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

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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 $\text{TR}_{\text{th}}$ obtained in RGDT and GIN respectively are predictive of the Phonological Awareness Battery (PhAB) standardized scores in children aged 7 to 12 years old.
- $\text{TR}_{\text{th}}$ 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

21 children
- 11♂ 10♀

8 typically developing (TD)
13 learning difficulties (LD)
Descriptive Analysis

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

$R^2$ Linear = 0.217
Statistical Analysis

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

<table>
<thead>
<tr>
<th>RGDT</th>
<th>GIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Tones of Identical Freq</td>
<td>Broadband</td>
</tr>
<tr>
<td>Within-channel</td>
<td>Between-Channel</td>
</tr>
<tr>
<td>Same set of peripheral acoustic neurons activated (Zhang, Salvi, &amp; Saunders, 1990)</td>
<td>Activates more freq channels.</td>
</tr>
<tr>
<td>Intensity coding rather than temporal processing</td>
<td>More central mechanism required to integrate information from multiple channels (Phillips &amp; Hall, 2000)</td>
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</tbody>
</table>
Discussions – Objective 1

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

RGDT
- Detection of Gap
- Count and Remember
- Verbal Expression

GIN
- Detection of Gap
- Press button
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)
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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- My wonderful classmates.
References

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.