about treatment outcomes that are not provided by measures of language or reading.

- Measures of language (vocabulary, syntax, narrative) are the best predictors of language outcomes.

- Measures of reading (word attack, word identification, fluency) are the best predictors of reading outcomes.
Most Processing Limitations Are Not Processing Disorders

- Phonological processing disorder
- Working memory disorder
- Phonological memory disorder
- Speed of processing disorder
- Rapid serial memory disorder
- Word retrieval disorder
- Syntactic processing disorder
- Semantic processing disorder
- Visual processing disorder
Criteria for a Processing Disorder

- Need a profession
  - Audiology—APD
  - Occupational Therapy—SID
  - Psychology—ADHD

- Need a diagnostic battery (preferably expensive) that only one professional can administer.

- Label needs to be a good meme (easy to understand, remember, and communicate to others).
Why Not a Phonological Processing Disorder?

- Not in the domain of one profession.

- Many professionals can administer the measures of phonological processing (e.g., CTOPP).

- Poor meme—difficult to understand and communicate to others.
Why Not a Working Memory Disorder?

- Not in the domain of one profession
- Assessment is too easy
- Too broad based
- Explains too many disorders
- Poor meme—what is working memory?
- Intervention is not straightforward
Reasons for APD Referrals to Audiologist

- difficulty following verbal instructions and answering questions
- difficulty with reading
- no diagnosed disorder and thus no services
- a diagnosis, but parent is not satisfied with current level of functioning or services.
When the APD Student is Referred to an SLP

1. Perform a comprehensive assessment to evaluate child’s language and/or reading abilities.

2. Generate possible reasons for child’s listening/learning difficulties problems.

3. Develop management plan to target spoken and written language abilities.
Possible Reasons for (Listening) Comprehension Problems

- Weak or distorted signal
- Hearing impairment
- Working memory limitation
- Language disorder
- Concepts are too complex
- Poor inferencing skills
- Inattention (ADHD)
- Lack of motivation
Possible Comprehension Goals

- Conceptual knowledge
- Linguistic knowledge (e.g., vocabulary, syntax, conjunctions, figurative language)
- Inferencing skills
- Text/genre knowledge
- Discourse knowledge (e.g., rules for narrative and conversational discourse)
Possible Reading Goals

- conventions of print
- purposes of print
- letter knowledge
- phoneme awareness (sound knowledge)
- sound-letter correspondences
- Vocabulary
- Word attack skills
- Fluency
- comprehension
Take-Home Message

- Target language-based skills (e.g., comprehension, reading, writing) and knowledge deficits (science, history, math, literature).

- Avoid goals that target general processing skills like auditory discrimination, auditory sequencing, phonological memory, or rapid serial naming. There is little or no evidence that targeting these skills improves language or reading ability (our evidence-based review, Fletcher, 2007).
Keep searching for more efficient and effective ways to improve language and reading abilities, but be wary of interventions that promise quick fixes.

Keep telling students to pay attention, try hard, listen, think, and remember.

But spend most of your time and effort teaching students the language and conceptual knowledge that will help them talk, listen, read, write, and reason better.
Fey et al. (2009). Evidence-based review of the efficacy of auditory intervention on auditory, language, and academic skills. ASHA Committee on the Role of the SLP.


Personal Perspective

Donna Geffner
Evidence Based Practice

(C)APD Treatment: A View From the Clinician’s Desk

Donna Geffner, Ph.D., CCC, SLP/A
St. John’s University, New York
What is an auditory processing disorder?

- The term APD is often loosely used by individuals from many disciplines and settings to mean many different things.

- The label APD has been applied to many deficits which contribute to its confusion. Some even question its existence as a direct entity and other attribute to any child or adult who has a listening problem- not recognizing that listening involves other cognitive and language skills.
- APD refers to the how the central nervous system uses auditory information.

- The CNS is responsible for function such as memory, attention, and language.

  **However, that is not APD.**

- APD is an auditory deficit not the result of the other higher-order cognitive, language and related disorders (ASHA, Task Force 2005; Bellis, ASHA, 2009).

- There are several disorders that affect the person’s ability to understand auditory information. And several disorders co-exist with APD, i.e., AD/HD, language based disorders, and learning disabilities (Geffner, 2007).
In many cases AD/HD co-exists with APD (40%-80%, Dimaggo & Geffner, 2005) and language disorders (Sharma, 2009).

It would be unfortunate to link them together as one but rather to recognize the heterogeneity of the population.

Given that mixture it is particularly difficult to sort out the APD from the population in order to study any aspect of it.
How APD and Language Processing are linked

- The impact of CAPD on language use is particularly evident in spoken language comprehension. Because spoken language comprehension is determined by a number of different factors, clinicians should be cautious in attributing spoken language comprehension difficulties to CAPD in any simple fashion.

- Audiologic considerations as well, play a role. Thus, a diagnosis of CAPD requires comprehensive audiologic assessment; such a diagnosis cannot be made solely on the basis of poor comprehension of spoken language or any language based measure.
According to the ASHA Technical report (ASHA, 2005), CAPDs have been reported in persons manifesting a large and diverse set of clinical problems. CAPD may have a role in both language learning and language use difficulties of clients with and without clear evidence of neuropathology. The report cautions clinicians not to infer the existence of CAPD solely from evidence of learning disability or language impairment.
Management and Treatments

- In studying efficacy of treatment, the ASHA Task Force (2005) identified three conceptual stumbling blocks for researchers and clinicians alike:
  - heterogeneity of the population
  - treatment goals
  - evaluating change
Management of CAPD entails two general and complementary approaches

a. The first approach is directed toward enhancing the client's own resources

b. The second approach is directed towards enhancing the auditory signal and improving the listening environment.

- Individuals with CAPD can benefit from interventions that help them increase their knowledge of language and their ability to access that knowledge in a time-efficient manner for speech processing.
Regardless of the nature of the processing deficit, most persons who have difficulty with the comprehension of spoken language will profit *both* from procedures that enhance the acoustic signal and from procedures that increase the scope and control of central resources, particularly language resources.

Given our current understanding of language disorders and of central auditory processing, techniques that facilitate language competence are likely to improve the auditory processing of language and vice versa (Bellis, 2009).
There are three general areas one focuses on when doing treatment for APD.

Bellis (ASHA, 2009) talks about:

- Changing the learning or communication environment
- Recruiting higher order skills to help compensate for the disorder, and
- Remediation of the auditory processing deficit.
When one discusses altering the environment, one usually refers to the use of:

- sound altering devices or assistive listening devices,
- electronic devices that help teachers deliver the information, and
- devices that assist listening and clarity of the message.

Such devices are FM systems.
It is generally agreed that the use of FM units has increased a child’s discrimination skills and ability to hear in classrooms and in a noisy situations.

There have been many studies that have shown the efficacy of using FM systems on youngsters who are not hearing impaired.

The following reports and research findings support the use of FM technology in both the classroom and as personal units.
The use of sound-field amplification system provides a teacher with an opportunity to:

- improve academic achievement for students
- decrease distractibility and increase on-task behavior
- increase attention to verbal instruction and activities and improve understanding
- decrease number of requests for repetition
- decrease frequency of need for verbal reinforcers to facilitate test performance
- decrease test-taking time
- improve spelling ability under degraded listening conditions
- increase sentence recognition ability
- improve listening test scores
- increase language growth
- improve student voicing when speaking

Crandell, Smaldino, & Flexer, 1995
- increase student length of utterance
- increase confidence when speaking
- increase preference by teachers and students for sound-field amplification in the classroom
- improve ease of listening and teaching
- reduce vocal strain and fatigue for teachers
- increase mobility for teachers
- reduce special education referral rate
- increase in seating options for students with hearing loss
- cost-effective means of enhancing the listening and learning environment
Sound-field units provide amplification for the entire classroom through the use of two, three, or four wall- or ceiling-mounted loudspeakers (Berg, 1987; Crandell, Smaldino, & Flexer, 1995).

All students in the room benefit from an improved S/N ratio of approximately +10 to +20 dB, no matter where they or the teacher are positioned (Flexer, Millin, & Brown, 1990; Palmer, 1997) (Flexer, 1999, p. 126).

Studies continue to show that sound-field FM systems facilitate opportunities for improved academic performance (Crandell, 1996; Flexer, Millin, & Brown, 1990; Neuss, Blair, & Veihweg, 1991; Palmer, 1996; Ray, Sarff, & Glassford, 1984; Zabel & Tabor, 1993).
A three year study of sound field FM amplification revealed the following results (Osborn, Graves, & VonderEmbse, 1989):

- The proportion of students requiring special services decreased after 3 years with amplified classrooms.

- Amplified kindergarten classes scored significantly higher on listening, language, and word analysis tests than did children in unamplified classrooms.

- Amplified classrooms had better on-task behaviors than students in unamplified classrooms.
As reported by principals, in amplified classrooms, there were fewer teacher absences due to fatigue and laryngitis.

Teachers in amplified kindergarten classrooms tended to use less repetition and rephrasing in their instruction.

The study began with 17 sound-field units; 3 years later, 47 units were in use because teachers wanted them, parents demanded that their children be placed in amplified classrooms, and administrators were convinced that student performance improved.
The advantages of sound-field amplification result from the use of a teacher-worn transmitter microphone that is positioned 4 to 6 inches from the speaker’s mouth, optimizing critical speech elements.

All pupils are consistently closer to the speech source (i.e., the loudspeaker), than they could be to a mobile teacher.

The speech signal is not only louder, but each student is closer to the signal (loudspeaker), thereby improving the S/N ratio.
However, a pupil cannot be as close to a loudspeaker as he or she can be to a personal FM receiver that directs the sound into the ear.

Personal FM receivers can provide a speech signal superior to that provided by a sound-field unit and therefore may be more appropriate for some children (Flexer, 1999, pp. 128-129).

Children who have normal peripheral hearing sensitivity but who have difficulty processing, understanding, or attending to classroom instruction could benefit from sound-field FM technology (Chermak & Musiek, 1997).
What do FM systems do for children in schools?

- They allow the child to hear the teacher’s voice at an appropriate and constant intensity level regardless of the distance between the child and the teacher.

- They allow the teacher’s voice to be more prominently heard than background noise (toys, papers, chairs scraping, whispering, pencils being sharpened, feet shuffling).

- They allow for self-monitoring of the child’s own voice through the conventional hearing aid microphone.

- They allow for the conventional hearing aid microphone to be turned off so that the child can concentrate only on the teacher. (www.asha.org/public/hearing/treatment/assist_tech.htm, 2009).
Compensatory Strategies

- Include strengthening central resources such as language and memory and other cognitive skills, so that they can be used to overcome the auditory disorder.

- Teach children to take responsibility for their own listening success or failure and become an active participant in daily listening activities through a variety of active listening and problem-solving techniques.

- Such strategies include asking for repetition and clarification, repeating what was heard to verify accuracy, and to place oneself in the best position to listen (seating arrangement).
Direct Treatment

- Involves remediation of the APD.

- Some programs in existence address phonemic awareness and some utilize computer based treatment.

- Many clinicians use the medical model of 1:1 to provide intervention.

- In doing such direct treatment, it is important that the type, frequency, and intensity of therapy be individualized for the specific type of APD present.
Earobics

- Earobics, (Earobics.com) has been a mainstay for SLPs working to develop auditory phonological processing skills.

- Earobics is a multisensory reading intervention solution designed to support at-risk readers and foster a safe and achievement-orientated learning environment.

- Earobics includes interactive software, guided instruction, student resources, teachers guides, correlations and assessments, customized professional development, and school-to-home connections.
Evidence Studies for Earobics

- In August of 2000, the Chicago Public Schools and Cognitive Concepts, Inc. (CCI) completed a pilot study to evaluate the effectiveness of Earobics in improving Chicago Public School students’ literacy performance in 12,000.

  - Results showed that students in all grades achieved dramatic, statistically significant gains in the full range of phonological awareness skills, spelling and decoding. Some grades advanced more than a full year in age and grade levels in only 10 to 12 weeks of using Earobics (Cognitive Concepts Inc., 2001).

- In Fall of 2000, Highland Elementary School in Owensboro, Kentucky conducted a pilot study to evaluate the performance of the Kindergarten and first grade students using pre- and post-test assessments.

  - Results showed after 15 weeks of Earobic instruction, the first grade students showed significant gains in phonemic awareness skills such as counting phonemes, comparing word lengths and representing phonemes with letters (Cognitive Concepts Inc., 2001).
In November of 2001, Cincinnati Children’s Hospital Medical Center conducted a study that involved 17 students who were referred for Central Auditory Processing Disorder (CAPD) testing.

- Results showed that students who received instruction with Earobics achieved statistically significant gains on overall performance on the PAT and made statistically significant improvements on each of the eight early literacy skills assessed by the PAT (Cognitive Concepts Inc., 2002).

In March of 2001, Polk County Public Schools in Florida conducted a pilot study on Earobics Literacy Launch.

- Results showed that the 5 Title I schools that had been using Earobics with “Open Court” or “Success For All” scored significantly higher gains than did 36 Title I schools that used either literacy basal without Earobics (P<0.02) (Cognitive Concepts, Inc., 2002).
In Spring of 2001, 178 kindergarten students from Newport News Public Schools in Virginia, were part of the study.

Results showed that students who used Earobics Literacy Launch achieved the targeted spring 2001 benchmark which was significantly higher in the Earobics group (55.4%) than in the control group (36%) (Cognitive Concepts Inc., 2002).

In May of 2001, Shadow Oaks Elementary School in Spring Branch Independent School District conducted a pilot study that involved a classroom of 16 kindergartan students.

Results showed that the students achieved statistically significant gains in both the midyear and end-of-year tests with the use of Earobic instruction (Cognitive Concepts Inc., 2001).
In December of 2002, Dr. Michael Pobanz of Los Angeles Unified School District conducted a study with thirty-nine students who received instruction with Earobics, and were compared to a control group who used the core reading program.

- Results showed that students in the Earobics group achieved significantly greater gains in phonological awareness, fluency and auditory memory than students who received instruction with Open Court Reading alone (Cognitive Concepts Inc., 2003).

In Spring of 2002, Seven Districts of Columbia elementary schools administered the Test of Phonological Awareness—Early Elementary (TOPA-EE) which measured improvements in students’ early literacy skills.

- Results showed that students in the Earobics classrooms scored significantly higher on the TOPA-EE than did students in the non-Earobics classrooms in first grade, second grade and third grade (Cognitive Concepts Inc., 2002).
At least three studies have examined the benefits of Earobics compared to a control group that received no treatment (Hayes, Warrier, Nicol, Zecker, & Kraus, 2003; Russo et al., 2005; Warrier, Johnson, Hayes, Nicol, & Kraus, 2004).

Results of each study confirmed significant benefits received by the experimental (treatment) group relative to the control group.

It seems apparent that the intensity and frequency of treatment are perhaps the most important variables influencing treatment outcomes.
Challenges in Investigating Outcome of Treatment

- A select population can bias the number of published studies reviewed and lead to a narrow conclusion.
- Subject population children with LD and reading disorders were excluded.
- Adults should have been included.
- Animal studies excluded could have provided data.
Challenges

- By excluding studies with dyslexic, the committee missed some strong evidence for effectiveness of AT.

- Temple et. al. (2003) found that FFW with dyslexic children resulted in improved language and reading performance and increased activation in multiple brain regions during phonological processing.

- Jancke et al. (2001) found improved frequency discrimination following training as reflected in FMRI in the superior temporal gyrus bilaterally.
Using music as stimuli for AT would have shown effectiveness,

Trainor et. al (2003) showed enhanced P2 following musical AT in children and adults.

Gabb et. al (2005) found enhanced pitch pattern processing and more efficient functional network involving traditional language regions.
Animal studies show (Threlkeld et. al, 2009) that in rats auditory training improved auditory discrimination performance.

Although a number of studies that compare software AT programs found little advantage of one over another, they nevertheless documented the effectiveness of these computerized AT programs (Cohen et. al, 2005; Gillan et. al, 2001; Gillan et. al, 2008).
The Five Steps of EBP
Levels of Evidence

According to Evidence Based Practice in the Health Sciences, there are 6 levels of Evidence that include research designs underlying evidence. Some provide stronger evidence than others based on their inherent characteristics.

The hierarchy is as follows:
- Systematic Reviews
- Randomized Controlled Trials
- Cohort Studies
- Case-Control Studies
- Case Series, Case reports
- Editorials, Expert Opinions
The order of the above reflects the quality of research designs by level, as well as the quantity of each study design in the body of published literature.

The Oxford Centre for Evidence-Based Medicine provides a more detailed description of each level, the highest level being the homogeneous systematic review of randomized controlled trials to the least level—expert opinion.
■ **Systematic Reviews**
  ■ The strongest type of evidence

■ **Randomized Controlled trials are**
  ■ a compilation of an experimental prospective study in which the participants are randomly allocated into an experimental group or a control group followed over time or the variables of interest
  ■ Cohort Studies are observational, prospective, and can be retrospective studies.
  ■ It involves identification of two groups (Cohorts) of patients, one that receives the exposure of interest and one that does not.
- **Case Control Studies** are observational and retrospective which involve
  - identifying patients who have the outcome of interest and control patients without the same outcome and looking back to see if they had the exposure of interest.

- **Case Series** is a descriptive report on a series of patients with an outcome of interest.
  - No control group is involved.
  - The weakest evidence of the studies since they describe a relatively small number of patients and no experimental manipulation is involved.

- **Editorials and Expert Opinion**
  - The clinical experience, expertise and judgment of a respected healthcare professional plays an important role in evidence based practice.
It is agreed that systematic reviews serve the profession well by its scrutiny and high standards.

Nevertheless, there are other measures of evidence that the Library of Health Sciences-Chicago, University of Illinois and the APA uphold as reasonable courses of action in determining treatment efficacy. Such measures include clinical experience and expert opinions.

While the level of evidence approach is useful, this model was developed for bio statistical treatments and epidemiologic studies, a different context than most studies relevant to audiology.

The model rates group studies as superior to individual case studies. However, group studies present “average” performance which may not apply directly to anyone particular person.
Case studies and retrospective studies (3 & 4 level evidence) can provide more evidence appropriate for a particular individual’s profile and intervention (Barlow & Herson, 1984).

We should not dismiss evidence because it is at a lower level nor should we accept evidence as infallible because it is assigned a higher level of evidence (Chemark, 2009).
Some of us are of the opinion that treatment does work and that evidence can be found substantiating successful management and treatment of children with APD over the years by SLPs/Audiologists.

There are studies that have tackled the question.
Frank Musiek

- Treatment evidence is found in Neuroscience Journals
- No question that AT is highly useful in CAPD as seen in these articles
- “The sheer abundance of neuroscience literature that supports the concept of AT for problems with auditory function and related issues is overwhelming”.
- The basic science is extremely strong
- Agnew, Dorn, & Eden, 2004
- Cohen et al., 2005
- Gillam, Crofford, Gale, & Hoffman, 2001
- Gillam et al., 2008
- Hayes, Warrier, Nicol, Zecker, & Kraus, 2003
- Kujala et al., 2001
- Moore, Rosenberg, & Coleman, 2005
- Russo et al., 2005
- Tallal et al., 1996
- Temple et al., 2003
- Warrier, Johnson, Hayes, Nicol, & Kraus, 2004
- Katz et al., 1984
- Devenyi, 1989
- Jirsa, 1993
- Alexander & Frost, 1982
Jack Katz

- Working with APD more than 50 years
- Saw relationship between APD and reading problems in children esp. phonemic synthesis
- Skills improved as did oral reading
- Results of Phonemic Synthesis Training (Katz, 2009) provides data from:
  1. Monitoring the therapy performance
  2. Test and retest of original test gathering
  3. Parent /teacher ratings of change in the areas of concern
Parents of children realize how easy it is to improve auditory skills with training in spite of being told that there is no such thing as auditory processing and there is no therapy for it! (Katz, 2009)
Experts

Robert Keith

- Expert opinion is a nonscientific approach.

Teri Bellis

- The Science is strong with evidence for Auditory training to benefit individuals with CAPD
“While the level of evidence approach is useful, it should be understood that this model was developed primarily for biostatistical treatments and epidemiologic studies, a somewhat different context than most studies relevant to audiology. Moreover, the model rates group studies as superior to individual case studies, however, this does not account for the fact that the results of group studies reflect “average” performance and might not directly apply to any particular individual. In fact, case studies and retrospective studies (which are classified as level 3 or 4 evidence) can often provide clinicians with evidence appropriate for a particular individual’s profile and intervention (Barlow & Hersen, 1984). A more pragmatic approach to evaluating evidence would be to not dismiss evidence simply because it is at a lower level and conversely not to automatically accept evidence as infallible simply because it is assigned a higher level of evidence.” (Chermak, 2009)
Author’s Opinions

- Although the final paper produced from the systematic study presents outcomes that are not hopeful, evidence from clinicians on tried and true methods do give us hope.

- Studying other populations than those studied here do show evidence for effectiveness.

- Further, because a systematic review involves accepting only those studies that received the higher rankings, many studies were omitted because they didn’t meet the criteria, i.e., subject blinding, control group, size, etc., for inclusion or they lacked sufficient information.
Many studies, i.e., Gillam, et al., which did not show benefits of any one program over the other in final outcome, nevertheless, did demonstrate that the programs understudy produced some reasonable outcomes.

A distinction should be made when tackling such a goal of evaluating treatments to a heterogenous and dynamic group. It cannot stand up to the same rigorous standards as an investigational drug study, where dosage and titrates are strictly controlled.

Another distinction should be made between learners and nonlearners. There are those who will not benefit regardless of the treatment used.
I believe that treatment has benefits and the SLPs should be in the position of delivering treatments and management, while continuing to collect data on efficacy.

The evidence for efficacy of FM usage is clear and beneficial in the classroom and in the individual therapy sessions- even in quiet conditions!

Teaching compensatory strategies and providing support/accommodations are helpful in the management. Such programs are hard to measure for efficacy.
Of concern is the methodology that is used to determine the presence of CAPD and the improvement following treatment based on such measures as backward masking. This measure may not be appropriate.

In some cases, the diagnosis may not be accurate and often the population is so heterogeneous, it is hard to tease out what is APD from language impairment.

When evaluating a heterogeneous population, there are so many confounding variables, it is hard to know what works and for whom.

Further, the heterogeneity of such groups makes it virtually impossible to make any statement regarding treatment efficacy.
There are many software programs on the market to help clinicians and parents address their child’s auditory weaknesses.

Some are language or phonologically based. Some deal with phonemic synthesis, memory training, auditory figure, group listening, prosody training and temporal processing. Cognitive training is also available which may include language training, metalinguistic, vocabulary development and organization skills.

The children we see all need a compilation of treatments dealing with the myriad of deficits encountered in this population.

School age children’s auditory perception of speech and non speech continue to develop during school age years which can be modified by auditory experience (Kraus et al., 1999)
Conclusion

There is much work to do ahead in deciphering just what the nature of APD is in a particular child—since no two children are alike—and to determine which programs are more appropriate for each child. We have a long journey ahead in determining what works and for whom.
Personal Perspective

Geraldine Wallach
THE ROLE OF THE SLP IN APD:
PEELING THE ONION

GERALDINE P. WALLACH
Dept of Communicative Disorders
California State University at Long Beach
THE APD COMMITTEE

A MODEL OF COLLABORATION
WHAT IS BUNNY # 2'S REAL PROBLEM?

MY BUTT HURTS !!!

What??
The colonists knew that their actions would have very serious consequences, or results. After hearing about the Boston Tea Party, Parliament decided to punish the colony of Massachusetts. A law was passed saying that no ship carrying colonial goods could leave Boston Harbor until the colonists had paid for all of the tea that was destroyed. To enforce the new law, Parliament ordered the Royal Navy to blockade Boston Harbor.

Social Studies: The Early United States (2000) p. 280
The Boston Tea Party was the colonists' response to an unfair tax instituted the prior year by the British Parliament.
SCIENCE

WHAT KIND OF ENERGY IS INVOLVED WHEN MATTER CHANGES STATE?

RECALL WHAT YOU KNOW ABOUT CHANGES OF STATE

EXPLAIN WHAT PROPERTIES HELP KEEP AIR IN REFRIGERATOR COLD

Science Discovery Works, p.b37
WHAT DO WE KNOW FOR SURE: CURRICULAR CONTENT

- UNFAMILIAR TOPICS/ABSTRACT
- EMBEDDED IN COMPLEX FORMS
- DECONTEXTUALIZED
WHAT ELSE DO WE KNOW: DERIVED LITERACIES

EACH SUBJECT HAS ITS OWN LANGUAGE, E.G. HISTORY = VERY INFERENTIAL; SCIENCE = TECHNICAL LANGUAGE
SO WHAT?

LANGUAGE DISORDERS RESIDE INSIDE AND OUTSIDE KIDS' HEADS
INSIDE/OUTSIDE CONCEPT
AT SCHOOL AGE LEVELS

DEMANDS OF THE CURRICULUM
AND THE INSTRUCTIONAL
REQUIREMENTS OF TEACHERS
PLUS STATE STANDARDS MUST BE
PART OF THE ASSESSMENT AND
INTERVENTION PROCESS FOR
STUDENTS WITH APD/LLD
A KEY QUESTION...

WHAT DO I AS AN SLP DO WHEN AN AUDIOLOGIST OR TEACHER SENDS ME AN APD REPORT OR REFERRAL?
OPTIONS...

- IGNORE IT
- TOSS REPORT IN SHREDDER
- CONSIDER A "RED FLAG"
- CREATE INTERVENTION THAT DEALS DIRECTLY WITH AUD SKILL
MY PERSONAL OPTION

- More likely see the diagnosis as a red flag (identification)
- Have to proceed to the contexts in which language and academic learning are problematic
- Find functional manifestations of auditory findings
WHERE WE ARE COMING FROM?

1. CREATE A VIABLE SET OF LANGUAGE INITIATIVES FOCUSED TOWARDS CONTENT AREA LEARNING

2. HELP KIDS DEVELOP THE LANGUAGE KNOWLEDGE, SKILLS, AND STRATEGIES NEEDED

(EHREN ‘06; WALLACH ETAL ‘09)
KNOWLEDGE, SKILLS, AND STRATEGIES

PARAPHRASING:

-- A COMPREHENSION STRATEGY

-- ONE NEEDS A KNOWLEDGE OF WORDS (SYNONYMS)

-- ONE ALSO NEEDS SYNTACTIC SKILLS

EHREN, 2006
DOES CAP INTERVENTION MEASURE UP?

1. LANGUAGE INTERVENTION AT SCHOOL AGED LEVELS = CURRICULAR CONTENT WITH LANGUAGE SKILLS TO GET KIDS THERE

2. KEEPING IDEAS AS CLOSE TO CONTENT AREA AS POSSIBLE (DERIVED LITERACIES)

3. WATCH THE COMPETING RESOURCES (TOO MANY FACTORS INTERACTING)
GUIDING PRINCIPLES:
METAPHORS FOR CONSIDERATION

-- GETTING TO THE CORE OF PROBLEM

-- MUST KEEP PEELING THE LAYERS OF THE ONION
PEELING THE ONION OF SENTENCE MEMORY TASKS

- METALINGUISTIC
- DECONTEXTUALIZED
- PRAGMATICALLY BIZARRE
- INFLUENCED BY LEXICAL FAMILIARITY
- HAS A PRODUCTION COMPONENT (COMPETING RESOURCES)
METAPHORS CONTD...
(KEEP CORE IN MIND)
METAPHORS CONTD...
(CHICKEN-EGG QUESTION)
ONE WAY MAPPING
(THE CAUSE EFFECT DIRECTION)

-- AP -> L
-- S -> W
-- C -> L
-- R -> E
CHICKEN - EGG ONE WAY MAPPING CONT'D: LANGUAGE KNOWLEDGE HAS POWER

-- LEARNERS CREATE EXPECTANCIES FOR WHAT THEY ARE LIKELY TO HEAR

-- THEIR EXPECTANCIES INFLUENCE WHAT IS ATTENDED TO, PERCEIVED, AND REMEMBERED

-- CHILDREN GET BETTER "SEQUENCING" WHEN NARRATIVE STRUCTURE IMPROVES

(GILLAM, ET AL '02; LAHEY AND BLOOM, '94; NITTROUER, '02)
THINGS ARE NOT ALWAYS WHAT THEY SEEM
DYNAMIC PROCESSING
(E.G. TWO STEP COMMANDS)

-- BEFORE YOU EAT DINNER, WASH YOUR HANDS
-- TAKE OUT YOUR MATH BOOKS BEFORE YOU START YOUR READING
-- TOUCH THE BIG RED TRIANGLE AFTER YOU PICK UP THE SMALL RED SQUARE
“A law was passed saying that no ship carrying colonial goods could leave Boston Harbor until the colonist had paid for all of the tea that was destroyed.”

From Social Studies: The Early U.S. 2000, p. 280 (See also Nippold’s work)
THINGS ARE NOT ALWAYS THE WAY THEY SEEM

- AUD DISCRIM TASKS = META JUDGEMENTS/PHONEMIC
- LINDAMOOD TASKS = CLOSER TO PRINT KNOWLEDGE
GUIDING PRINCIPLES

1. GET TO THE CORE OF WHAT OUR KIDS WITH LLD NEED (BE RELEVANT AND FUNCTIONAL)

2. UNDERSTAND THE COMPLEX CAUSE/EFFECT RELATIONS AMONG DISCRETE SKILLS AND “HIGHER ORDER” SKILLS

3. KNOW THAT THINGS Aren’T ALWAYS WHAT THEY SEEM (LABELS CAN DECEIVE)

4. RECOGNIZE THAT AUDITORY, LINGUISTIC AND ACADEMIC PROBLEMS ARE BOTH “INSIDE” AND “OUTSIDE” KIDS’ HEADS
SOME FINAL THOUGHTS

-- CLAIM OF CAUSE-EFFECT
RELATIONS OF CAP DISORDERS
AND OTHER PROBLEMS REJECTED
BY MANY (E.G., BISHOP and
NITTROUER)

-- APPRECIATE INTRICATE LINKS
BETWEEN VARIOUS ASPECTS OF
LANGUAGE PROCESSING FOR
DESIGNING BETTER TOOLS
FINAL THOUGHTS CONT’D...

-- LANGUAGE INTERVENTION STRUCTURED WITH KNOWLEDGE, SKILLS AND STRATEGIES IN THE CONTEXTS RELATED TO “THE REAL WORLD”

-- EVEN IF CAP DISORDERS EXIST, WE NEED TO GET AT THEM BY CREATING STRATEGIC LANGUAGE INTERVENTION PROGRAMS (EHREN)
THE IMPORTANT QUESTION

WHAT ARE THE LANGUAGE UNDERPINNINGS OF THE ACADEMIC TASKS FACING OUR KIDS?

(NORRIS '97; EHREN '00; WALLACH '08)
THINK OF WAYS TO HELP OUR KIDS CONSTRUCT KNOWLEDGE

“WATER UP’ THE CURRICULUM
(ED ELLIS ‘97)

-- ELABORATE ON IDEAS

-- BROAD CONCEPTS

URGENT!
THINK OF WAYS TO HELP OUR KIDS WORK THE LANGUAGE

--- DEVELOP AND USE STRATEGIES TO COMPREHEND LANGUAGE

--- DEVELOP WAYS TO ORGANIZE INCOMING, SPOKEN, AND WRITTEN LANGUAGE
DON'T BUY APPLES IF YOU WANT TO MAKE ORANGE JUICE
CAPD: THE MOTHER OF ALL MYTHS?

--- DIALOGUE NEEDED ABOUT THE TOPIC

--- VARYING VIEWS AMONG PROFESSIONALS

--- CAN WE FIND COMMON GROUND?
It all depends on how you look at it!
Questions