Introducing the NAL Dynamic Conversations Test: Development and Validation

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Why we need the NAL-DCT

WHO ICF category *	Level of communication **	Mental processes	
Body structure/ function	**Hearing** (i.e. passive, access to sound)	Perceive and identify sounds	
Activity	**Listening** (i.e. hearing with intention and attention)	+ Recognise sounds	
Activity	**Comprehending** (i.e. one-way reception of information and meaning)	+ Process information to derive meaning	
Participation	**Communicating** (i.e. two-way transfer of information and meaning)	+ Form a response	

* WHO, 2001; ** Kiessling et al (2003)

Why we need the NAL-DCT

WHO ICF category *	Level of communication **	Mental processes	Clinical tests
Body structure/ function	**Hearing** (i.e. passive, access to sound)	Perceive and identify sounds	Pure-tone audiometry
Activity	**Listening** (i.e. hearing with intention and attention)	+ Recognise sounds	Word and sentence recall tests
Activity	**Comprehending** (i.e. one-way reception of information and meaning)	+ Process information to derive meaning	Rating scales
Participation	**Communicating** (i.e. two-way transfer of information and meaning)	+ Form a response	Rating scales

* WHO, 2001; ** Kiessling et al (2003)

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

	Min	Max	notes
Length (mins)	2.37	5.90	Greatest for 1-talker
Speech Speed (wpm)	130	218	Greatest for 3-talker
Flesch-Kincaid Grade Level	1.4	12.5	Greatest for 1-talker

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

A Europe	**C** New Zealand	**E** Other
B Asia	**D** Australia	

You will hear three students discussing a group project.

Choose six answers from the box and write the correct letter, A–I, next to questions 1 – 6.

A	actors	**F**	equipment
B	furniture	**G**	shooting schedule
C	background noise	**H**	understudies
D	costumes	**I**	shop-owners
E	local council		

Film Project

Visit locations and discuss **1)**.....

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Contact the **2)**..... about roadworks

↓

Plan the **3)**.....

↓

Hold auditions and recheck availability of the **4)**.....

↓

Choose the **5)**..... from the volunteers

↓

Rehearse

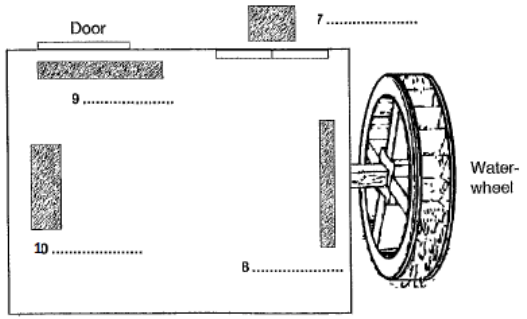
↓

Collect **6)**..... and organise food and transport

Choose four answers from the box and write the correct letter, A–G, next to questions 7 -10.

A	lights
B	fixed camera
C	mirror
D	torches
E	wooden screen
F	bike
G	large box

Old water-mill



NAL National Acoustic Laboratories
Australian Government

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.)

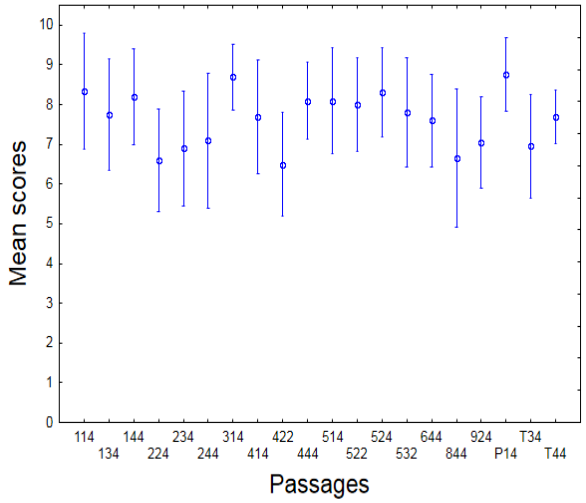
Rank passages by difficulty

10 normal hearing adults

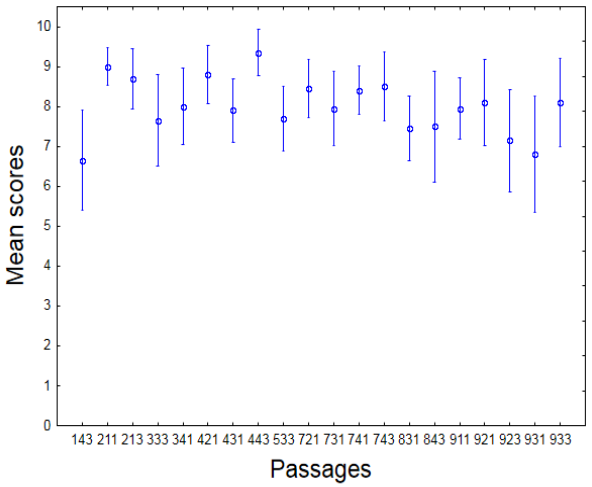
All passages completed under headphones with babble noise (SNR = -2dB)

Within each talker condition excluded 4 outlying passages & divided passages into 4 equivalent sets

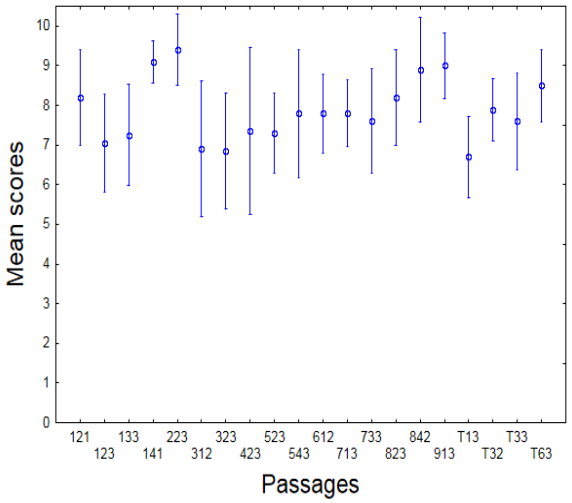
One-talker



Two-talker



Three-talker

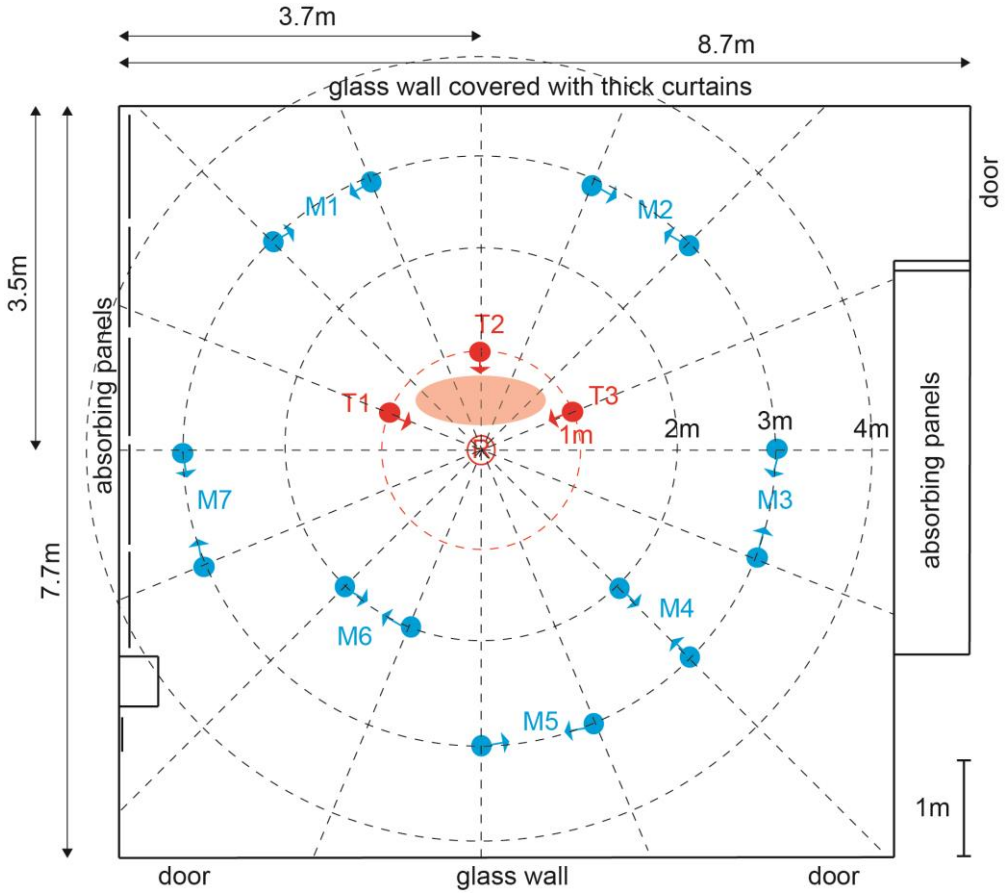


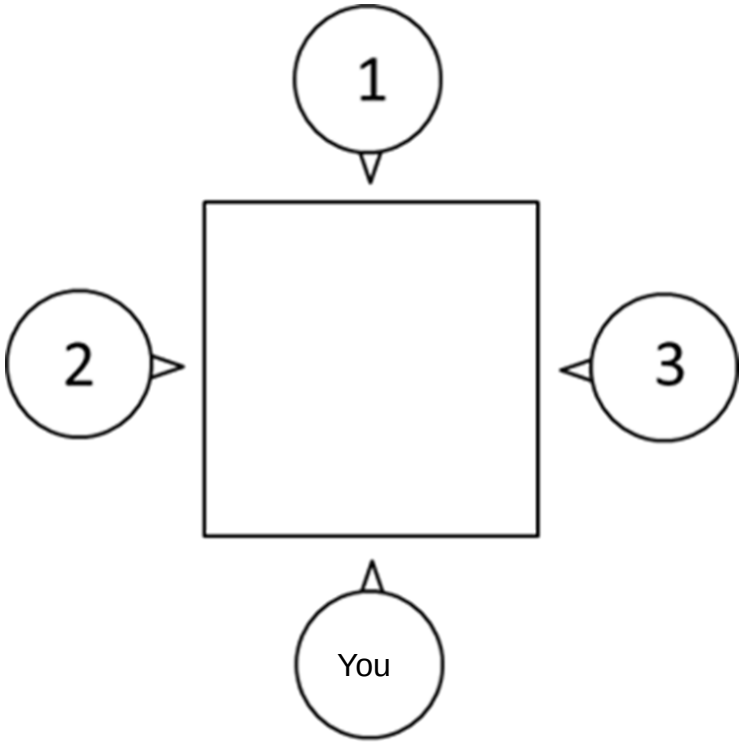
Validation on normal-hearing sample

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

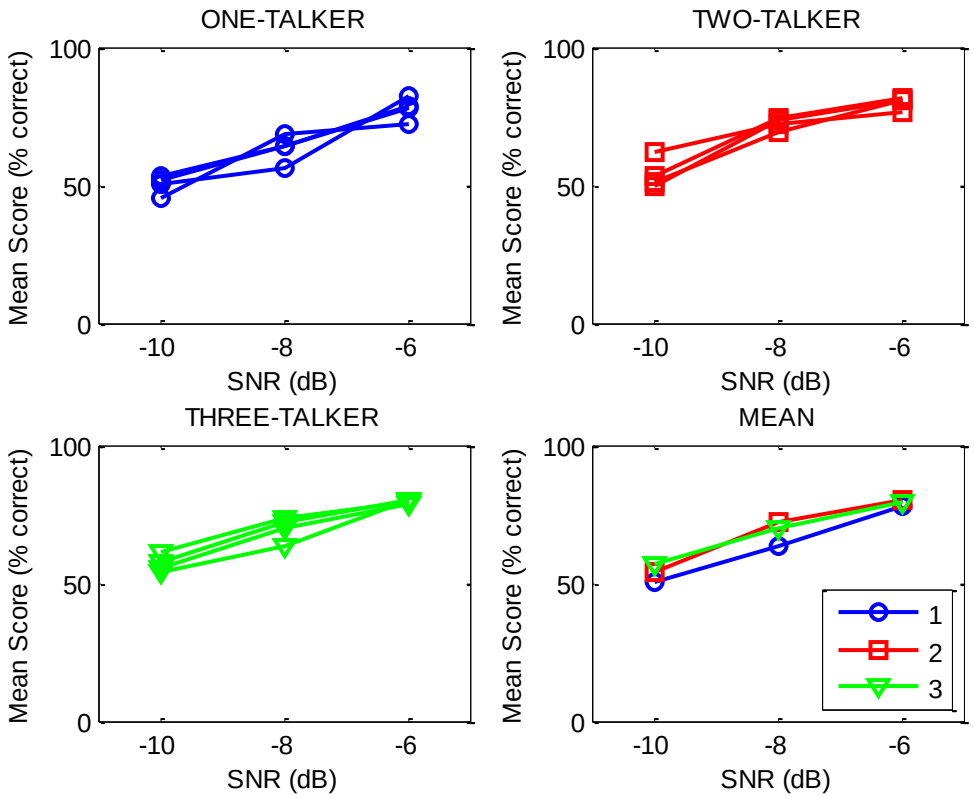
<u>Test Protocol</u>
Pure Tone Audiometry
NAL-Dynamic Conversations Task
in anechoic chamber
(spread over 3 appointments)

NAL-DCT- Validation (cont.)





Set Equivalence by SNR



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: $F_{(3,79)} = 2.35$, $p = 0.08$

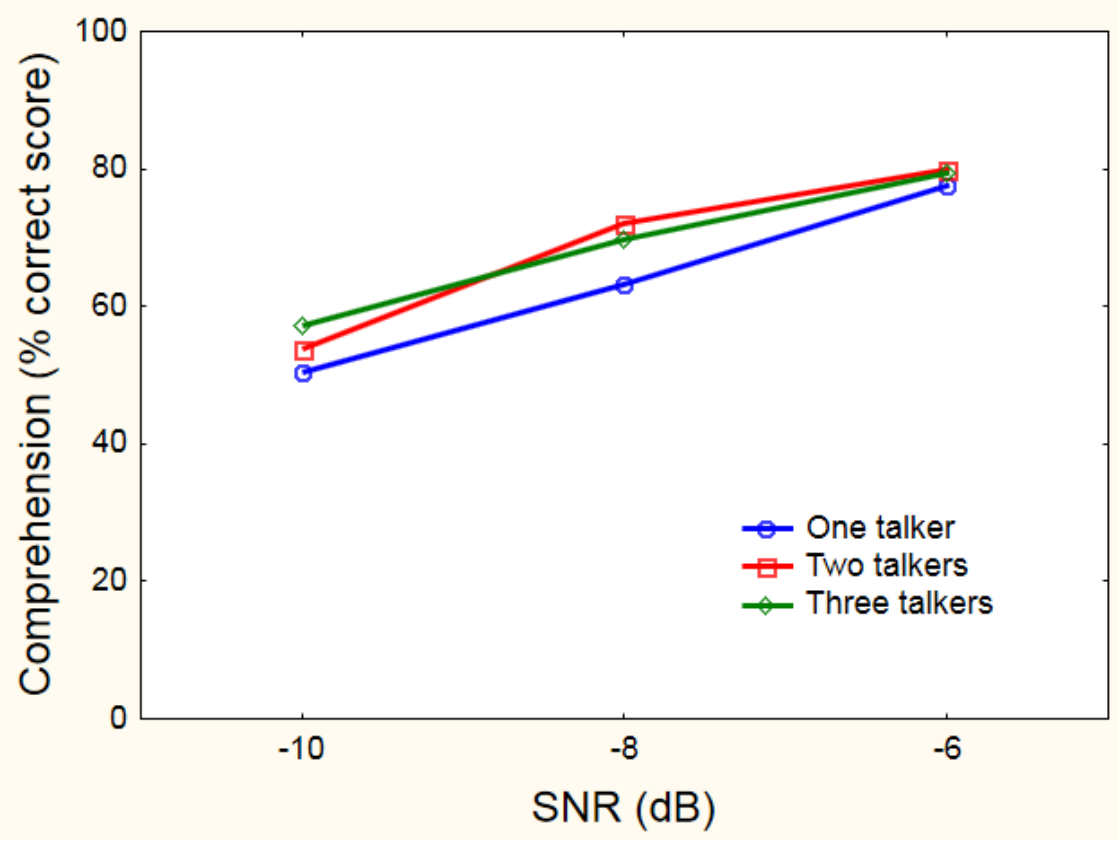
Significant main effect of SNR:

One-talker: $F_{(2,79)} = 77.18$, $p < 0.001$*

Two-talker: $F_{(2,79)} = 145.89$, $p < 0.001$*

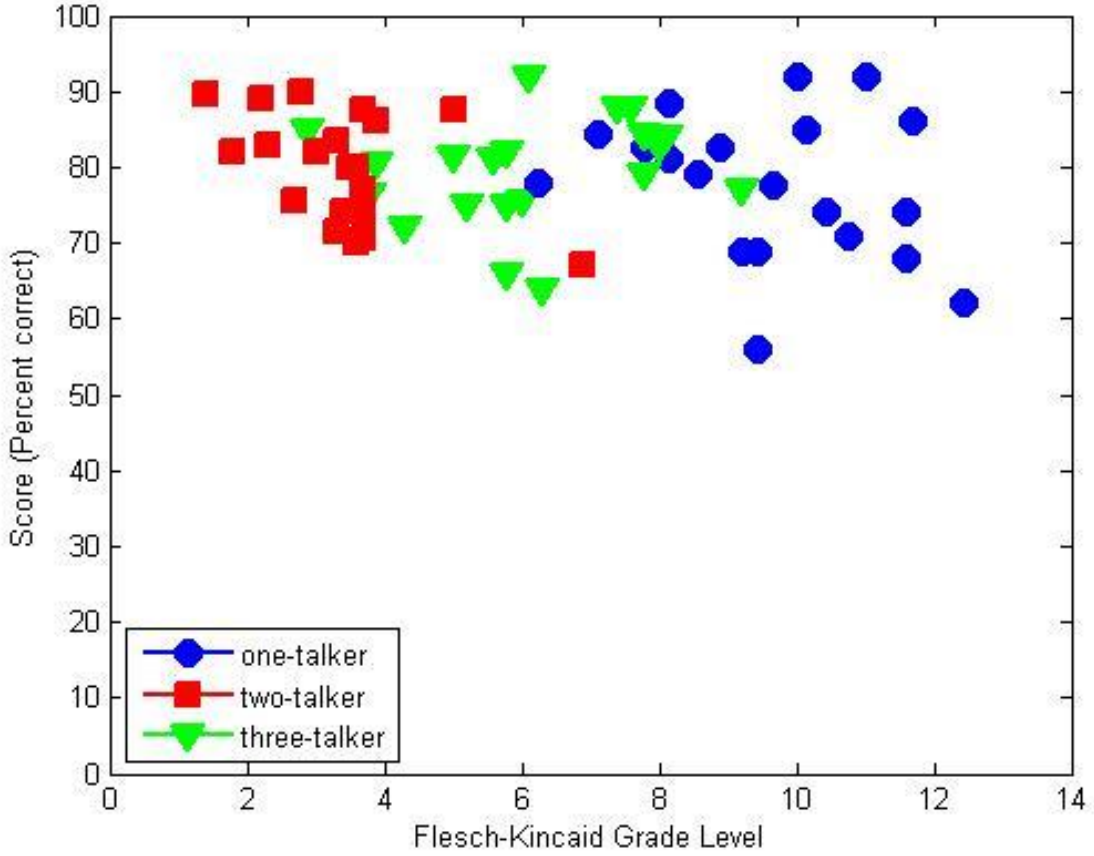
Three-talker: $F_{(2,79)} = 68.30$, $p < 0.001$*

NAL-DCT Dynamic Effect



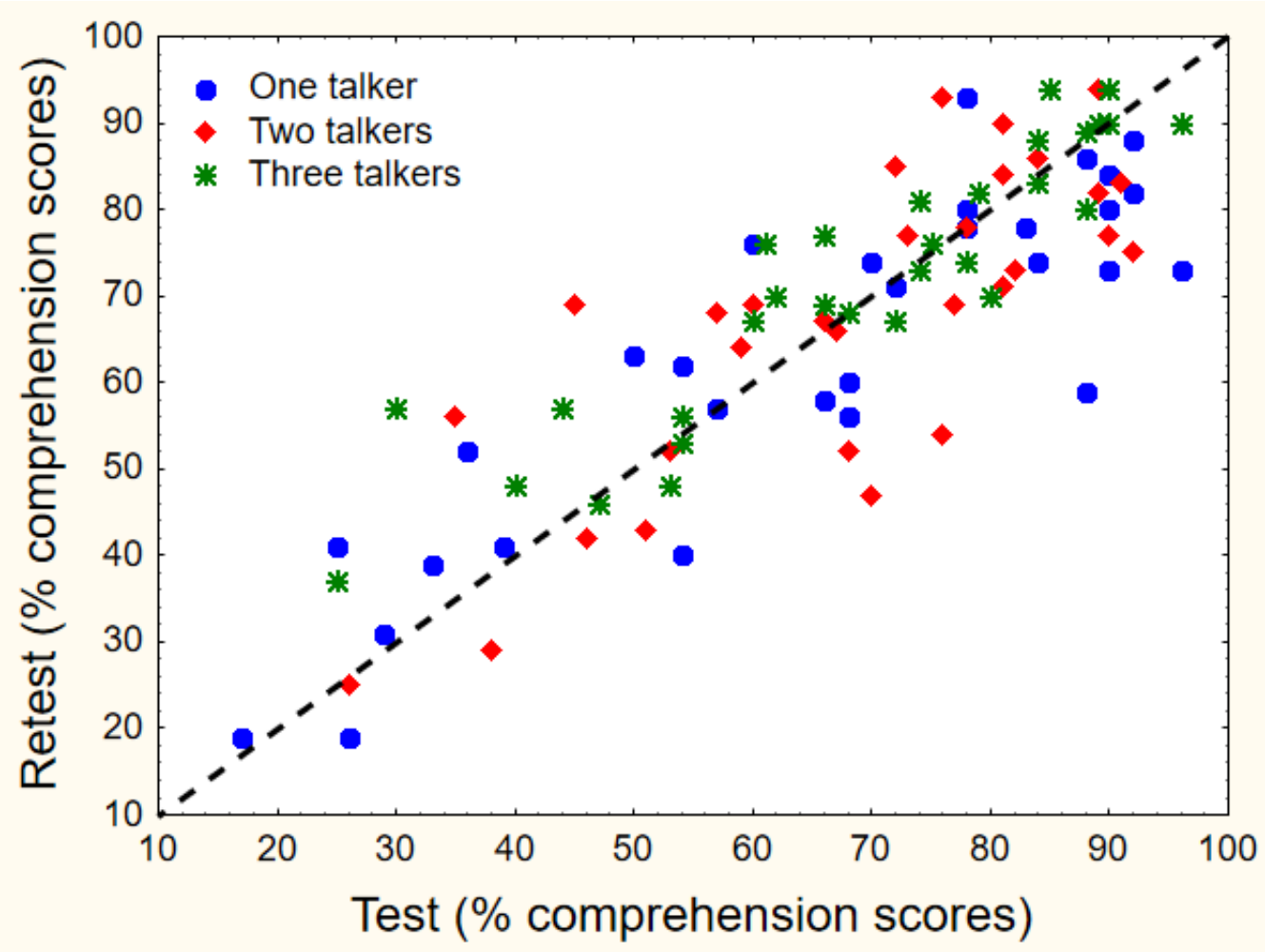
Significant effect of number of talkers:
$F_{(2,58)} = 15.9$; $p < 0.01$*

Comprehension Score by Reading Level



No significant correlation
r = 20.18, p= 0.15

NAL-DCT Test-Retest reliability

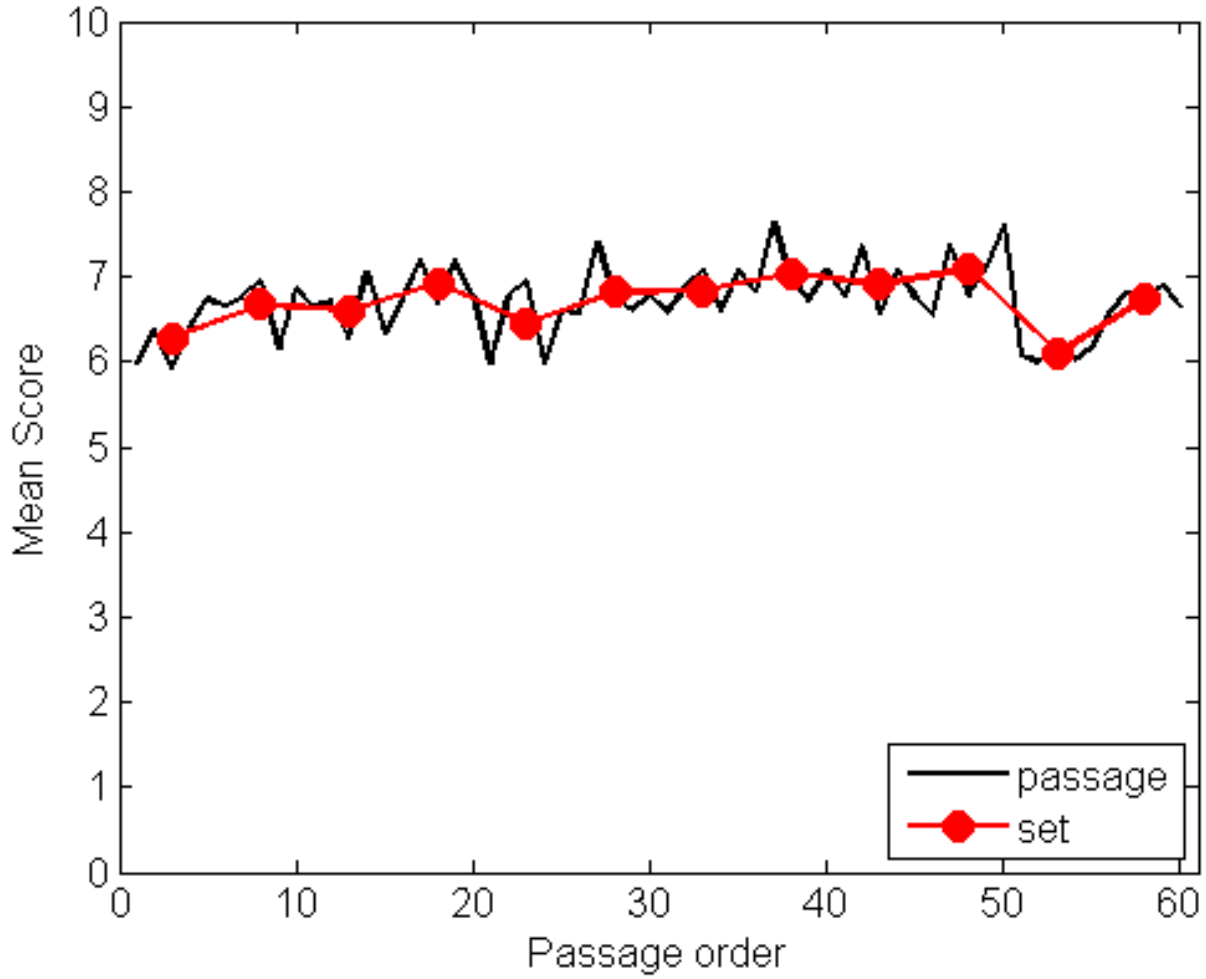


Mean difference
= -0.03 percentage points
$F_{(1,81)} = 0.001$; $p = 0.97$

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

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For more info

Dynamic Speech Comprehension Test for Assessing Real-World Listening Ability
(2016) Best V, Keidser G, Freeston K, Buchholz J, JAAA (in press).

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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.

	One-talker	Two-talker	Three-talker
Mean score	7.6 7.6 7.6 7.7	7.9 7.8 7.9 7.8	7.8 7.7 7.9 7.8
Passage length (min)	4.64 3.78 3.77 4.17	3.05 3.61 3.24 2.98	3.63 3.64 4.04 3.44
Speech rate (words per minute)	166 165 175 168	185 183 186 189	194 198 186 194
Reading grade	9.9 10.2 9.3 9.2	3.2 3.5 3.0 3.8	6.8 4.9 6.6 6.7