Introducing the NAL Dynamic Conversations Test: Development and Validation

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# Why we need the NAL-DCT

<table>
<thead>
<tr>
<th>WHO ICF category *</th>
<th>Level of communication **</th>
<th>Mental processes</th>
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<td>Activity</td>
<td><strong>Listening</strong> (i.e. hearing with intention and attention)</td>
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Development of the NAL-DCT

Recordings
IELTS
72 passages (24 each of 1-talker, 2-talker and 3-talker)
Spoken by 3 male & 3 female voice actors
Recorded in anechoic chamber
Edited to remove errors

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mins)</td>
<td>2.37</td>
<td>5.90</td>
<td>Greatest for 1-talker</td>
</tr>
<tr>
<td>Speech Speed (wpm)</td>
<td>130</td>
<td>218</td>
<td>Greatest for 3-talker</td>
</tr>
<tr>
<td>Flesch-Kincaid Grade Level</td>
<td>1.4</td>
<td>12.5</td>
<td>Greatest for 1-talker</td>
</tr>
</tbody>
</table>
You will hear a conversation between three students about a tutorial presentation.

Circle the correct answer:

1) At first Fiona thinks the boys' tutorial topic is
   A inappropriate
   B dull
   C interesting
   D fascinating

2) According to the boys, the banana
   A has only been domesticated recently
   B is economical to grow
   C is very nutritious
   D is his favourite food

3) According to the boys bananas were introduced into Australia from
   A India
   B England
   C China
   D Africa

Complete the notes below (with no more than 3 words for each answer).

Each banana tree produces 4)_________________________ of bananas.

On modern plantations in tropical conditions a tree can bear fruit after 5)_________________________.

Banana trees prefer to grow 6)_________________________ and they require rich soil and
7)_________________________. The fruit is often protected by 8)_________________________.

Ripe bananas emit a gas which helps other 9)_________________________.

10) Circle the TWO correct boxes

Consumption of Australian Bananas

<table>
<thead>
<tr>
<th>A</th>
<th>Europe</th>
<th>C</th>
<th>New Zealand</th>
<th>E</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Asia</td>
<td>D</td>
<td>Australia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Development of the NAL-DCT (cont.)

Passage Screening

*Screen questions*
- 5 normal hearing adults
- All passages completed under headphones with babble noise (SNR = +5dB)
- Identified problematic questions and modified them
- 4 normal hearing adults completed all passages with edited questions
Development of the NAL-DCT (cont.)

*Rank passages by difficulty*
10 normal hearing adults
All passages completed under headphones with babble noise (SNR = -2dB)
Within each talker condition excluded 4 outlying passages & divided passages into 4 equivalent sets

One-talker  Two-talker  Three-talker
Validation on normal-hearing sample

Participants
30 normal-hearing adults
age 17- 40 (mean 26.4)
4FAHL ≤ 15dBHL
17 female:13 male

Test Protocol
Pure Tone Audiometry
NAL-Dynamic Conversations Task
in anechoic chamber
(spread over 3 appointments)
NAL-DCT- Validation (cont.)
No significant main effect of set:
One-talker: $F_{(3,79)} = 0.96, p=0.42$
Two-talker: $F_{(3,79)} = 1.32, p = 0.28$
Three-talker: $F_{(3,79)} = 2.35, p=0.08$

Significant main effect of SNR:
One-talker: $F_{(2,79)} = 77.18, p < 0.001^*$
Two-talker: $F_{(2,79)} = 145.89, p < 0.001^*$
Three-talker: $F_{(2,79)} = 68.30, p< 0.001^*$
NAL-DCT Dynamic Effect

Significant effect of number of talkers:
\[ F_{(2,58)} = 15.9; \ p < 0.01^* \]
Comprehension Score by Reading Level

No significant correlation
$r = 20.18$, $p = 0.15$
NAL-DCT Test-Reetest reliability

Mean difference
= -0.03 percentage points
$F_{(1,81)} = 0.001; \ p = 0.97$

Test-retest SD = 1.3dB

(compared with 0.8 -1dB reported for sentence tests)
NAL-DCT Learning/fatigue effect

Test order not significant

$F_{(59, 1711)} = 1.22, \ p = 0.13$
Summary and Next Steps.....

• The NAL-DCT appears to be valid for experimental purposes
• We have developed 4 equivalent sets which can test 4 different conditions without fatigue or practice effects
• Next step is to explore its sensitivity to hearing impairment and usefulness in assessing hearing aid benefit.

……and that study is now complete and you can hear Gitte Keidser talk about it in the 4pm session today
Acknowledgements

• IRC™ for financial support
• Chris Oreinos, Adam Westermann and James Galloway for technical assistance
• The many volunteers for their time and patience

For more info


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Development of the NAL-DCT (cont)
Equivalent Sets

Table 1: Average statistics of the four balanced sets of passages in each talker condition.

<table>
<thead>
<tr>
<th></th>
<th>One-talker</th>
<th>Two-talker</th>
<th>Three-talker</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean score</strong></td>
<td>7.6</td>
<td>7.9</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>7.6</td>
<td>7.8</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>7.6</td>
<td>7.9</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>7.7</td>
<td>7.8</td>
<td>7.8</td>
</tr>
<tr>
<td><strong>Passage length (min)</strong></td>
<td>4.64</td>
<td>3.05</td>
<td>3.63</td>
</tr>
<tr>
<td></td>
<td>3.78</td>
<td>3.61</td>
<td>3.64</td>
</tr>
<tr>
<td></td>
<td>3.77</td>
<td>3.24</td>
<td>4.04</td>
</tr>
<tr>
<td></td>
<td>4.17</td>
<td>2.98</td>
<td>3.44</td>
</tr>
<tr>
<td><strong>Speech rate (words per minute)</strong></td>
<td>166</td>
<td>185</td>
<td>194</td>
</tr>
<tr>
<td></td>
<td>165</td>
<td>183</td>
<td>198</td>
</tr>
<tr>
<td></td>
<td>175</td>
<td>186</td>
<td>186</td>
</tr>
<tr>
<td></td>
<td>168</td>
<td>189</td>
<td>194</td>
</tr>
<tr>
<td><strong>Reading grade</strong></td>
<td>9.9</td>
<td>3.2</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>10.2</td>
<td>3.5</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>9.3</td>
<td>3.0</td>
<td>6.6</td>
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<td>3.8</td>
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