SIEMENS

2014 Siemens Expert Series

June 3, 2014 at 12 PM ET

Matching Technology & Features to Patient Needs

Presented by Catharine Palmer, Ph.D.

The focus of this course is on the customization of fitting the patient. By asking the right questions and understanding today's technology features, we can match technology to patients more successfully. Sample cases will be presented and discussed.

June 17, 2014 at 11 AM ET

Assessment and Remediation of CAPD

Presented by Harvey Dillon, Ph.D. and Sharon Cameron, Ph.D.

Spatial Processing Disorder is a specific, well-defined form of Central Auditory Processing Disorder. It is the reduced ability to use spatial cues to focus on a target speaker while suppressing interfering sounds from other directions. Unlike other forms of CAPD, its diagnosis is relatively immune from the effects of cognitive and language deficits. This talk will explain the major cause, diagnosis and remediation of this disorder.

July 24, 2014 at 12 PM ET

Tools Patients Might Find Helpful in Understanding Different Hearing Aid Technology

Presented by Michael Valente, Ph.D.

This presentation will introduce tools that may be useful to counsel patients about expectations from amplification as well as other tools that can make it easier to explain technology levels. The Speech Intelligibility Index (SII) will be discussed to counsel patients on the impact of hearing loss in speech understanding.

August 12, 2014 at 12 PM ET

Understanding and Managing Severe Hearing Loss

Presented by Pamela Souza, Ph.D.

Among all individuals with hearing loss, patients with severe hearing loss are the most significantly impaired, and the least successful with hearing aids. And there is no "typical" patient – communication ability varies widely, as does hearing-aid success. In this presentation we explore the abilities, challenges and possible solutions for adults with pure-tone thresholds between 60 and 90 dB HL.

August 22, 2014 at 12 PM ET

Day-To-Day Hearing Aid Fittings: Clinical Nuggets From Recent Research

Presented by H. Gustav Mueller, Ph.D.

This course will review the recent findings from select clinically-relevant publications regarding hearing aids, and will illustrate how these finding can be applied to everyday hearing aid selection and fitting. In some cases this involves modifications of test procedures, other information that impacts technology decisions, and some of the findings relate to improving our counseling techniques.

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then select "Login to mySiemens"

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2014 Siemens Expert Series with Harvey Dillon, Ph.D.

Assessment and Remediation of CAPD

If you are experiencing audio or visual difficulties, please contact AudiologyOnline at 800-753-2160

THE HEARING CRC

National Acoustic Laboratories
A division of Australian Hearing

Central auditory processing disorders (CAPD): diagnosis and remediation

Harvey Dillon & Sharon Cameron

With thanks to:

Helen Glyde

Dani Tomlin

Jess Whitfield

Mridula Sharma

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National Acoustic Laboratories, Sydney, Australia

Presentation Overview

Spatial Processing Disorder (SPD)

- What is SPD and how does it relate to CAPD?
- What causes it?
- How do we remediate it?

Issues in CAPD test construction

- How do CAPD scores relate to cognitive ability, listening difficulty and academic success?

A national service in Australia for children with CAPD

- Structure and results

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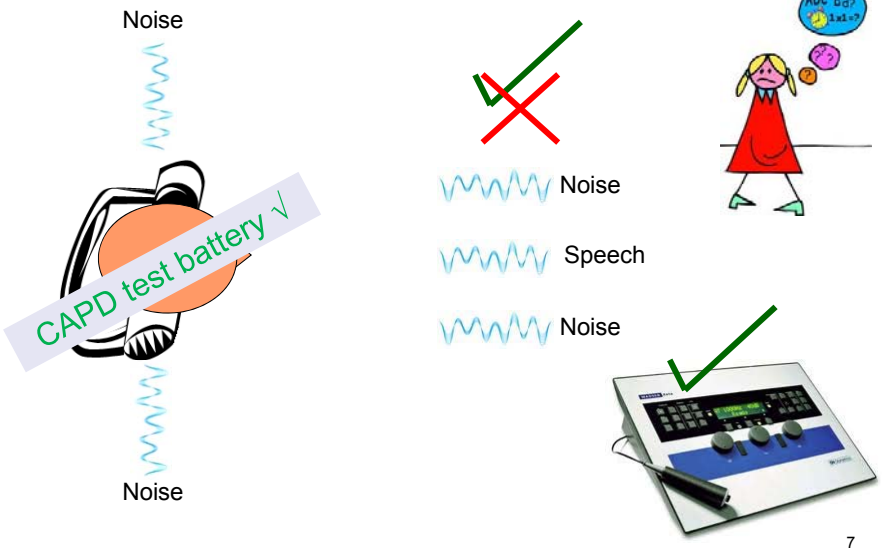
Spatial Processing Disorder:

Overview

Diagnosis, cause, remediation

Spatial Processing Disorder
(deficit in spatial release from masking)



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Spatial Processing Disorder –

Unique amongst CAPD because we:

- Know its major cause
- Can diagnose it, unrelated to cognitive ability
- Have extensive normative and reliability data
- Can remediate it (blinded, randomized trial)
- Remediation generalizes to real life

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Assessing Spatial Processing Ability

9

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Listening in Spatialized Noise – Sentences Test (LiSN-S)

Ability to ***separate*** target stimuli from distracting stimuli that arrive from other directions.

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LiSN-S

- Adaptive speech-in-noise test.
- Virtual auditory environment under headphones.
- Target sentences from 0º.
- Distracter stories at 55 dB SPL from either 0º or ± 90º.
- Stops when SE < 1.0 dB, or max of 30 sentences.

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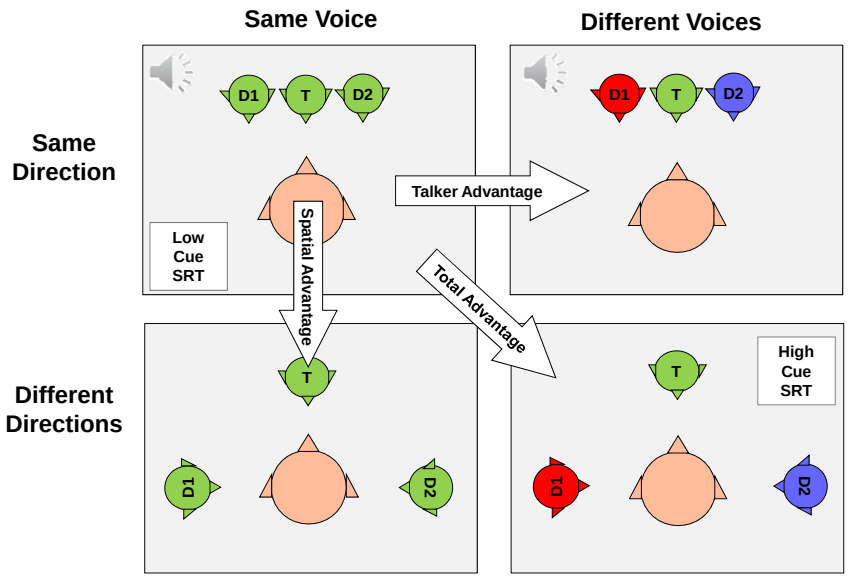
LiSN-S Measurement Screen

12

Four LiSN-S Conditions



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Anticipated Advantage of Using Difference Scores

- Four base scores likely affected by:
  - Cognitive abilities (memory, IQ, attention)
  - Language abilities (vocabulary, closure skills, second language)
- Three difference scores relatively immune to these

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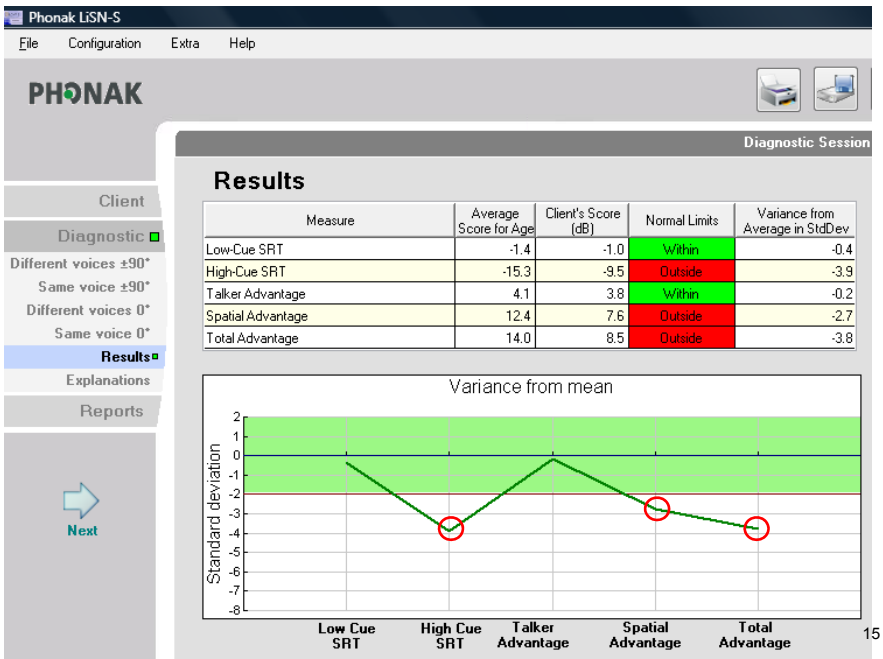
LiSN-S results profile: spatial processing disorder



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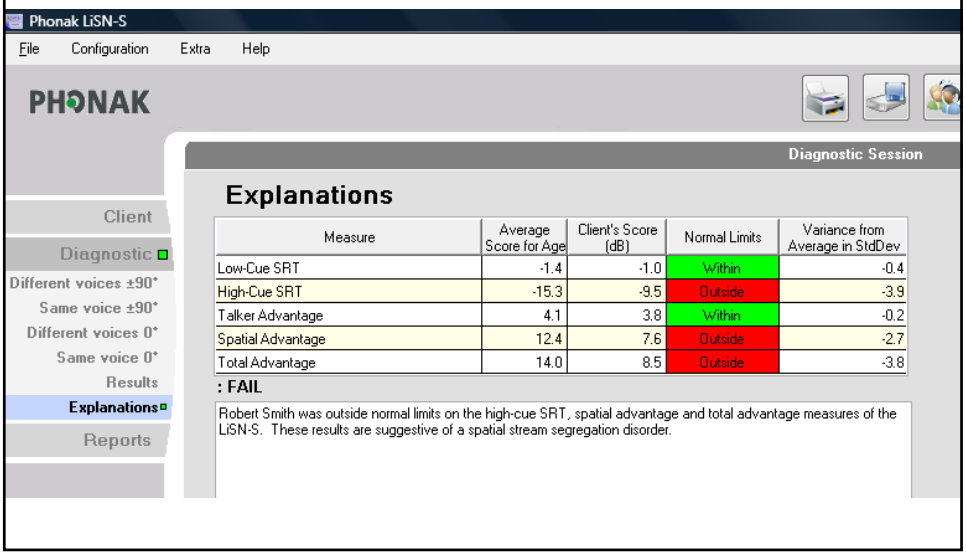
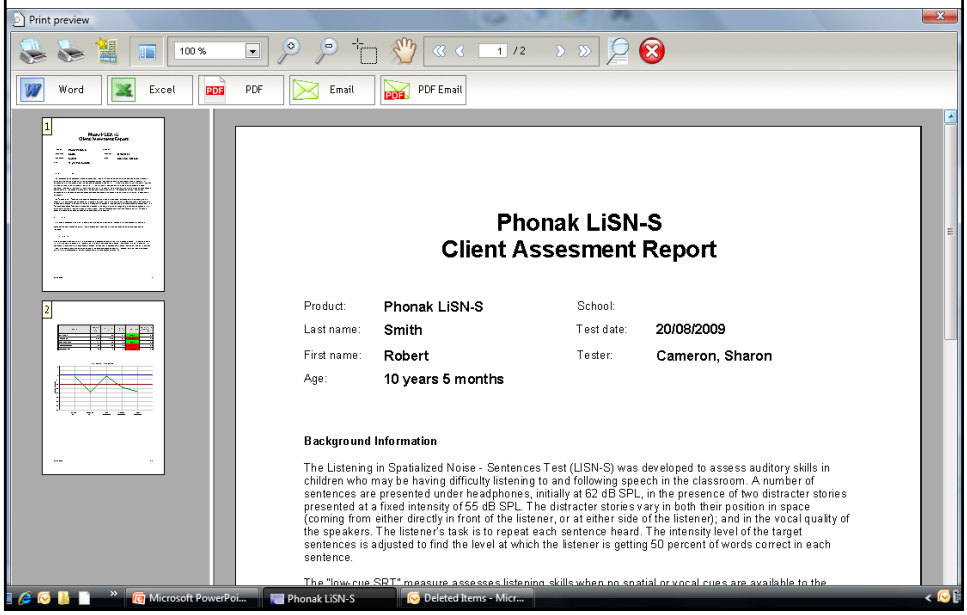
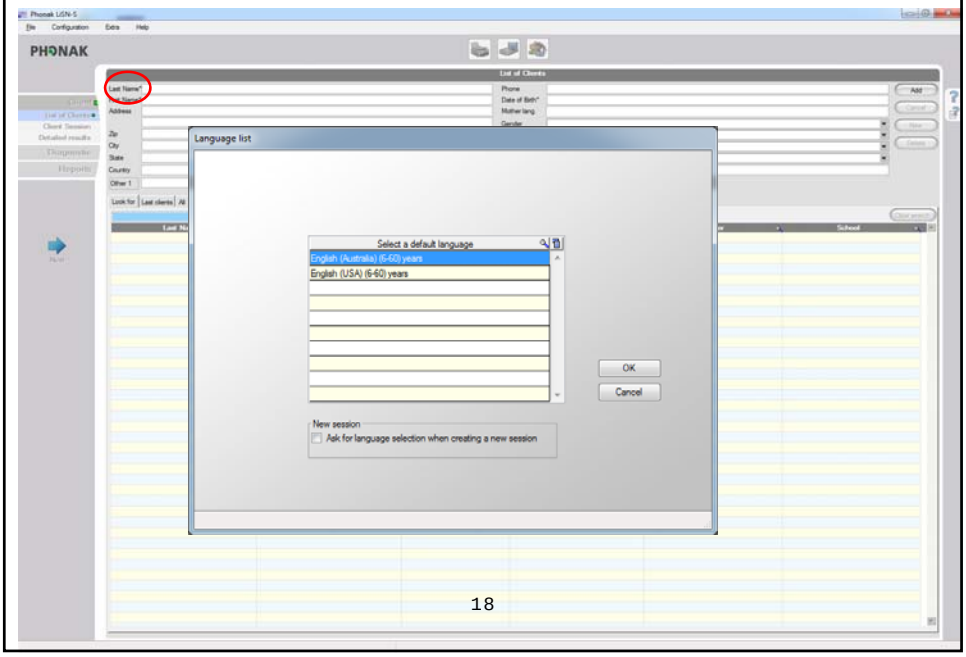
Explanation Screen

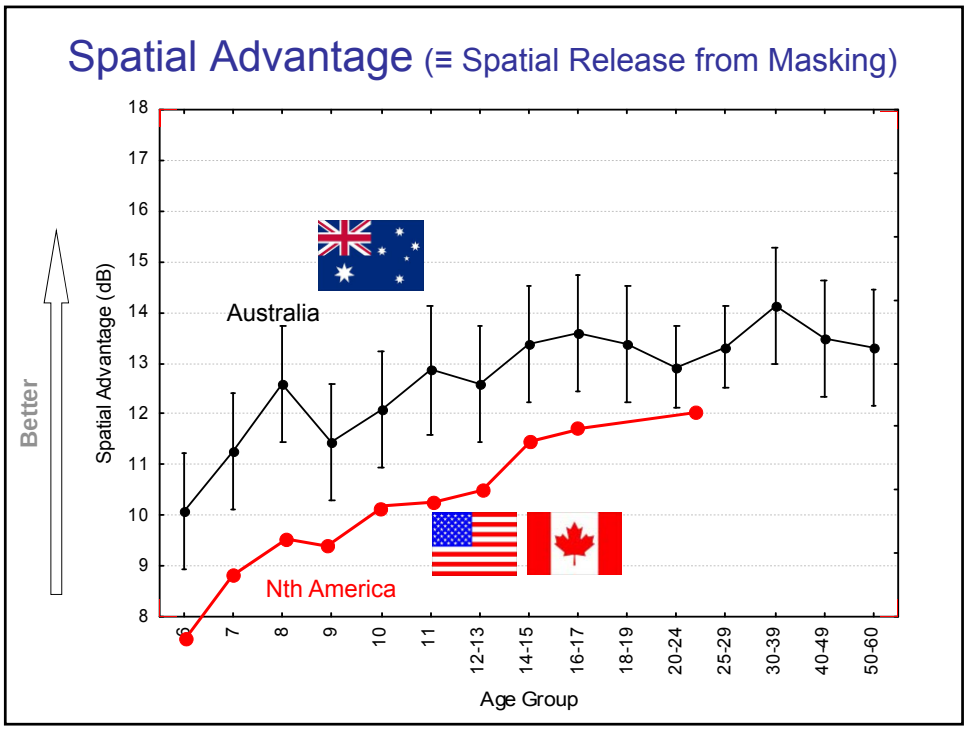


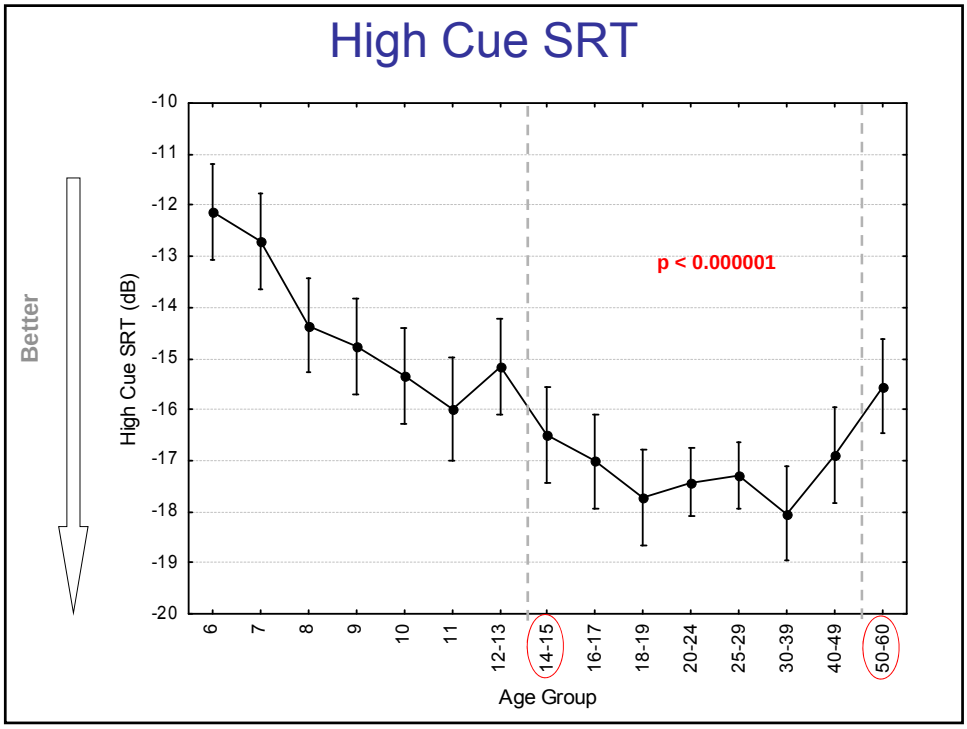
Client Assessment Report



Language: USA English or proper English




Spatial Advantage (≡ Spatial Release from Masking)
Better
Spatial Advantage (dB)
18
17
16
15
14
13
12
11
10
9
8
Australia
Nth America
6
7
8
9
10
11
12-13
14-15
16-17
18-19
20-24
25-29
30-39
40-49
50-60
Age Group


High Cue SRT
Better
High Cue SRT (dB)
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
p < 0.000001
6
7
8
9
10
11
12-13
14-15
16-17
18-19
20-24
25-29
30-39
40-49
50-60
Age Group

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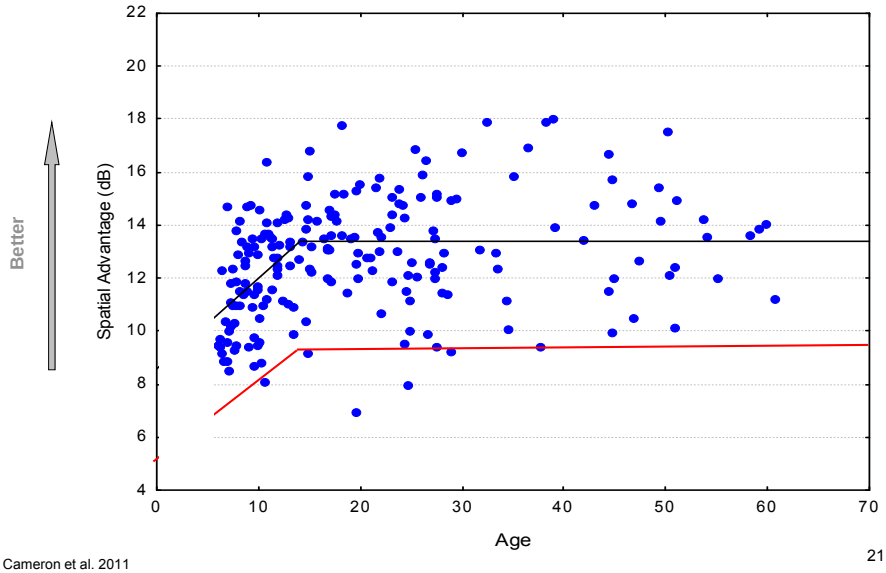
LiSN-S Cut-off Scores



Cameron et al. 2011

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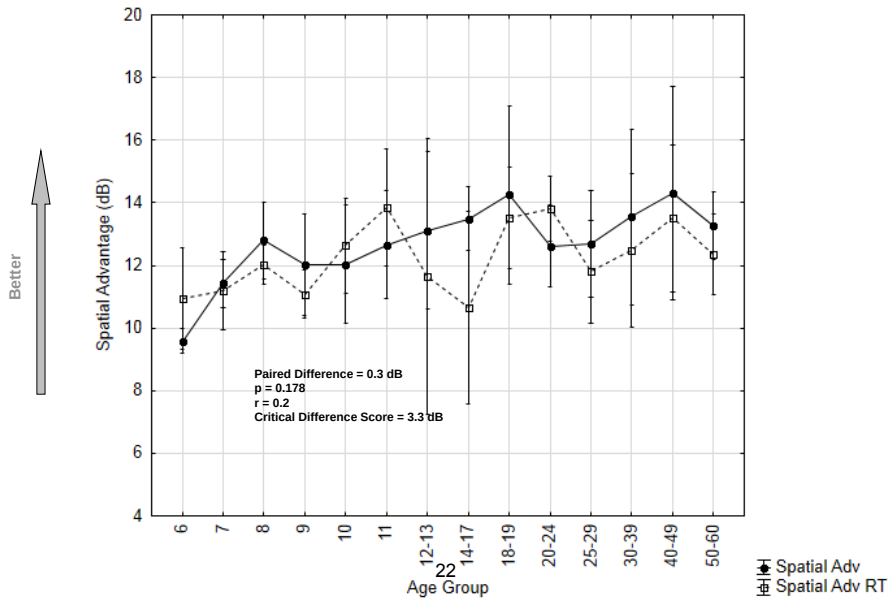
LiSN-S Spatial Advantage Test-Retest Reliability (n=95)



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CHILDREN WITH SPATIAL PROCESSING DISORDER

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Children with Spatial Processing Disorder

- Nine children aged 6 to 11 years experiencing listening difficulties in class relative to peers who had no learning or attention disorder and WISC IQ >90 on all subscales (SusAPD group).
- Eleven children with confirmed language, memory or attention disorders, and WISC IQ overall score >90 (LD group).
- Assessed on LISN-S and results compared to 70 age-matched controls.
- Assessed with a traditional (C)APD test battery

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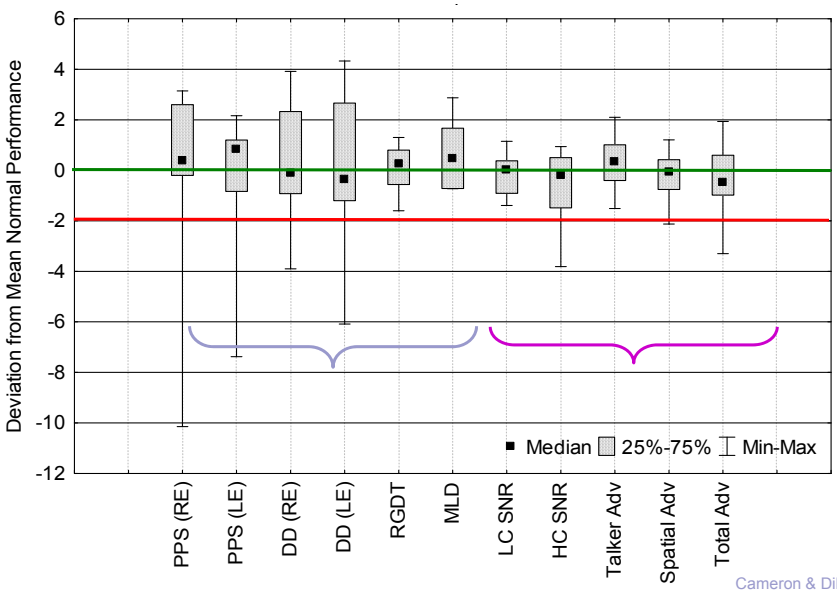
LiSN-S vs. Traditional Battery (LD Group)



Cameron & Dillon (2008)

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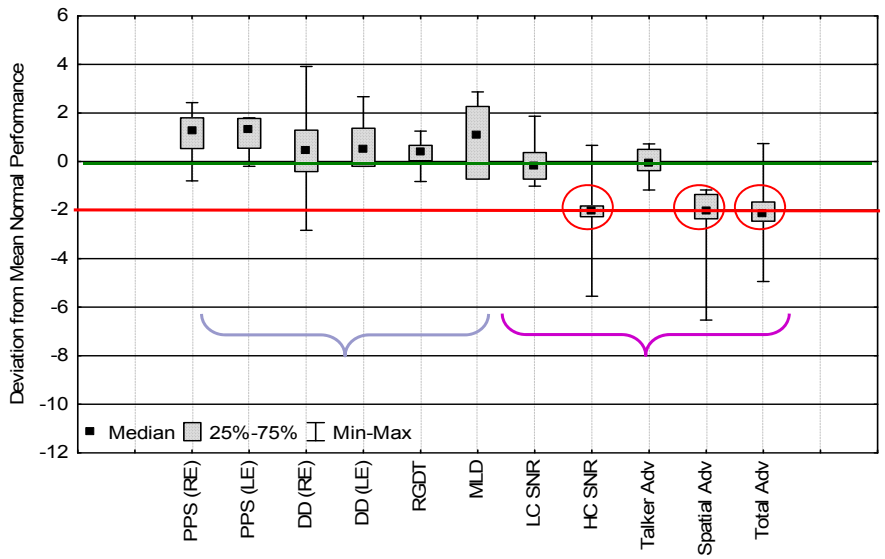
LiSN-S vs.Traditional Battery (sus CAPD Group)



Cameron & Dillon (2008)

Link between SPD and Chronic Otitis Media (COM)

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SPD and chronic otitis media (COM)

- 50% of children (24/49) ***diagnosed with SPD*** at NAL reported a history of COM. (Dillon et al., 2012).
- 30% of children (15/50) ***previously diagnosed with COM*** at University of Melbourne were diagnosed with SPD. (Graydon & Rance, ongoing).
- Spatial processing deficit ***worse for early onset age and longer duration*** of COM (n=35; Tomlin & Rance, under review).
- 6 yo children with history of COM have ***below average spatial advantage*** (n=17; z= -1.0) (Kapadia et al, 2012).
- 13-17 yo adolescents with history of COM have ***below average spatial advantage*** (n=20; z= -0.75) (Kapadia et al, 2014).
- 10% of a ***population sample*** (9/90) of Aboriginal children from remote Australia diagnosed with SPD. (Unpublished data).
- 7% of a ***population sample*** (10/144) of Aboriginal children from regional Australia diagnosed with SPD. (Cameron et al., in review).

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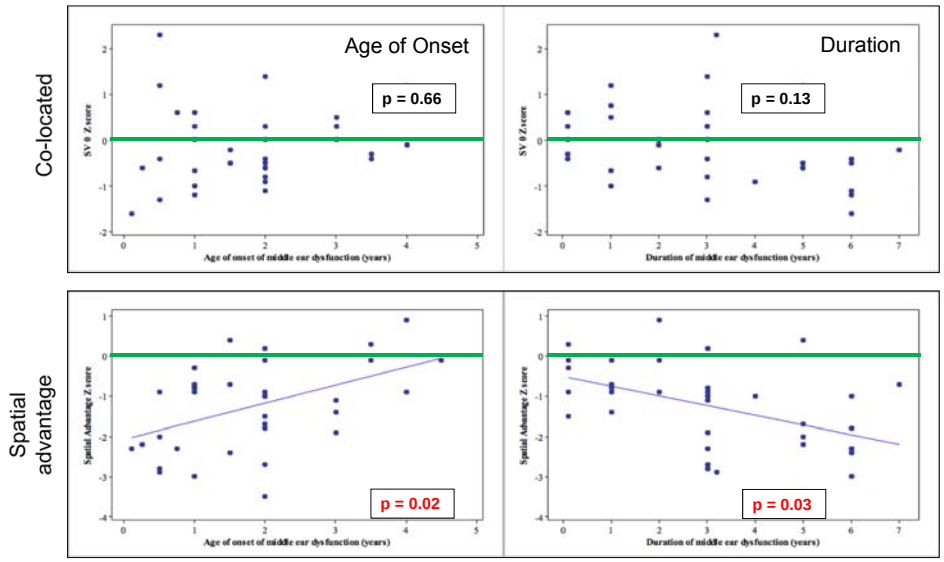
Correlation between SPD and Onset and Duration of COM



Tomlin & Rance (Under Review)

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Interpretation Based on These and Other Studies

Chronic otitis media

↓

Fluctuating access to binaural cues

↓

reduced effectiveness in better-ear glimpsing

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Remediation of SPD:

The LiSN & Learn Auditory Training Software

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LiSN & Learn

- Deficit-specific remediation for SPD.
- Trains children to attend to a frontal target stimulus and filter out distracting talkers from left and right.
- Adapts to 70% performance level.
- Used in the home or schools/clinics).
- Provides detailed feedback, analysis and reporting.

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Description of LISN & Learn

- Five games presented on PC over headphones.
- Target sentences at 0º azimuth.
- Competing stories - same voice at ±90º - (55 dB SPL).
- Weighted up-down adaption of target level.
- SRT calculated over 40 sentences.
- 131,220 unique sentences.
- 50 training sessions (2 games x 5 days p/w x 10 weeks).
- Reward system.

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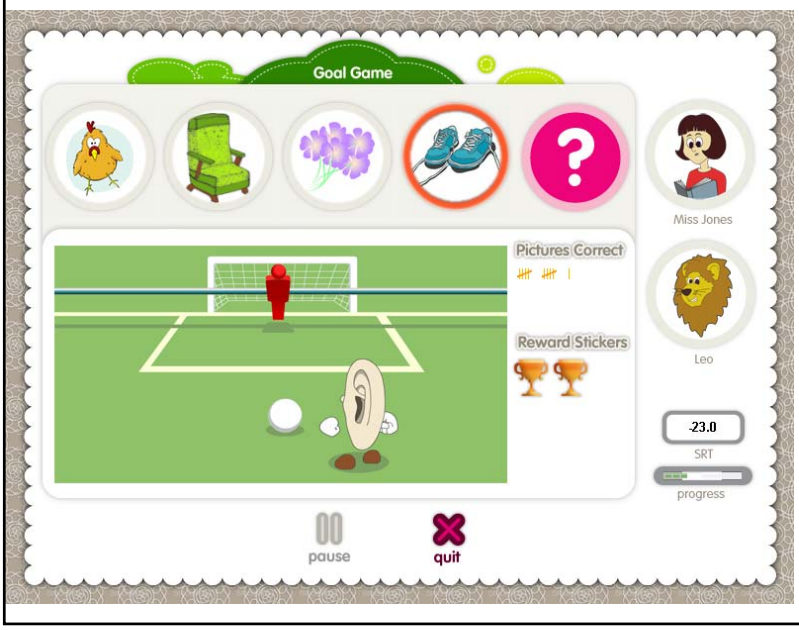
Target: The horse kicked six wet <u>shoes</u>



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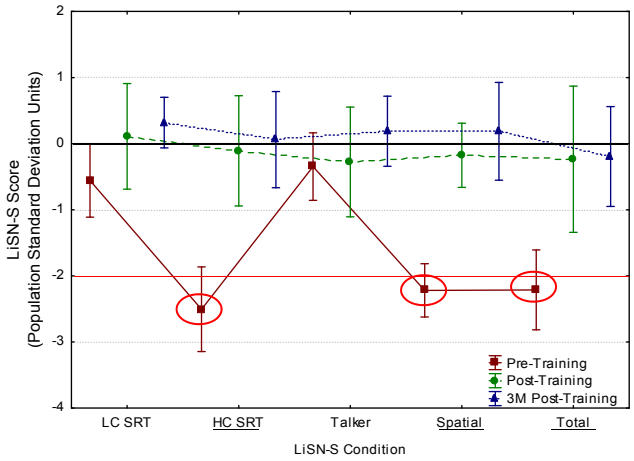
LiSN-S Results - Pre- vs. Post-Training



LC SRT	p = 0.158
Talker Advantage	p = 0.981
HC SRT	p = 0.0002
Spatial Advantage	p = 0.0002
Total Advantage	p = 0.001

Cameron & Dillon (2011)

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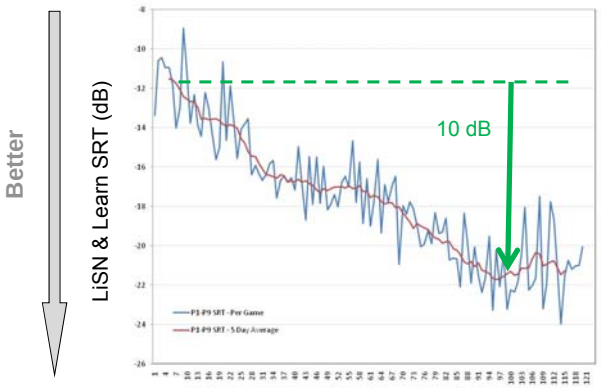
LiSN & Learn – Preliminary Study

- 9 children with SPD (6 to 11 years)
- LiSN & Learn – 2 games/day, 5 days/week, 12 weeks



Average SRT
First vs Last 30 Days
p = 0.000052

Cameron & Dillon (2011)

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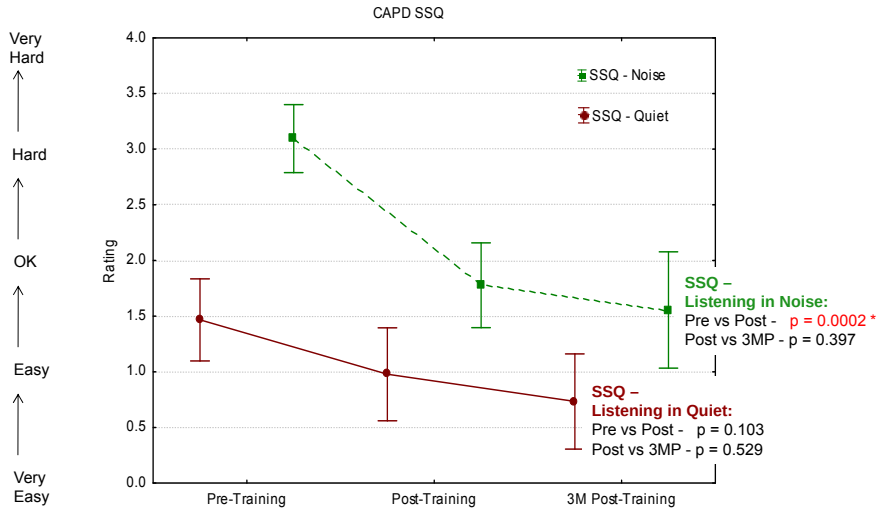
Self-Report Questionnaire - Pre- vs. Post-Training



Cameron & Dillon (2011)

Blinded Randomized Control Study

1. 10 children (aged 6 yrs 0 mths to 9 yrs, 9 mths) diagnosed with LiSN-S as having SPD:
   a) 5 x *LiSN & Learn* (experimental group)
   b) 5 x *Earobics* (control group)
2. Questionnaires
   a) Participant (LIFE)
   b) Parent (Fishers)
   c) Teacher (LIFE)
3. *LiSN & Learn* or *Earobics* training – 15 minutes daily x 60 sessions
4. Re-evaluate LiSN-S and questionnaires post-training

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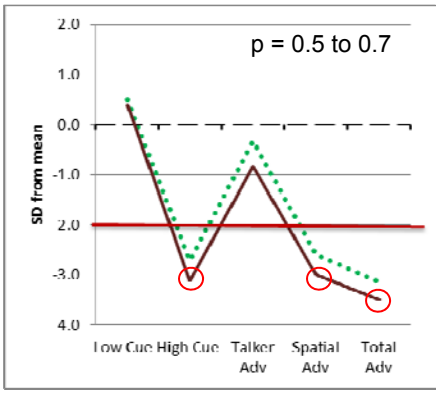
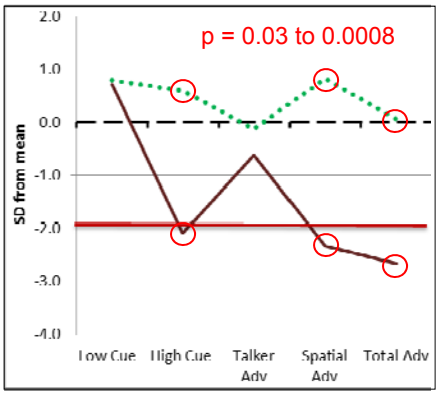
LiSN-S Results – Pre vs. Post Training

Earobics (n = 5)



Lisn & Learn (n = 5)



Cameron, Glyde & Dillon (2012)

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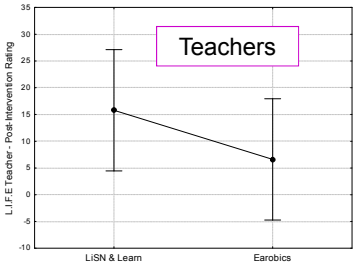
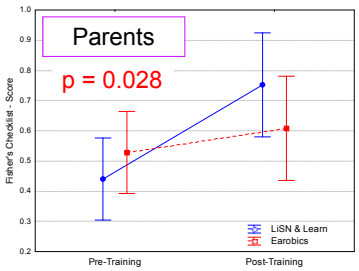
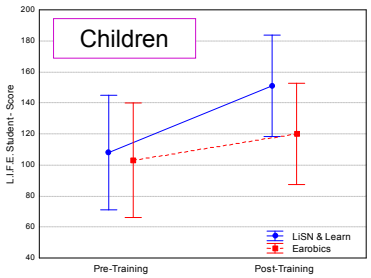
Questionnaires – Post Training Improvements



L&L = 16 pts;
Earobics = 7 pts;
where 0 pts = "no improvement"



L&L = 31%; Earobics = 9%



L&L = 22%; Earobics = 9%

40

Catalyst

The Australian Broadcasting Commission

Disclosure

The National Acoustic Laboratories, is an Australian government laboratory

- **NAL licences the LiSN-S test to Phonak, and is paid a royalty on sales.**
- **NAL directly sells the LiSN & Learn training package through its web site.**

CAPD test scores, listening in real life, academic performance and cognition

Subjects

Dani Tomlin

- Clinical Group: (n=105)
  - Children referred for clinical AP assessment
  - Aged 7.0 to 12.9 years (Mean Age 8.9 yrs, ± 1.5)
- Control group: (n=50)
  - No reported auditory, listening or academic difficulties
  - Aged 7.0 to 12.2 years (Mean age 9.1 yrs. ± 1.4)
- Peripheral hearing assessments all normal

Measures obtained

AP

Frequency Pattern Test (*%*)

Dichotic Digits Test (*%)*

Gaps In Noise (*msec)*

Listening in Spatialised Noise Sentences test (LiSN-S) (*dB)*

Masking Level Differences (*dB)*

Cognition

Non verbal IQ

Auditory Working Memory

Sustained Attention

(*Quotient Scores)*

Academic Results

Reading Fluency –WARP

NAPLAN

(*Numerical scores)*

Listening Ability

Questionnaires:

LIFE (child)

Fisher (Parent)

TEAP (Teacher)

(*Total item scores)*

Results need to allow for development & comparison of measures → z scores

Source: Dani Tomlin

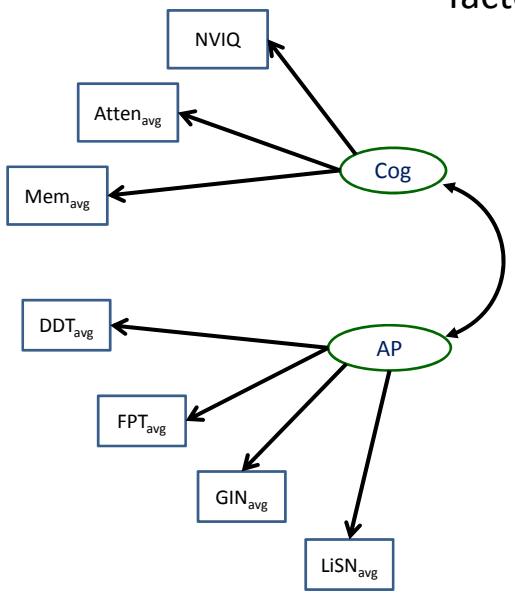
CAPD scores versus cognitive scores

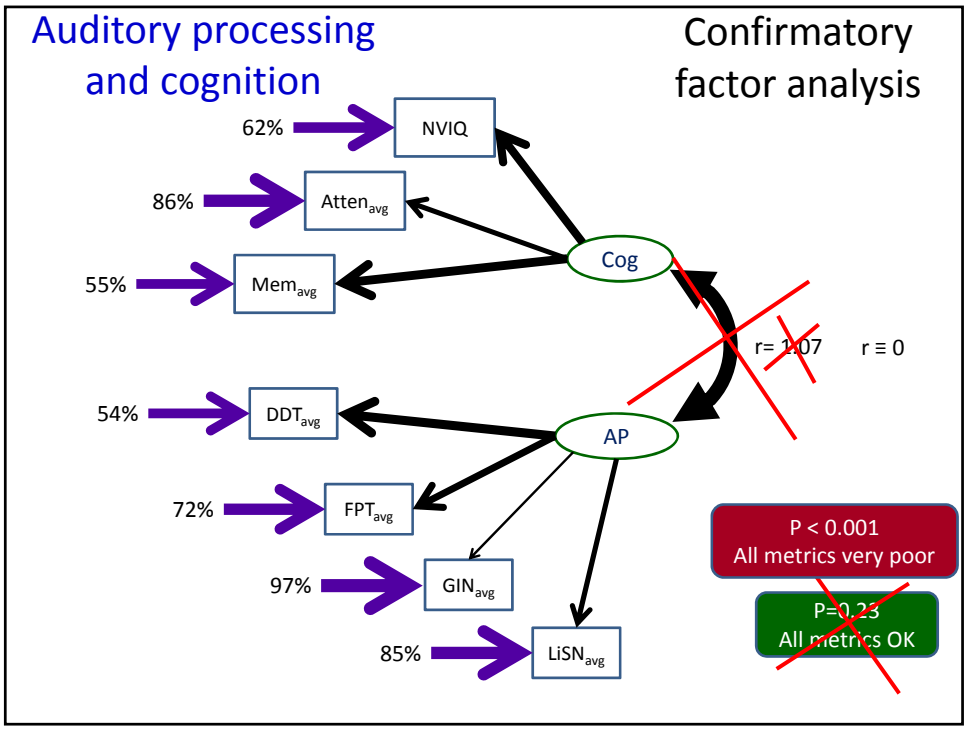
	Digit Span Forward	Digit Span Reverse	Non-verbal IQ	Sus Aud Atten
DDT_L	0.43	0.39	0.38	0.19
RDT_R	0.36	0.34	0.28	0.22
FPT	0.25	0.36	0.43	0.16
GIN	0.09	0.04	0.13	0.12
MLD	0.15	-0.05	0.07	0.04
LiSN_LC	0.27	0.18	0.28	0.00
LiSN_HC	0.12	0.11	0.22	0.14
LiSN_Spat Adv	0.00	0.03	0.08	0.04

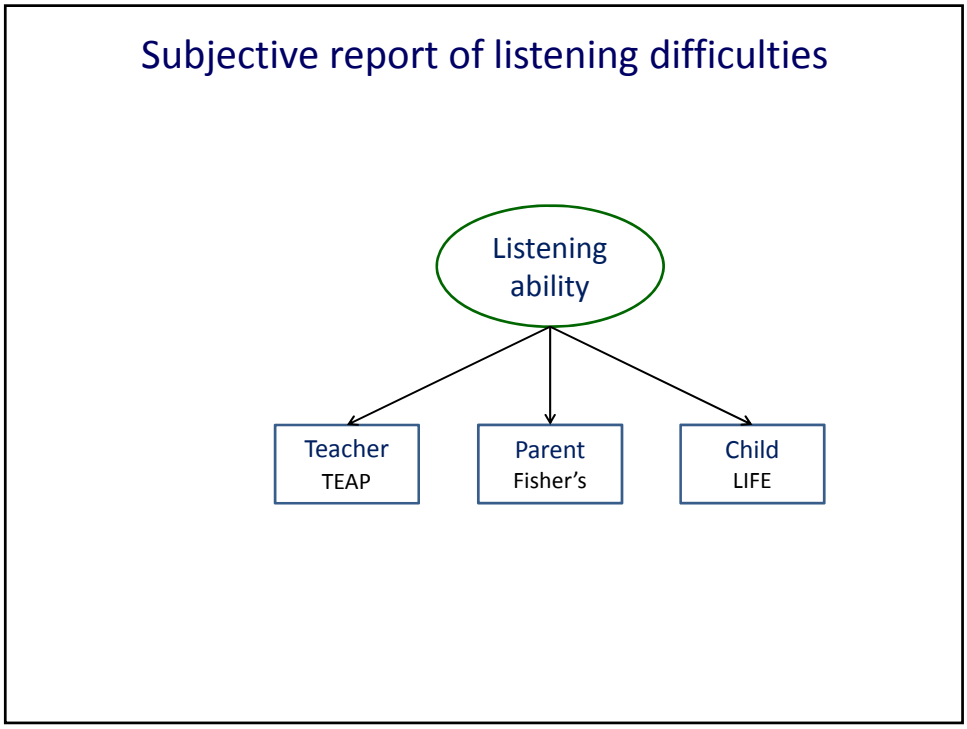
Structural equation modelling

Caution: heterogeneous!

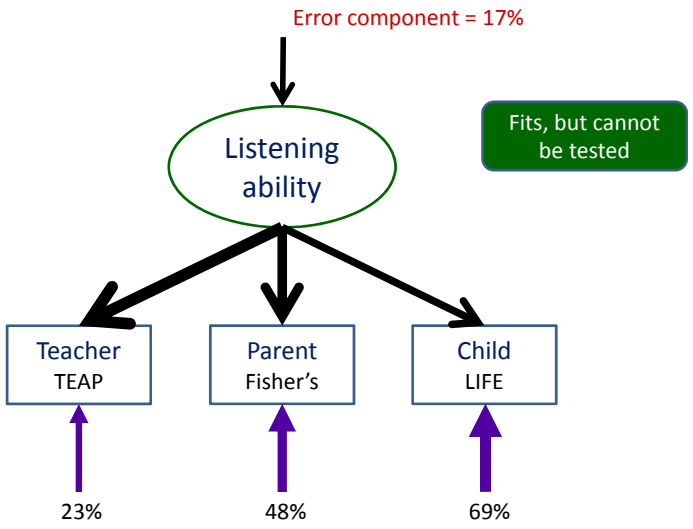
Confirmatory factor analysis



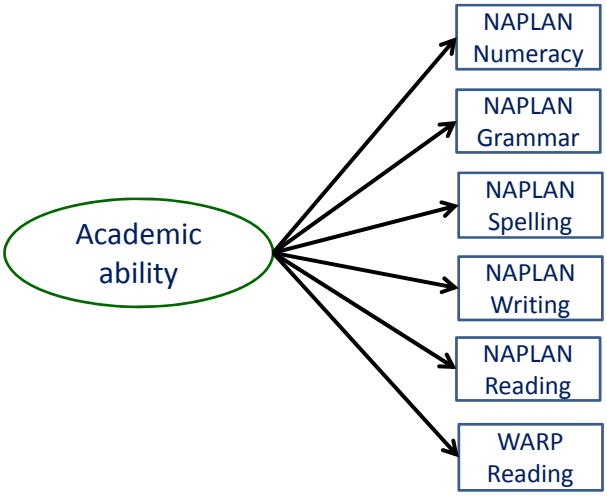

Auditory processing and cognition
Confirmatory factor analysis
62%
NVIQ
86%
Atten avg
55%
Mem avg
Cog
r= 1.07
r ≡ 0
54%
DDT avg
AP
72%
FPT avg
97%
GIN avg
85%
LiSN avg
P < 0.001
All metrics very poor
P=0.23
All metrics OK

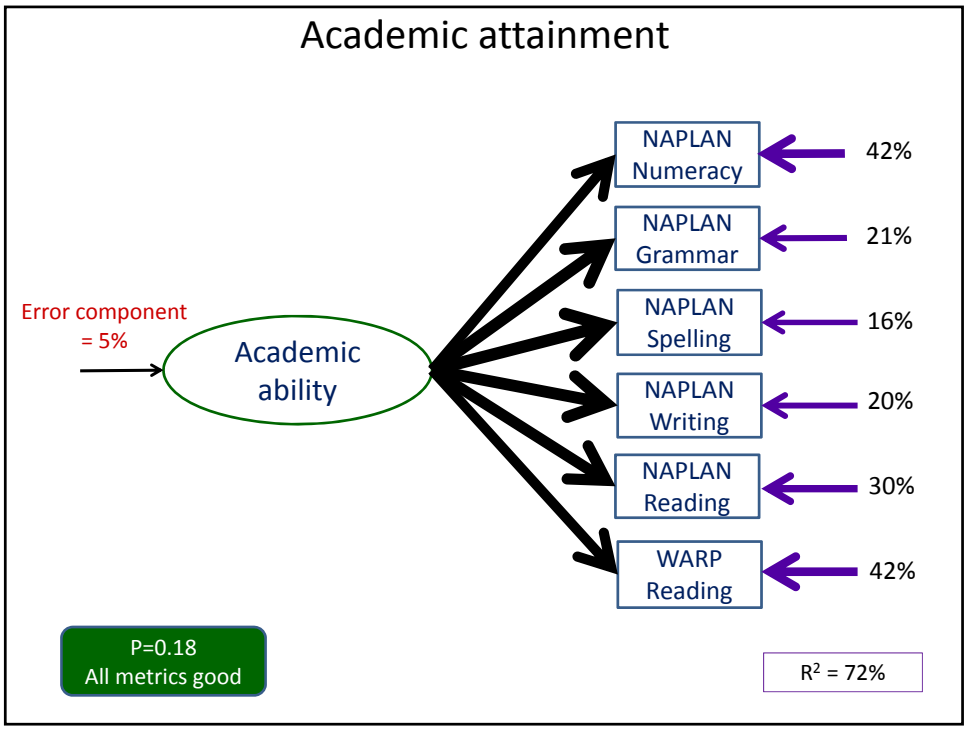

Subjective report of listening difficulties
Listening ability
Teacher
TEAP
Parent
Fisher's
Child
LIFE

Subjective report of listening difficulties



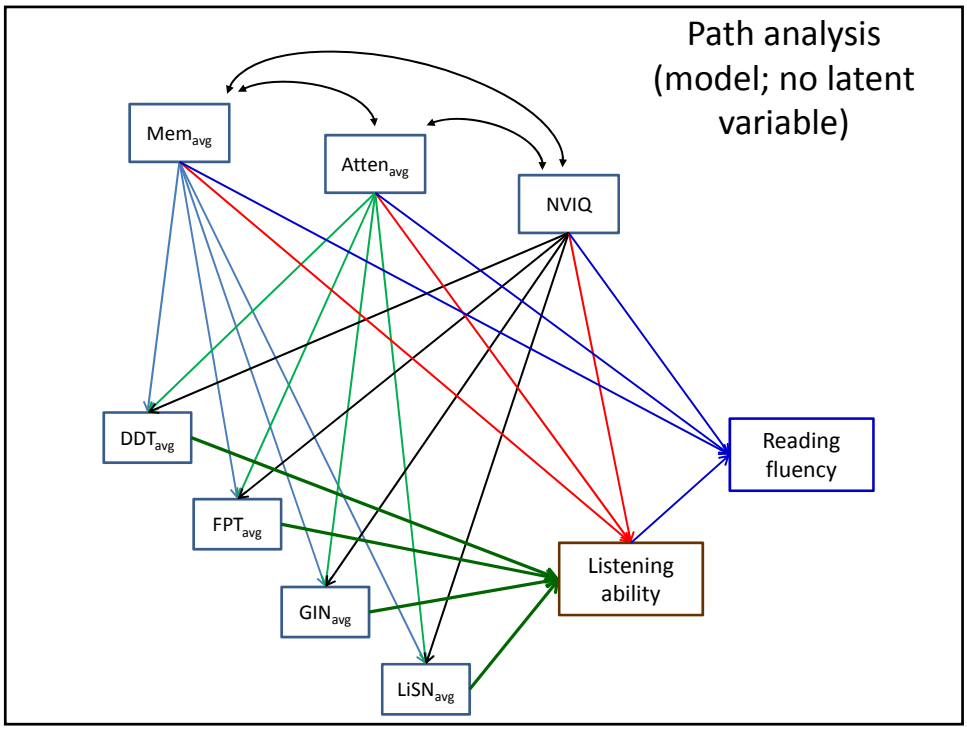
Academic attainment

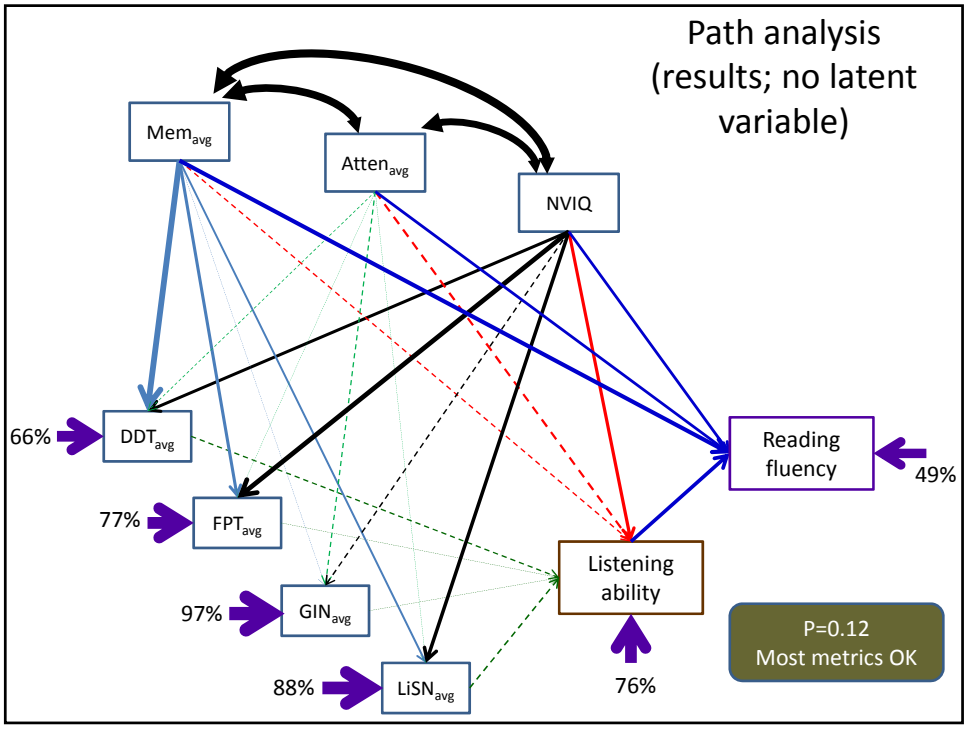


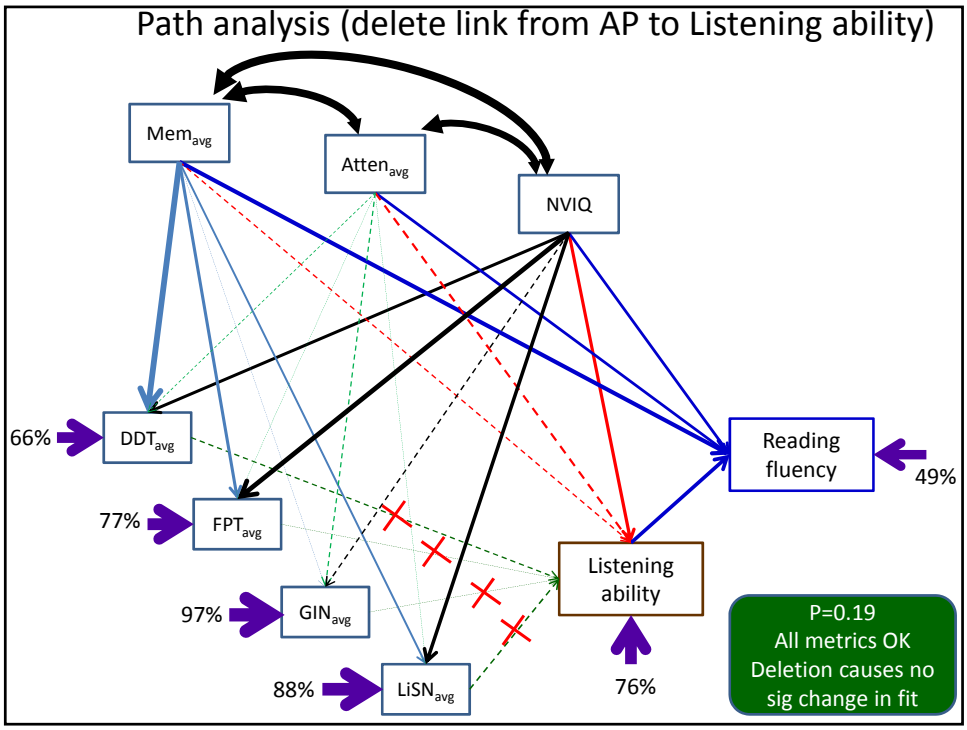


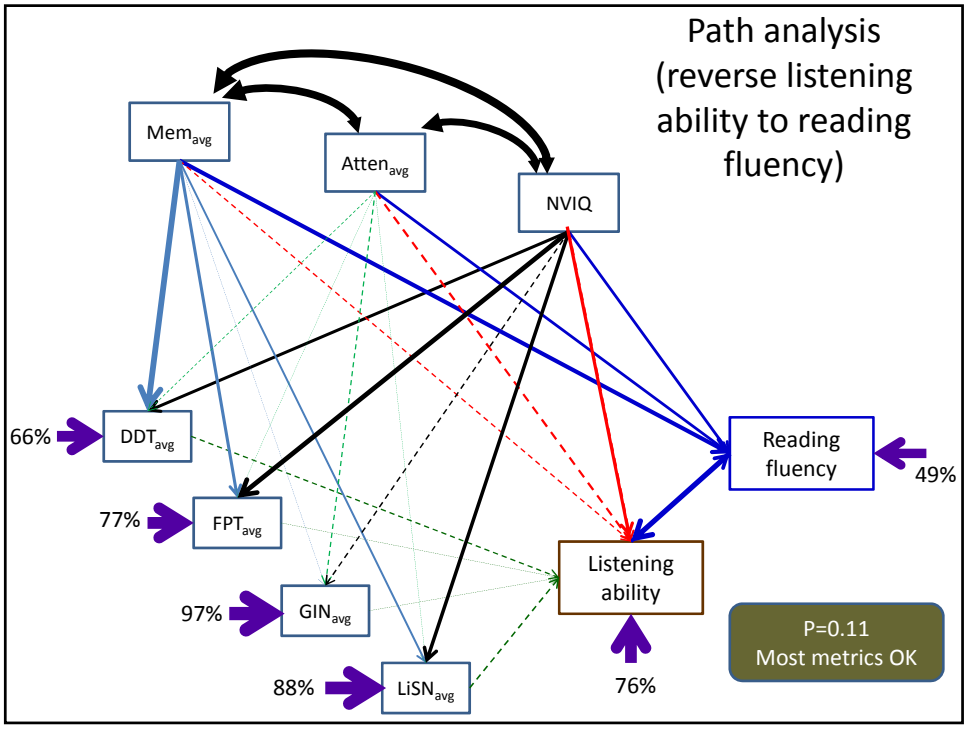
Relationships between variables in different domains

Path analysis


Path analysis
(model; no latent variable)
Mem$_{avg}$
Atten$_{avg}$
NVIQ
DDT$_{avg}$
FPT$_{avg}$
GIN$_{avg}$
LiSN$_{avg}$
Reading fluency
Listening ability

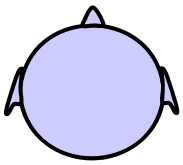

Path analysis
(results; no latent variable)
Mem$_{avg}$
Atten$_{avg}$
NVIQ
66%
DDT$_{avg}$
77%
FPT$_{avg}$
97%
GIN$_{avg}$
88%
LiSN$_{avg}$
Reading fluency
49%
Listening ability
76%
P=0.12
Most metrics OK


Path analysis (delete link from AP to Listening ability)
Mem$_{avg}$
Atten$_{avg}$
NVIQ
66%
DDT$_{avg}$
77%
FPT$_{avg}$
97%
GIN$_{avg}$
88%
LiSN$_{avg}$
Reading fluency
49%
Listening ability
76%
P=0.19
All metrics OK
Deletion causes no sig change in fit


Path analysis (reverse listening ability to reading fluency)
Mem$_{avg}$
Atten$_{avg}$
NVIQ
66%
DDT$_{avg}$
77%
FPT$_{avg}$
97%
GIN$_{avg}$
88%
LiSN$_{avg}$
Reading fluency
49%
Listening ability
76%
P=0.11
Most metrics OK

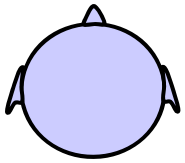
Dichotic Digits and Cognition

Dichotic Digits Test



Dichotic presentation
Dichotic ability
Auditory working memory
Attention
IQ

Dichotic Digits Difference Test



Diotic condition
Auditory working memory
Attention
IQ

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Correlations – DDDT and cognition

	Dichotic	Diotic
Attention - Prudence	0.37	0.32
Attention - Vigilance	0.34	0.24
Number memory forward	0.35	0.41
Number memory reverse	0.34	0.47
Non-verbal IQ	0.26	0.26

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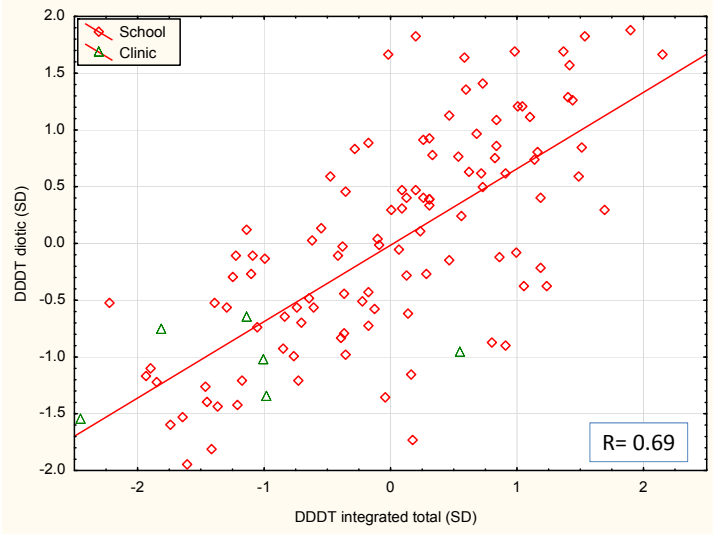
Dichotic vs diotic perception



Dichotic presentation

Dichotic ability
Auditory working memory
Attention
IQ

Diotic condition

Auditory working memory
Attention
IQ

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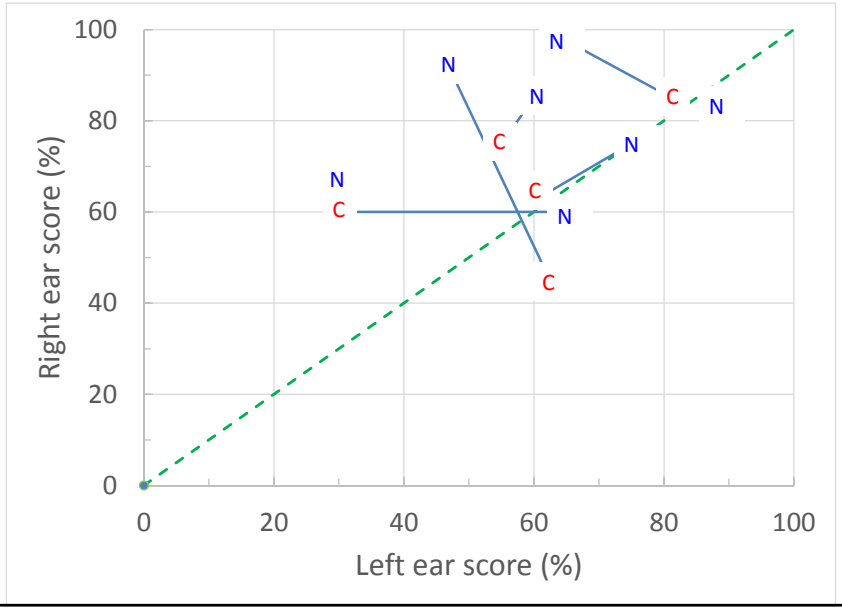
Dichotic scores for clinical cases



What is APD?

"When *I* use a word,' Humpty Dumpty … tone, 'it means just what I choose it to … nor less."

"The question … you ***can*** make words mean so many diff…

Little point deliberating "What is APD and what is in and what is out?" It is whatever we define it to be.

ASHA (2005)
"(C)APD is a deficit in neural processing of auditory stimuli that is not due to higher order language, cognitive, or related factors."

Moore, Ferguson et al (2010)
"What is currently called APD, for individuals without known neurologic lesions, should be redefined as primarily a cognitive disorder, rather than a sensory disorder."

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APD can be thought of as:

1. A concept
2. A set of symptoms

   … but other things can cause the same symptoms
3. Failure by some criterion amount on tests in a battery

   … but other things can cause failure

   … and failure has unknown real-life consequences

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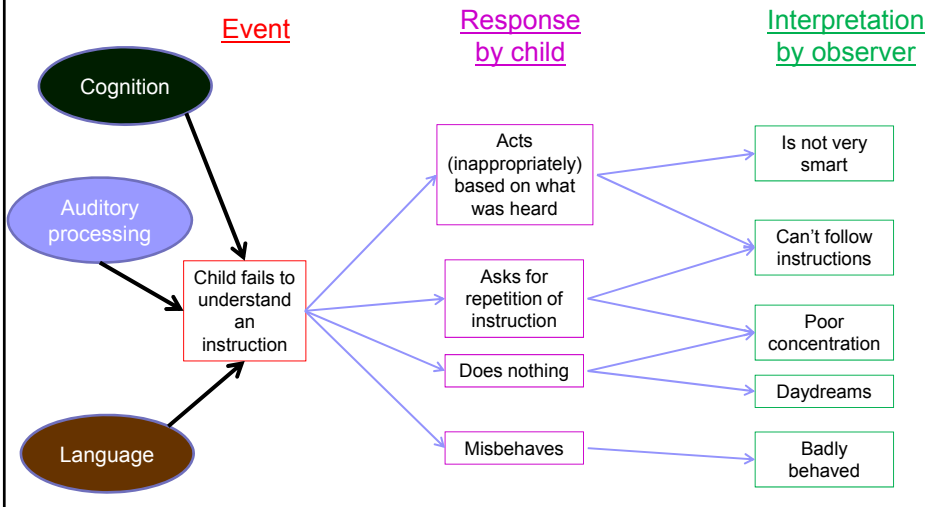
Questionnaires to diagnose CAPD

Questionnaires (or other ways to gather symptoms) might be able to confirm there is a problem, but can't tell us the cause.



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Reasons for APD referral

1. Children are typically referred for APD assessment because of:
   - Perceived difficulties in understanding speech, and/or
   - Poorer than expected academic progress

2. Difficulty understanding speech and poor academic progress can be caused by any of:
   - Auditory processing disorder
   - Specific language impairment
   - Cognitive deficit

……. acting individually or in combination

Therefore, not all children with genuine listening difficulties being assessed for APD will have APD

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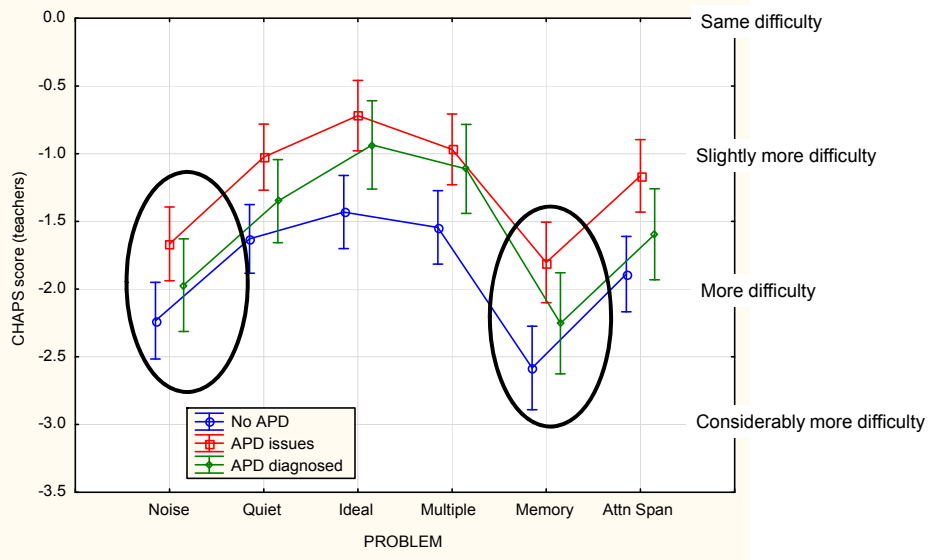
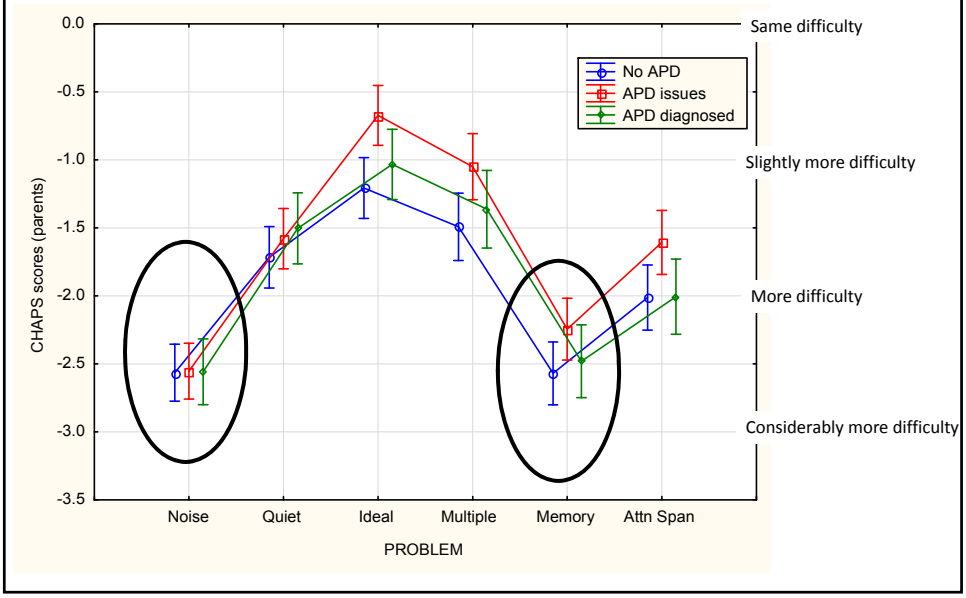
Teachers' CHAPS scores – children referred to Great Ormond Street Hospital for APD assessment



Parents' CHAPS scores – children referred to Great Ormond Street Hospital for APD assessment



Reason for assessing APD

Not primarily diagnosis, but doing something about it!

1. **Management:** changing the input to the child
2. **Treatment:** overcoming the deficit itself - training
3. **Compensation:** giving the child skills to compensate for a deficit that can't be fixed

But also diagnosis:

- Impact on person, significant others, school
- Obtaining funding for support

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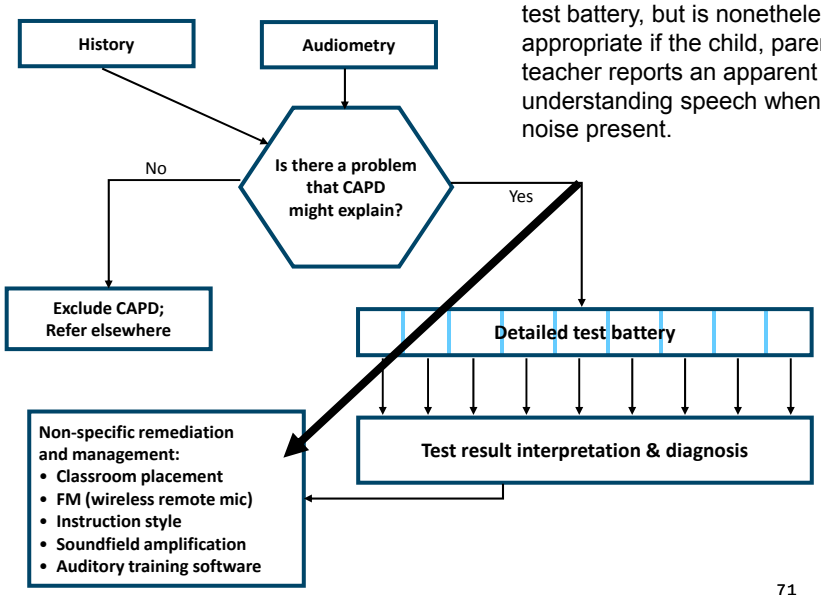
Management of APD



Management of APD (FM systems, classroom placement) is not at all informed by performance on a CAPD test battery, but is nonetheless appropriate if the child, parent or teacher reports an apparent deficit in understanding speech when there is noise present.

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Treatment of APD

Treatment (i.e. training to reverse the deficit) *should* be specified on the basis of a detailed diagnosis of the deficit, but there are very, very few examples of an evidence-based treatment that follows from the detailed diagnosis, that improves performance on the test, and that generalizes to real-life benefit.

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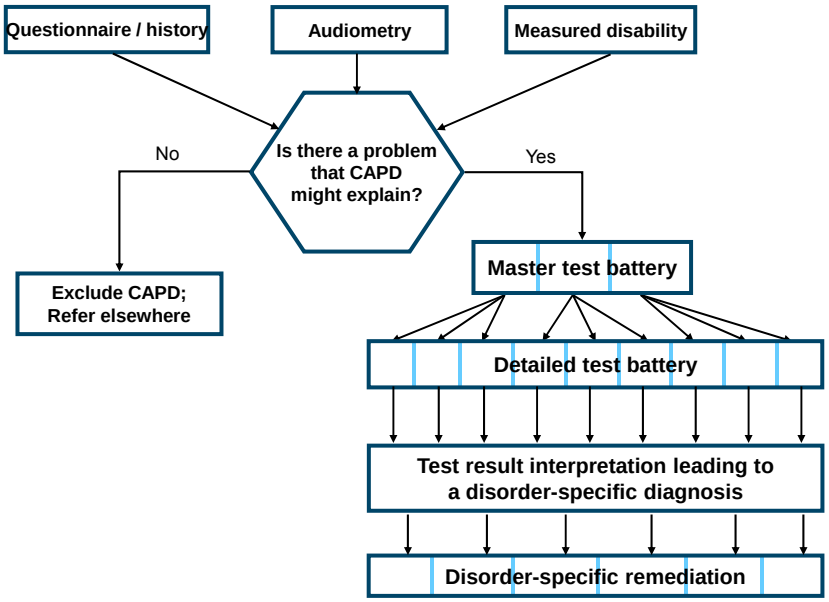
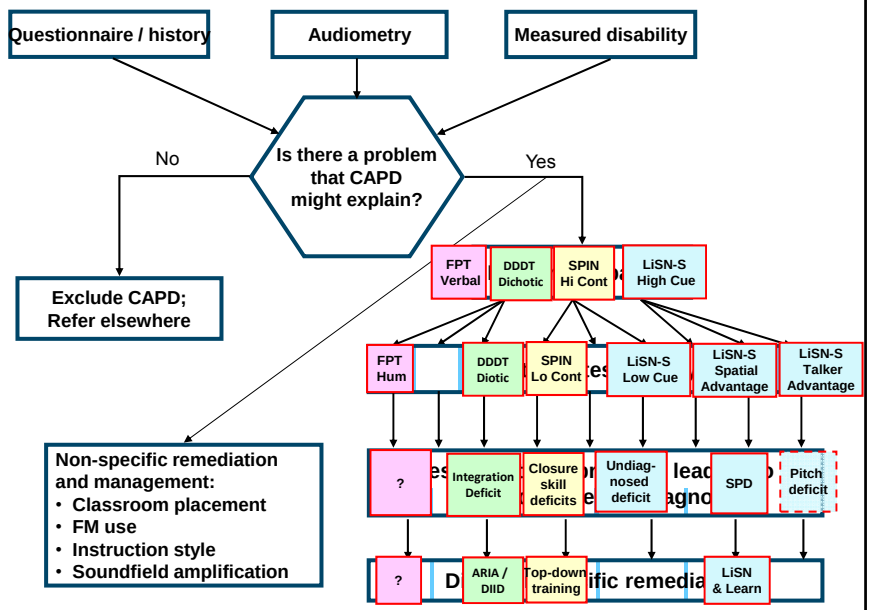
Dealing with problems in understanding speech



Dealing with problems in understanding speech



Causation

1. The direction(s) of causation in the relationships, and the time scale of causation, between auditory processing abilities, language abilities, cognitive abilities, reading ability, and parent/teacher report of functional listening ability are largely unknown.

2. Interventions for putative underlying causes are the only way to determine them.

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And finally

It is not productive to ***define*** APD as either ***not*** involving cognition, or as ***only*** involving cognition.

Rather, focus on finding out
- ***Whether*** individual children have difficulty listening,
- ***Why*** they have difficulty when listening, and
- ***What*** can be done to change that.

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Spatial Processing Disorder:

Prevalence in a clinical population

Australian Hearing's CAPD Service

- Operating in 42 Australian Hearing centers around Australia since May 2012.
- Diagnosis, assessment and management of specific aspects of CAPD.
- Recruitment targets children experiencing difficulty hearing in background noise.
- Tests are chosen which:
  1. Have been shown to be associated with difficulties in real life.
  2. Are reliable, repeatable and relatively quick to administer.
  3. Lead to remediation that is backed by research evidence.

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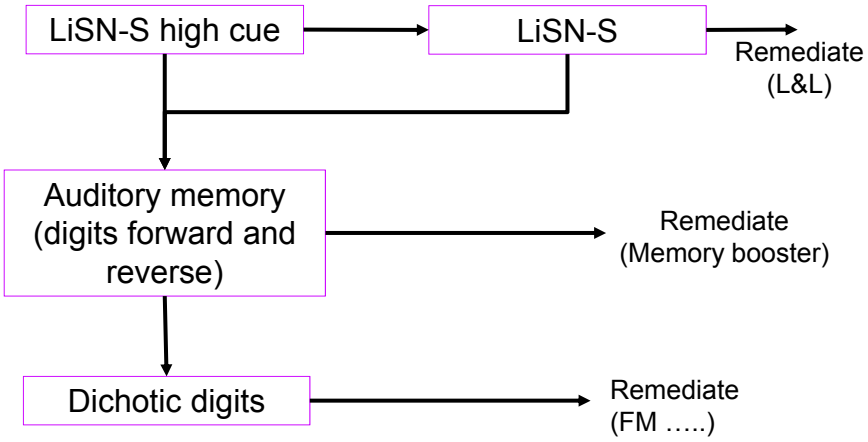
National Acoustic Laboratories, Sydney, Australia

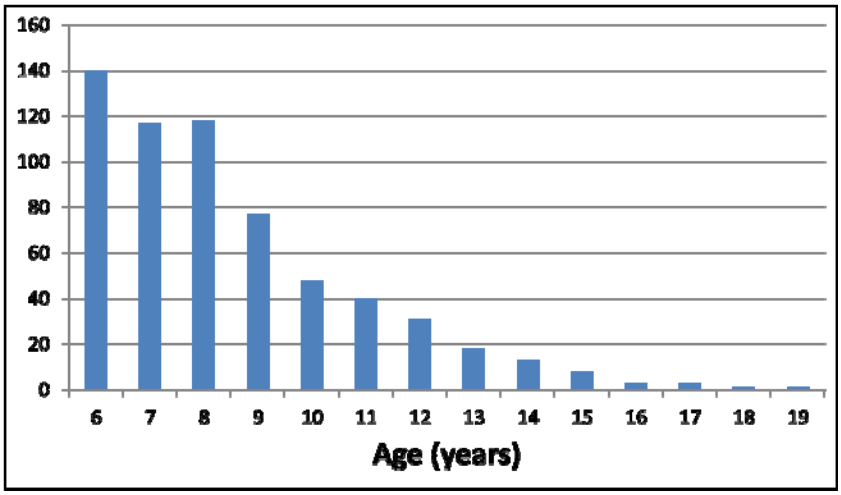
Test structure



National Acoustic Laboratories, Sydney, Australia

Age Distribution

N=618



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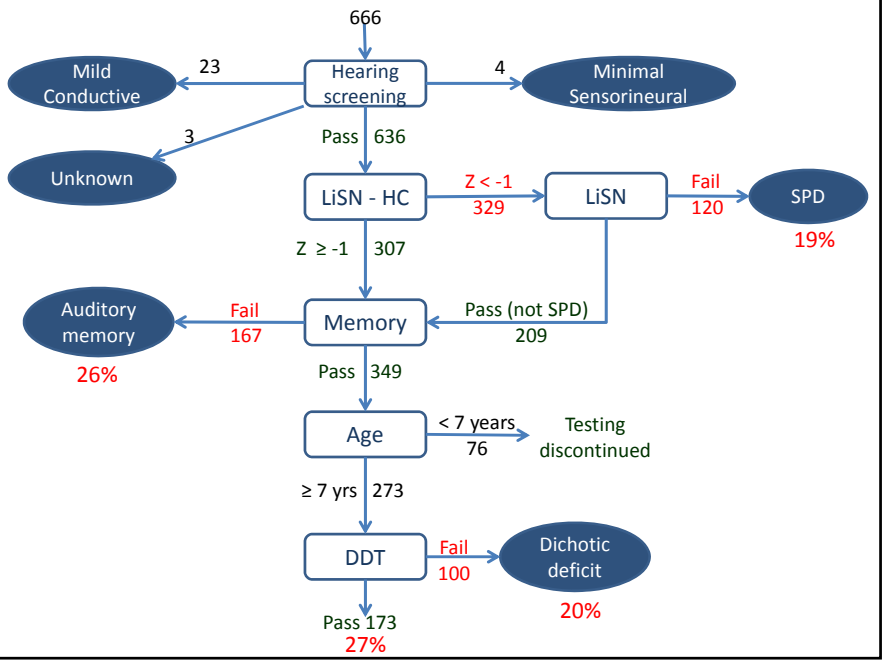
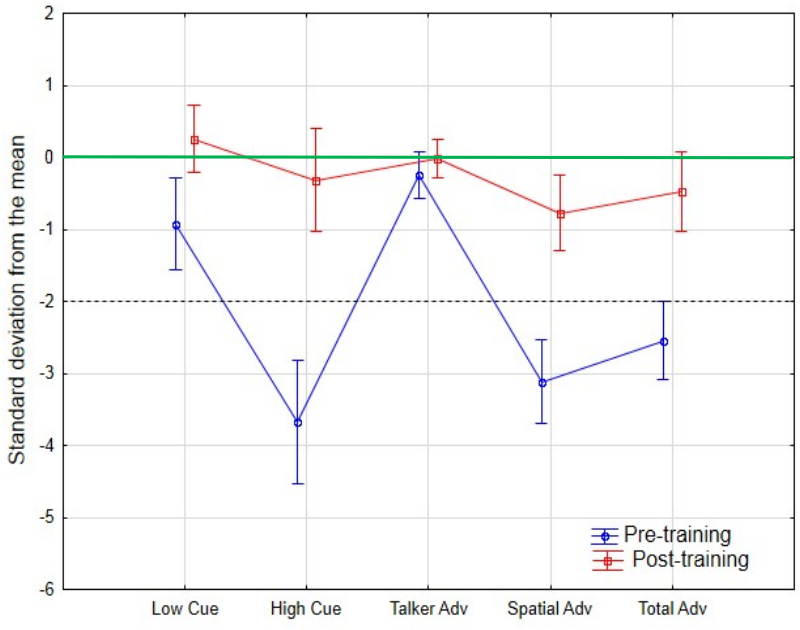
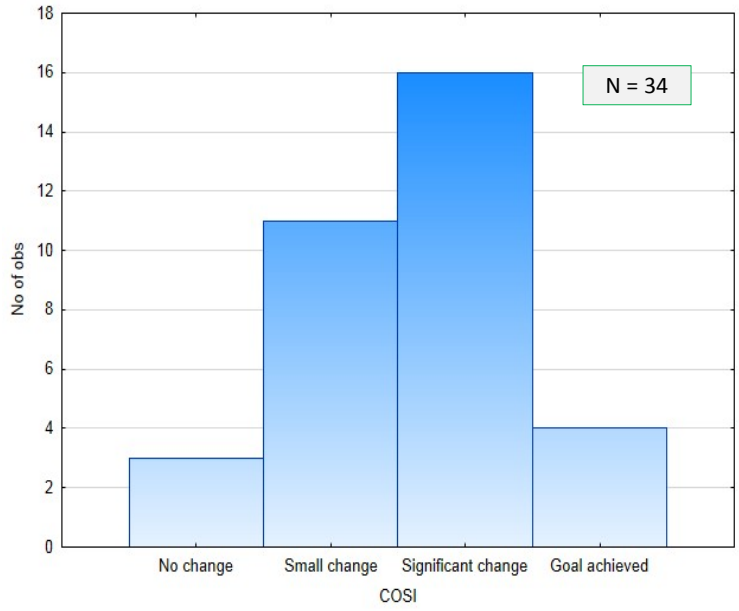
Passes and Fails



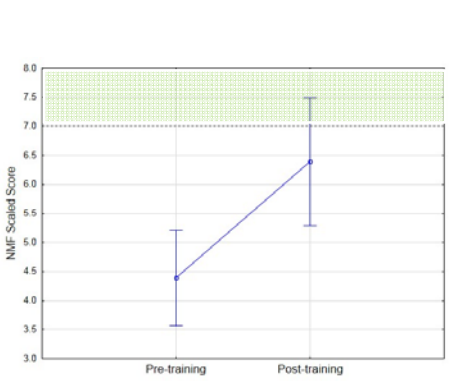
National CAPD service results: LiSN & Learn effects

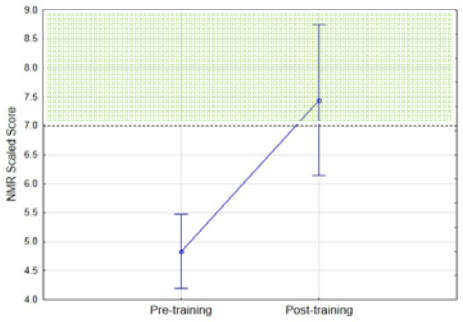


LiSN & Learn training: COSI results



Effect of Memory Booster training





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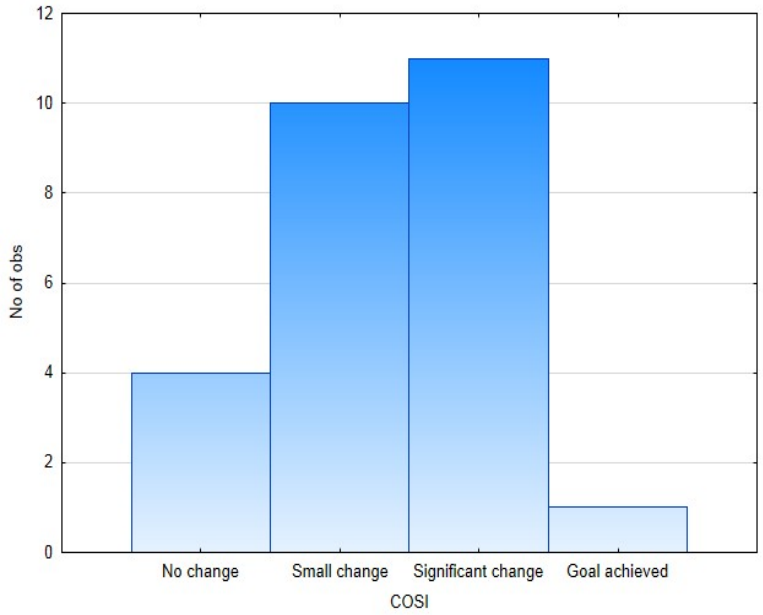
COSI scores for Memory Booster training



In summary

- Spatial Processing Disorder (SPD) is a well-defined type of APD
- SPD is commonly caused by COM, but can be fully remediated
- Performance on many other AP tests affected by cognitive abilities.
- Link between AP test scores and real-life hearing difficulties is uncertain
- Hearing difficulties can be ***managed***, irrespective of diagnosis of APD
- ***Treatment*** of APD likely to benefit from *very* specific diagnoses
- Need for auditory processing tests less affected by cognitive abilities.

→ Difference tests

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Thanks for listening

The support of the Commonwealth Department of Health is greatly appreciated

CAPD.NAL.gov.au - *TV news story*
- science TV show