Comparing Two Different Clinical Tools (Gap-In-Noise & Random Gap Detection Tests) in Assessing Children's Auditory Temporal Processing Skills

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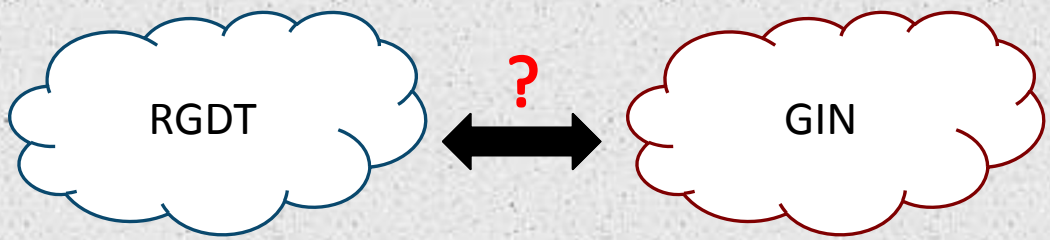
Background

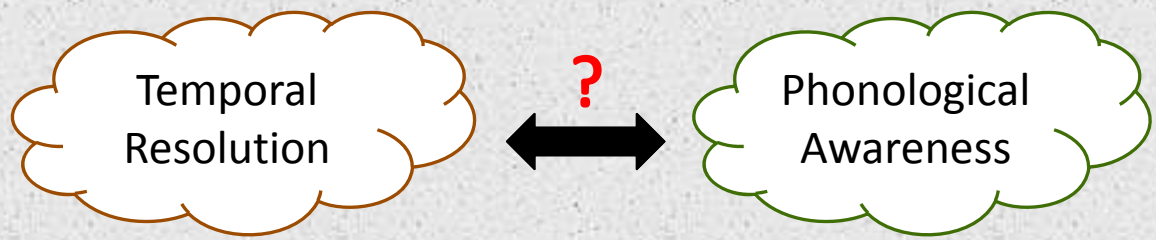
- RGDT (Keith, 2000) and GIN (Musiek et al., 2005) are the only clinically available temporal resolution (TR) assessment tools.
  - Current data mostly on typically developing children.
  - Conflicting results were reported (Zaidan et al, 2008; Amaral et al., 2013; Chermak and Lee (2005).
- TR is deemed important for developing good phonological awareness (PA) skill (Tallal, 1980), but its controversy remains
- No studies available on RGDT/GIN is better in predicting children's PA skill.

Study Objective 1



- To examine the relationship between RGDT and GIN tests, in terms of its correlation in the TR thresholds (TR_{th}) obtained in children aged 7 to 12 years old.
  - Significant correlation in the TR_{th} obtained from both RGDT and GIN tests

Study Objective 2



- To investigate if the TR_{th} obtained in RGDT and GIN respectively are predictive of the Phonological Awareness Battery (PhAB) standardized scores in children aged 7 to 12 years old.
  - TR_{th} obtained from each of the tests can significantly predict the PhAB standardized scores.

Methodology

Ethics Approval from DSRB

- Approval Number: 2014/00462

Recruitment

- from NUH clinic and personal contacts

Screening Protocols

- Basic Audiological Assessment & Test of Everyday Attention for Children

Assessment Protocols

- RGDT, GIN and PhAB

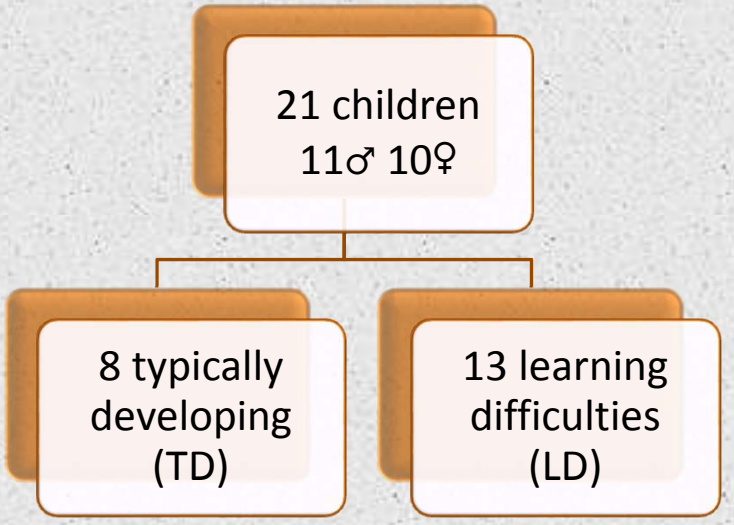
Exclusion Criteria

- hearing loss
- global developmental delay
- history of brain injury
- bacteria infection affecting neural development
- developmental disorders
- cognitive deficits

Inclusion Criteria

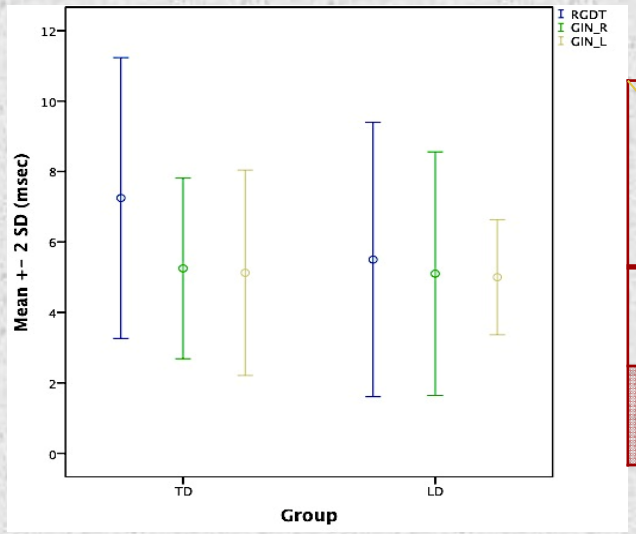
- PTA: thresholds ≤20dBHL from 250-8kHz
- Type A tympanogram bilat
- At least age-scaled score 7, in at least 3 out of 5 TEA-Ch subtests

Study Sample



- 21 children (7 to 12 y/o)
  - Mean age: 9.4 years
  - SD: 1.5 years
- Learning difficulties group:
  - APD
  - Dyslexia
  - Language Impairment

Descriptive Analysis

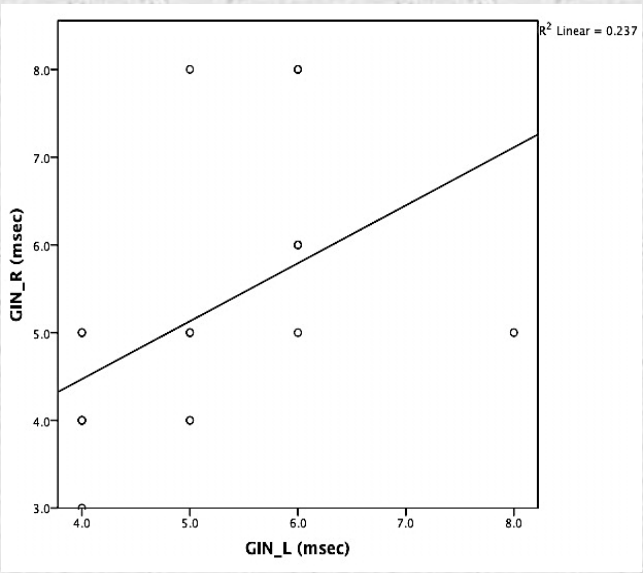


Group \ Tests	RGDT (msec)		GIN_R (msec)		GIN_L (msec)	
	μ	σ	μ	σ	μ	σ
TD (n = 8)	7.25	1.99	5.25	1.28	5.23	1.46
LD (n = 10)	5.50	1.95	5.10	1.73	4.89	0.82

Mean and Standard deviations for RGDT, GIN Right ear (GIN_R) and Left ear (GIN_L) TR_{th} for both groups of children

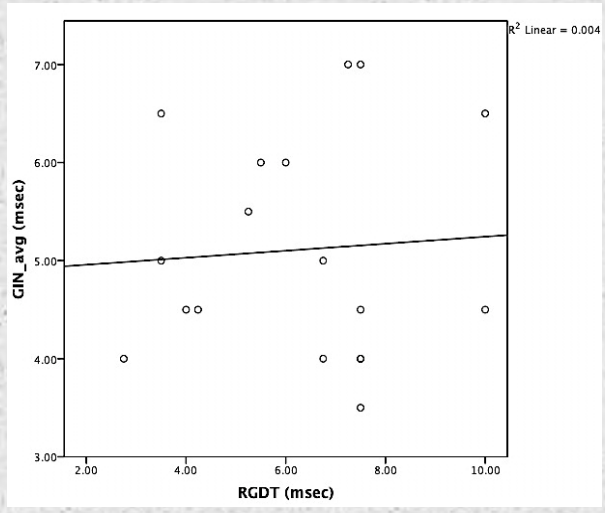
Statistical Analysis

- Wilcoxon Signed test
  - No significant difference between GIN_R & GIN_L thresholds ($p > 0.05$)
- Spearman's correlation
  - Significant correlation between GIN_R & GIN_L thresholds ($r = 0.666$, $p < 0.01$)
- Average of GIN_R and GIN_L (GIN_avg) was calculated for subsequent analyses

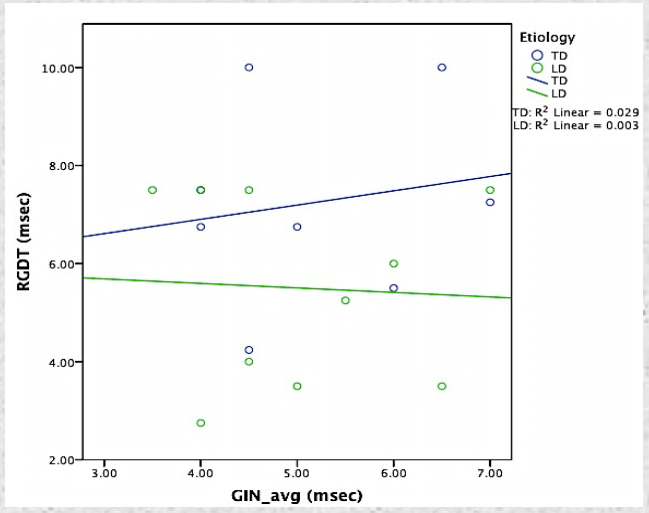


Scatterplot of GIN_R and GIN_L TR_{th}

Statistical Analysis



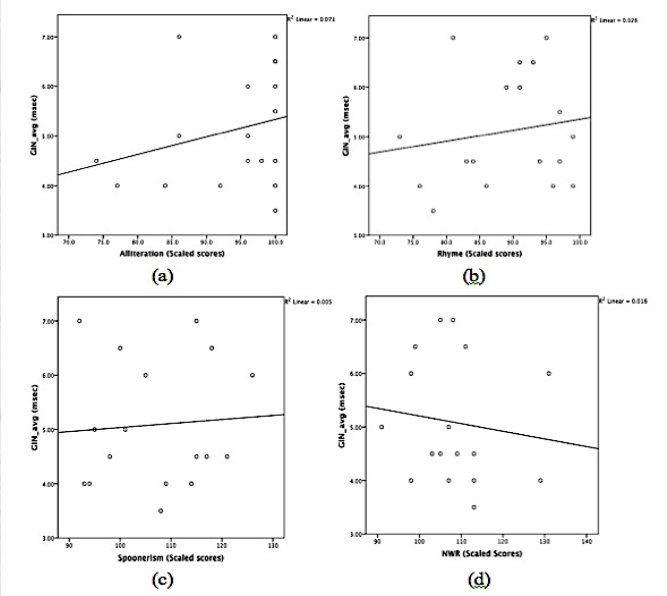
(a)



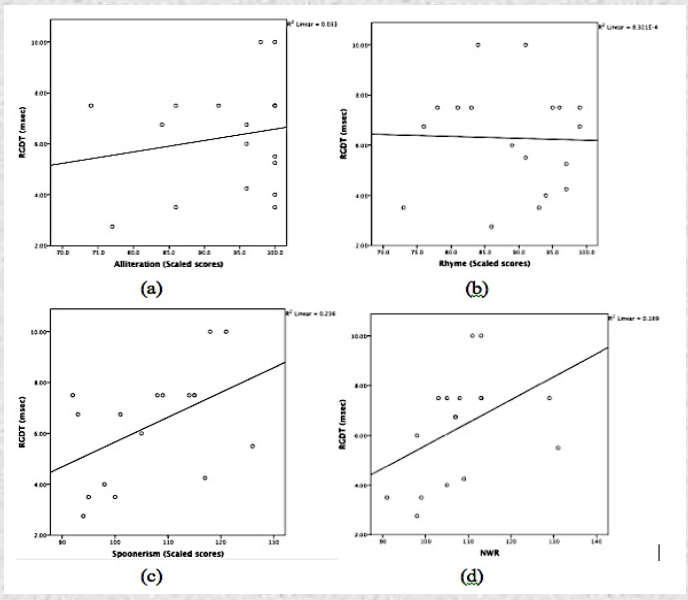
(b)

Pearson's correlation suggests no significant correlation between RGDT and GIN_avg TR_{th} ($r = 0.078$; $p = 0.759$)

Statistical Analysis



GIN_avg & PhAB



RGDT & PhAB

Multiple Regression analyses suggested both RGDT and GIN_avg does not significantly predict the scores of PhAB

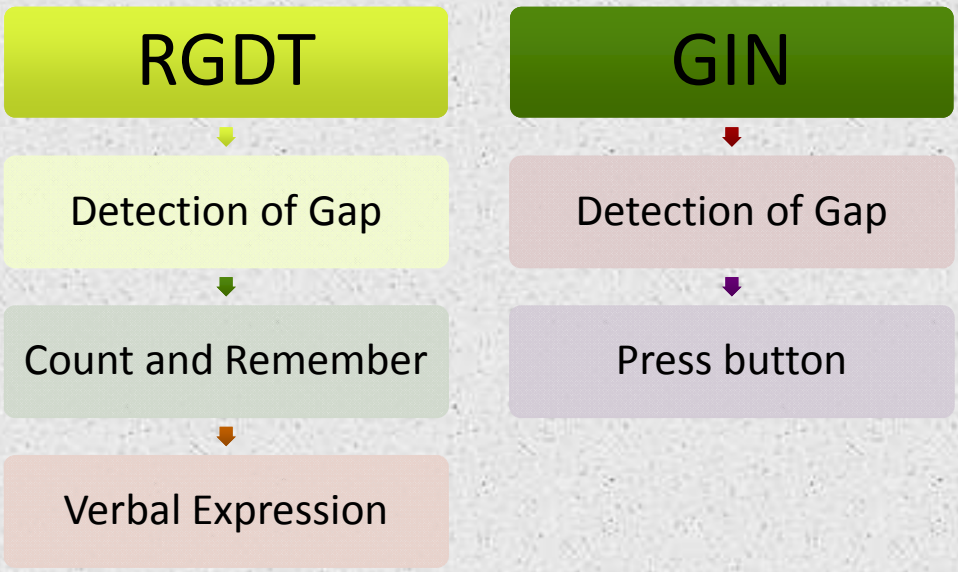
Discussions – Objective 1

- Non-correlated relationship between RGDT and GIN
  - Test Stimuli

RGDT	GIN
• Pure Tones of Identical Freq • Within-channel • Same set of peripheral acoustic neurons activated (Zhang, Salvi, & Saunders, 1990) • Intensity coding rather than temporal processing	• Broadband • Between-Channel • Activates more freq channels. • More central mechanism required to integrate information from multiple channels (Phillips & Hall, 2000)

Discussions – Objective 1

- Non-correlated relationship between RGDT and GIN
  - Patient Response Mode



Discussions – Objective 2

- TR threshold does not predict PA skill
  - Acquisition of a good PA skill is not restricted to the ability to synthesize rapid acoustic signals.
  - Perception of phonetic features is not solely dependent on TR skill (Ziegler, Pech-Georgel, George, Alario, and Lorenzi, 2005)
  - Similar findings from previous studies. Nittrouer (1999), Rosen and Manganari (2001) and Mody, Studdert-Kennedy, and Brady (1997).

Discussions – Objective 2

- Non-speech auditory tests may not be appropriate in predicting linguistic ability.
  - Activate different areas of the auditory cortex (Zatorre, Belin, & Penhune, 2002).
  - Different processing pathway in CANS (Binder et al., 2000; Uwer et al., 2002)
  - Auditory processing skills are not a strong predictor of language and reading competency (Loo et al., 2010).

Clinical Implications

TR assessment

RGDT quicker and easier to administer.

*CAUTION in scoring!

Inconsistent RGDT → re-test with GIN.

Predicting PA

GIN broadband stimuli closer to human's speech

Between-channel gap detection: better VOT perception model

Limitations

- Children categorized into TD group based on parental report & feedback
- Auditory memory and cognitive skills not evaluated.
- Small sample size

Conclusion

- Different mechanism mediating RGDT and GIN
- TR is may not be the sole contributor of poor PA skill

Future Directions

- True ear effects of TR skill
  - Administering RGDT monaurally
  - Administering GIN binaurally

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THANK YOU

RGDT Test

Keith (2000)

Instructions:

- verbally indicate '1' for one beep tone, and '2' for two beep tones heard.

Presentation:

- Pure tones, 50dBHL
- Binaural, insert earphones
- Practice List
- Test List: 500Hz, 1kHz, 2kHz, 4kHz

Scoring

- Lowest gap: smallest IPIs perceived as two distinct stimuli, indicated as '2'
- Threshold: average of the sum of the smallest IPIs perceived at each octave frequency
- Cut off: 20msec

GIN Test

Musiek et al. (2005)

Instruction:

- press response button as soon as a gap is perceived in the noise segment

Presentation:

- Broadband noise, 50dBHL
- Monaurally, insert earphones
- Practice List
- Actual test list (60 gaps per list, one list per ear)

Scoring

- Approximate Threshold: *shortest gap with at least 4/6 correct identifications (cut off: 7msec)*
- % correct of total num. of gaps (cut off: 54%)

- **Duration of IPIs**
- RGDT - 2, 5, 10, 15, 20, 25, 30, 40 msec
- GIN - 2, 3 4, 5, 6, 8, 10, 12, 15, 20 msec

- Why remove 3 from analysis?
  - Inconsistent responses.. Not sure if it is really due to poor TR, inattentiveness or higher order disability.
  - If they really have poor TR, they should have high TR thresholds.
  - They were able to perform in GIN.
- Why only 4 subtests in PhAB?
  - Other subtests assess phonological production speed and phonological fluency.