

How Young Can You Test (C)APD? The Auditory Skills Assessment (ASA)

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Pearson Webinar Series

Agenda

- Current Research
- Auditory Skills Assessment (ASA)
 - Components
 - Content domains
 - Development research
- Applications for screening young children
- Q&A

Current Research in Testing Young Children



How young can I test for linguistic
and non-linguistic auditory skills?

What Has Been Done to Assess Auditory Skills in Young Children?



Allen & Nelles, 1996

- Found that the ability of normal hearing children ages 4–7 years on an auditory discrimination task improved with increasing age until age 7 at which time performance was adult-like
- The 7-year-olds and the adults were able to discriminate the sequence of tonal pairs with component frequencies
- As the sequences were increased, the 4- to 6-year-olds as a group were **not** able to perform the task

Jensen & Neff, 1993

- Children's ability (ages 4–6 years) to discriminate between stimuli that vary along single acoustic dimensions is much **poorer** than that of adults
- Intensity discrimination was adult-like by **age 5**
- Frequency and duration improved with age, but remained poorer than adults' discrimination for many 6-year-olds
 - This may be reflected in general music skill development, as in the commonly observed difficulties of young children to stay "on tune" or in rhythm



Boets, Wouters, van Wieringen, & Ghesquière,
2007 Katholieke University ▪ Leuven, Belgium

- Found that the children who presented significant pre-school deficits in phonological awareness, rapid automatic naming, speech-in-noise perception and frequency modulation detection were those who had increased family risk and literacy impairment at the end of first grade



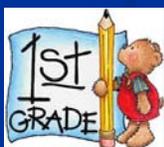
Torgesen & Mathes, 1998

- Found that children can detect and compose **rhymes** by kindergarten
- By the end of kindergarten, they can isolate and pronounce the beginning sounds in a word
- Midway through 1st grade, they can isolate and pronounce all the sounds in two- and three-phoneme words



Torgesen & Mathes, 1998

- By the end of 1st grade, children can isolate and pronounce the sounds in four-phoneme words containing initial blends
- Although some children may acquire some rudimentary phonological awareness skills as early as 2½ to 3 years of age, more advanced skills not mastered until the end of 1st grade

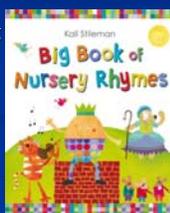


Kraus, Koch, McGee,
Nicol, & Cunningham, 1999

- Auditory discrimination skills are developed by **age 6**
- They used just noticeable differences (JND) and mismatch responses for synthetic syllables that differed in formants. This does not require a behavioral response or attention
- Many aspects of auditory perception of non-speech and speech stimuli are largely mature by school age but perception continues to develop during school-age years, which can be modified by auditory experience

Burt, Holm, & Dodd, 1999
United Kingdom

- Children as young as **3 years of age** can be aware of onsets and rimes, and a strong relationship has been established between the knowledge of nursery rhymes and the development of **intrasyllabic awareness skills** (Maclean et al., 1987)
- Phoneme isolation and segmentation have the best predictive validity for later reading skills (Lieberman & Shankweiler, 1985; Yopp, 1988)



Auditory Skills in Special Populations

- Children with reading impairments show subtle speech perception deficits in quiet but very significant deficits in **background noise** (Ziegler, Pech-Georgel, George, Alario, & Lorenzi, 2005)



The Auditory Skills Assessment (ASA)

What are **the components, the content areas, and the research** behind this development effort?

Auditory Skills to be considered for Assessment



Product Domains/Sections

ASA DOMAINS AND SECTIONS	
Speech Discrimination Domain	
Section 1: Speech Discrimination in Noise	Discriminate words heard against a background of conversational noise
Section 2: Mimicry	Repeat a spoken nonword
Phonological Awareness Domain	
Section 3: Blending	Recognize or say a word after hearing its syllables or phonemes spoken in pieces
Section 4: Rhyming	Indicate whether two spoken words rhyme
Nonspeech Processing Domain	
Section 5: Tonal Discrimination	Indicate if two tones are from the same instrument
Section 6: Tonal Patterning	Indicate which of two tones was presented last

Note: Ages 3;6-4;11 are administered the tasks in the Speech Discrimination Domain only; ages 5;0-6;11 are administered all six sections across all three domains.

Auditory Skills Tested in Development Research

- Speech Discrimination in Quiet (27 items)**
 - For each item, one stimulus word is played from a stimulus CD
 - Child must point to the one picture from a set of four that illustrates the word
- Speech Discrimination in Noise (27 items)**
 - For each item, one stimulus word is played against a background of conversation-like noise from a stimulus CD
 - Child must point to the one picture from a set of four that illustrates the word
- Mimicry (24 items)**
 - For each item, a nonsense word that follows conventional English sound patterns is played from a stimulus CD
 - Stimulus words are 1-4 syllables long
 - Child is asked to repeat the word

Auditory Skills Tested in Development Research (cont.)

- Blending (24 items)**
 - For each item, phonemes of a common vocabulary word, separated by brief pauses, are played from a stimulus CD
 - Part 1: Child points to the one picture from a set of six that illustrates the word
 - Part 2: Child is asked to say the blended word (no visual clues)

Auditory Skills Tested in Development Research (cont.)

- Segmentation (18 items)**
 - Concept of "first" and "last" sound taught through examples and practice items
 - For each item, a one-syllable nonsense word is played from a stimulus CD
 - Items 1-9: Child is asked to say the first sound in the nonsense word
 - Items 10-18: Child is asked to say the last sound in the nonsense word
- Rhyming (15 items)**
 - Concept of rhyming taught through examples and practice items
 - For each item, a pair of words is played from a stimulus CD
 - Child is asked if the two words rhyme (yes/no)

Auditory Skills Tested in Development Research (cont.)

7. Memory (12 items)

- For each item, a set of 2–4 unrelated, common vocabulary words are played from a stimulus CD
- > Child is asked to repeat the words in the same order
- > Responses were scored according to the number of correct words repeated (content score), plus a bonus point if words were given in the correct sequence (sequence score)

Auditory Skills Tested in Development Research (cont.)

8. Tonal Discrimination (12 items)

- For each item, a pair of musical tones are played from a stimulus CD: either (1) one oboe and one piano, or (2) two tones from the same instrument
- > Child is asked if the two sounds are the same (yes/no)

9. Tonal Patterning (12 items)

- Concept of “which played last” taught through examples and practice items
- For each item, two successive tones—one from each instrument (oboe/piano)—is played from a stimulus CD
- A card with a picture of an oboe and a piano is presented
- > Child points to the picture of the instrument that was played last



Research Questions

1. **At what age can children understand and successfully perform the task** posed in each auditory skill subtest?
2. **At what age can reliable data be obtained** for each subtest?
3. Do the subtests **discriminate sufficiently between clinical and nonclinical** cases?
4. Is there value to testing **speech vs. non-speech discrimination**?

Limitations of Testing Young Children

- Memory and attention
- Many do not have intelligible speech
- Age-appropriate instructions and response requirements
- Concept limitations
- Difficult to test and obtain consistent responses
- Poor reliability

General Administration Procedures Employed to Minimize Response and Concept Limitations

- Select words likely to be recognized by young children
- When picture pointing response is required, picture-word association training is provided.
- When mimicry response is required, provide items that are easily articulated.

- Every effort was made to introduce and explain tasks in a way that young children would understand (child-friendly, scripted examiner text).
- Practice items are provided to ensure that children knew how to do the tasks.
- Teaching provided after failed practice items.

TESTING

Listen and point to the picture of the word you hear:

cone



Geffner & Goldman, 2007

Administration Procedures

- Studies 1 and 2 began with **49 training items**.
- All subtests except Speech Discrimination in Quiet began with several practice items to ensure that children knew how to do the tasks.
- Teaching provided after failed practice items.
- Every effort was made to introduce and explain tasks in a way that young children would understand (child-friendly, scripted examiner text).

Method

Study 1 (May–June 2007)

- $N = 547$
- Ages 3:6–6:11
- Nonclinical cases of children with no prior diagnosis of hearing loss and no current ear infections
- Subtests: Speech Discrimination in Quiet, Speech Discrimination in Noise, Mimicry, Rhyming, Blending, Segmenting, Memory

Study 2 (July–August 2007)

- $N = 209$
- Ages 3:6–6:11
- Nonclinical cases of children with no prior diagnosis of hearing loss and no current ear infections
- Subtests: Nonspeech Processing—Tonal Discrimination and Tonal Patterning

Method

Study 3 (Oct–Nov 2007)

- $N = 45$
- Ages 3:6–6:11
- Clinical cases of children judged by SLPs to be at-risk for auditory skill deficits
- Subtests: All subtests from Studies 1 & 2 except Speech Discrimination in Quiet

Research Questions

1. **At what age can children understand and successfully perform various types of tasks** that reflect different auditory skills?
2. **Can reliable data be obtained** for children of a certain age performing particular auditory skills tasks?

Analysis

The following results would suggest that a particular subtest is an age-appropriate assessment tool:

- Fewer than 20% of children with normal hearing acuity score at or near the “guessing” or “chance” level
 - indicates task is comprehensible for children at this age
- Internal-consistency reliability statistics obtained for the subtest for a particular age group are acceptably high
 - indicates subtest is measuring a specific construct

Results

Analysis of the data from Studies 1–3 found that reliable data could be obtained for children as young as **3 years 6 months** for the following subtests:

- Speech Discrimination in Quiet
- Speech Discrimination in Noise
- Mimicry
- Memory

Results

Reliable data could be obtained for children as young as **5 years** for:

- Mimicry
- Blending
- Rhyming
- Non-speech Processing—Tonal Discrimination & Tonal Patterning

Reliable data could be obtained for children as young as **5 years 6 months** for:

- Segmentation

Research Questions

3. Do the subtests **discriminate sufficiently between clinical and nonclinical** cases?

Results

An analysis of the score differences between the nonclinical samples in Studies 1 and 2 and the clinical sample in Study 3 indicated that **all of the subtests compared showed acceptable levels of sensitivity and specificity.**

Subtest	Sensitivity	Specificity	Mean z^*
Speech Discrimination in Noise	.60	.60	-.56
Mimicry	.60	.59	-.37
Rhyming	.65	.64	-.57
Blending	.65	.62	-.79
Segmentation	.65	.54	-.63
Memory	.65	.62	-.62
Non-speech Processing	.70	.65	-.98

*Age-based z scores based on the nonclinical sample.

Note: Speech Discrimination in Quiet was not included in Study 3; thus, it is not reported here. Analyses adjusted for sex, SES, and race/ethnicity.

Research Questions

4. Is there value in testing **speech vs. non-speech discrimination?**

Non-speech Processing

- Among the various tasks presented to young children (ages 3.6-6.11) discriminating between two musical instruments and their patterns was the most discerning between a typical population and those at risk for CAPD.



ASA Standardization

- December 2008 through May 2009
- 600 + children at 123 sites
- Final norms based on nationwide sample of 475 children, ages 3 years 6 months through 6 years 11 months
 - Stratified by sex, race/ethnicity, SES (mother's education level), and geographic region.

ASA Standardization

- **Norm sample**
 - Normal hearing acuity
 - English as primary (most frequently spoken) language
 - Normal vision
 - Free of upper respiratory problems or ear infections at the time of testing

ASA Standardization

- **Norm sample exclusionary criteria**
 - Prior diagnosis of hearing loss
 - History of chronic or recurring ear infections
 - Had PE tubes
 - Receiving Sp.Ed services or a clinical diagnosis that would impact their language or cognitive functioning
 - At risk for auditory skill deficits, including auditory processing disorders

ASA Standardization

- **Clinical sample**
 - Judged by an audiologist or SLP to have difficulty with auditory skills
 - Normal hearing acuity
 - English as a primary (most frequently spoken) language
 - Normal vision
 - Free of upper respiratory problems or ear infections at the time of testing
 - Use of a criterion referenced questionnaire

ASA Standardization

- **Clinical sample exclusionary criteria**
 - Prior diagnosis of hearing loss
 - History of chronic or recurring ear infections
 - Had PE tubes
 - Receiving SpEd services or a clinical diagnosis of intellectual disability or autism spectrum disorder

ASA Cut Scores

- An overall cut score was determined for each 6-month age group, indicating a cutoff at the total score level between normal and at risk cases based on the norm sample, the clinical sample, and a matched control sample.

ASA Clinical Validity

- Compared to the matched control sample, the clinical sample's average scores are significantly lower ($p < .01$) on all ASA domains and the overall total scores for both age ranges reported (3:6-4:11 and 5:0 - 6:11)

ASA Cut Scores

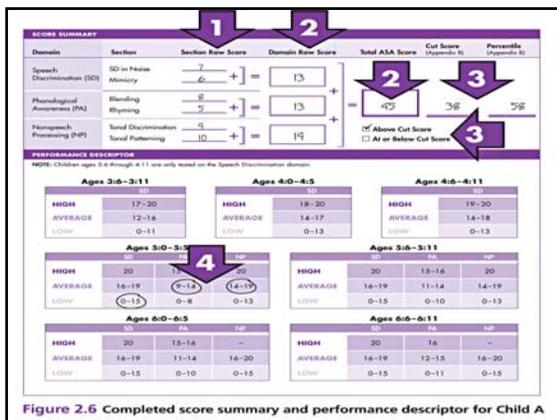
- The sensitivity and specificity of the cut scores are .77 and .68, respectively
- In setting the cut scores, preference was given to attaining high sensitivity because of the importance of flagging children who truly have poor auditory skills

Administration Time



What makes ASA different?

- Large, full-color illustrations tested to appeal to young children
- No headphones or specialized equipment
- Quick administration



Applications

- Early identification and intervention**
 - Possible candidate for in-depth evaluation and/or intervention
- Universal screening**
 - Possible companion to hearing screening
- Progress Monitoring**
 - Check progress of intervention

