Speech Perception and Oral Language Development of Deaf Children in Mainstream schools

Emily Lam, Tammy Lau, Wilson Yu

Jockey Club Sign Bilingualism and Co-enrolment in Deaf Education Programme

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賽馬會手語雙語共融教育計劃
JOCKEY CLUB SIGN BILINGUALISM AND CO-ENROLMENT IN DEAF EDUCATION PROGRAMME

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THE CHINESE UNIVERSITY OF HONG KONG

手語及聾人研究中心
Centre for Sign Linguistics and Deaf Studies

Acknowledgement

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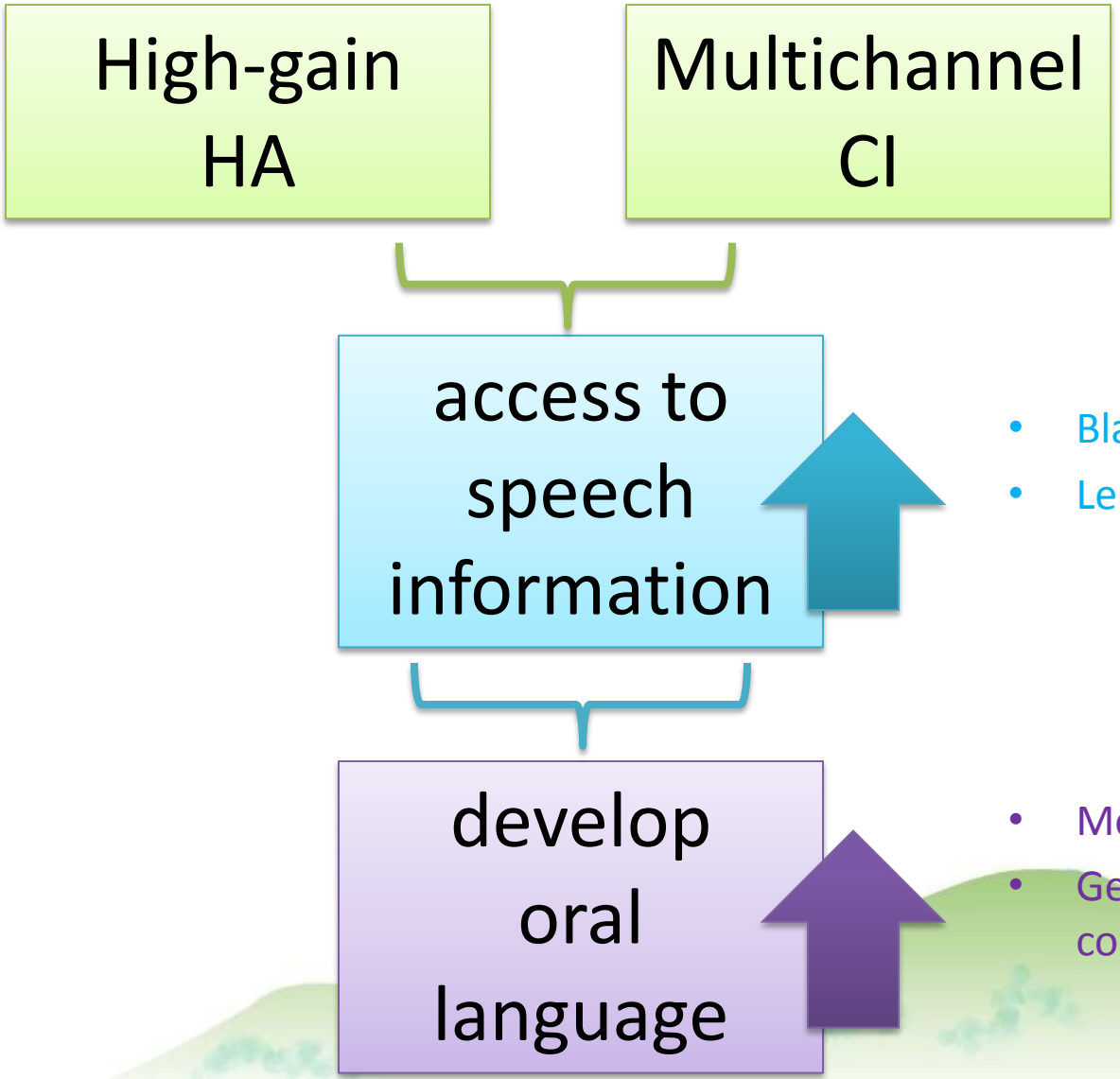
The impact of hearing impairment

“deaf-mute” ??

聾-啞 ??

HI has a negative impact on speech perception and oral language development!

The role of hearing technology



- Blamey (2003)
- Leigh (2008)

- Moog (2002)
- Geers and colleagues (2003)

The oral language ability of deaf children

- ⇧ reports on the benefit of CI and neonatal hearing screening (Yoshinaga-Itano et al., 1998; Moog, 2002; Blamey & Sarant, 2002; Nikolopoulos et al., 2004; Svirsky et al., 2004; Hayes et al., 2009; Niparko et al., 2010; Meinzen-Derr et al., 2011)

- Oral language abilities of deaf children are still diverse and with large individual differences (Blamey, 1998; Svirsky et al., 2000; Geers, 2006; Fitzpatrick, 2011)

- The language growth rate of deaf children over the time is also questionable (Delage & Tuller, 2007; Geers et al., 2008; Hayes, 2009)

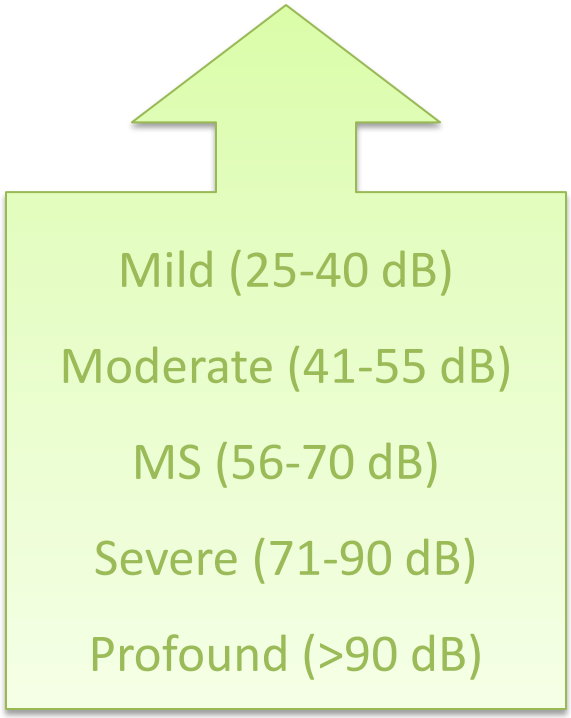
Contributing factors

- Demographic factors
  - Residual hearing prior to CI (Geers, 2006; Niparko, 2010)
  - Parent-child interactions (Niparko, 2010)
  - Socioeconomic status (Niparko, 2010)
  - Degree of HL (Sininger et al., 2010; Fitzpatrick, 2011)
  - Parent education (Fitzpatrick, 2011)
  - Age of receiving amplification / CI (Geers, 2006; Nicholas & Geers, 2007; Sininger et al., 2010)
  - Cochlear implant use (Sininger et al., 2010)
  - Rehabilitation focus (Geers, 2006)

- Outcome measurement
  - Speech perception (Blamey, 1998; Blamey et al., 2001; Pisoni, 2004; DesJardin, 2009)

Speech perception

Degree of Hearing Loss vs **Speech Perception Ability**



- a process by which the speech is heard, interpreted and understood
- critical for early linguistic development

Assessing the speech perception ability

- Contemporary speech perception measures
  - Speech feature perception test (DesJardin, 2009)
  - Closed-set / open-set word perception test (Blamey, 1998; Lee & van Hasselt, 2004)
  - Sentence speech perception test (Bench et al., 1979)
  - Tone perception test (Lee et al., 2002)

- Beware of the tester's lexical knowledge and speech production ability

The speech perception ability of deaf children

- Speech perception abilities of deaf children are delayed relative to normal hearing children (Lee et al., 2002)

- A high correlation of speech perception ability & language development (Blamey et al., 1998; Blamey et al., 2001; Pisoni, 2004) than any demographic variable (Blamey et al., 2001)

- Better speech perception ability ⇨ better receptive language development ⇨ better expressive language development? (DesJardin et al., 2009)

Research Questions

1. What is the speech perception and oral language abilities of deaf children in HK?

2. What factor(s) may better predict oral language outcome in deaf children?

3. What is the development of oral language ability of deaf children over the time?

Methodology

Participants

- 111 Cantonese-speaking children
- Hearing loss: PTA ≥ 25dB in the better ear
- Studying in mainstream primary schools
  - 97 in mainstreaming program
  - 14 in sign-bilingual education program
- Performance IQ ≥ 70, no other diagnosed disabilities

Number of participants by groups

	School Grade						
Hearing Loss	P1	P2	P3	P4	P5	P6	**Total**
mild	2	5	1	3	4	5	**20**
moderate	4	4	4	3	2	3	**20**
Mod-sev	3	5	2	2	2	5	**19**
severe	5	6	2	3	0	3	**19**
profound	13	4	5	5	1	5	**33**
Total	**27**	**24**	**14**	**16**	**9**	**21**	**111**

Demographics (time point 1)

	N	Age of Diagnosis	Mode of amplification			Deaf parents	program	
			nil	HA	CI		sign bilingual	main-streaming
mild	20	3;02	3	17			1	19
moderate	20	2;08		20				20
ms	19	2;09		19			1	18
severe	19	2;00		18	1	3	3	16
profound	33	1;01		9	24	3	9	24
Total	**111**		**3**	**83**	**25**	**6**	**14**	**97**

Measurements

1. Cantonese Lexical Neighborhood Test (CLNT)

   Yuen, K. C. P., Ng, I. H. Y., Luk, B. P. K., Chan, S. K. W., Chan, S. C. S., Kwok, I. C. L. et al., (2008)

2. Cantonese tone identification test (CANTIT)

   Lee, K. Y. S. (2012)

3. Hong Kong Cantonese Oral Language Assessment Scale (HKCOLAS)

   T'sou, B., Lee, T.H.-T., Tung, P., Man, Y., Chan, A., To, C.K.S. *et al.* (2006)

Measurements

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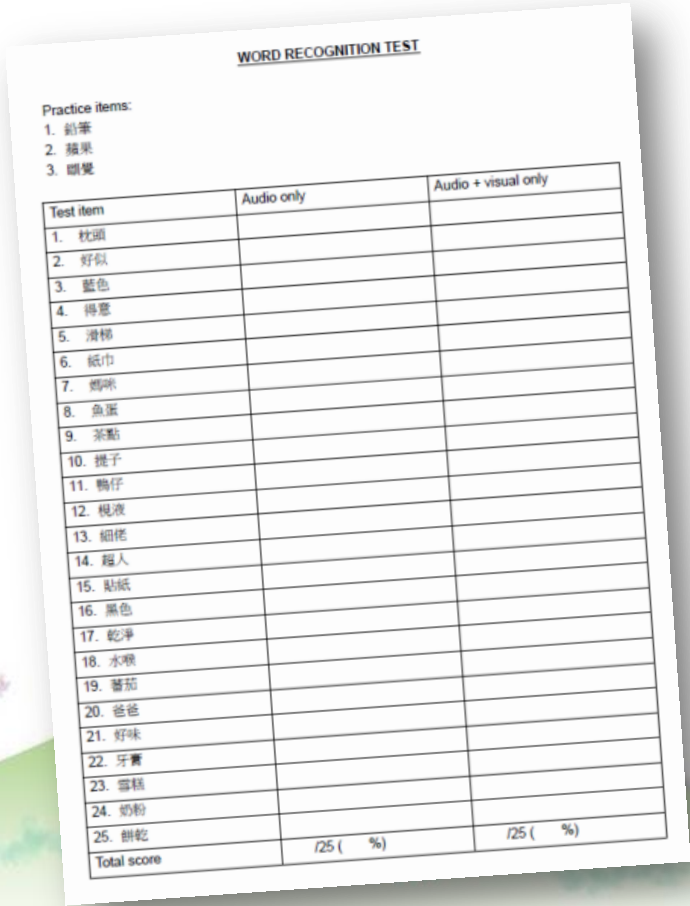
   (Yuen, K. C. P., Ng, I. H. Y., Luk, B. P. K., Chan, S. K. W., Chan, S. C. S., Kwok, I. C. L. et al., 2008)

- 25 disyllabic words
- Live voice presentation
- correct recognition >> ✓



WORD RECOGNITION TEST

Practice items:
1. 鉛筆
2. 蘋果
3. 眼覺

Test item	Audio only	Audio + visual only
1. 枕頭		
2. 好似		
3. 藍色		
4. 得意		
5. 滑梯		
6. 紙巾		
7. 貓咪		
8. 魚蛋		
9. 茶點		
10. 提子		
11. 鴨仔		
12. 梘液		
13. 細佬		
14. 雞人		
15. 貼紙		
16. 黑色		
17. 乾淨		
18. 水喉		
19. 番茄		
20. 爸爸		
21. 好味		
22. 牙膏		
23. 雪糕		
24. 奶粉		
25. 餅乾		
Total score	/25 (%)	/25 (%)

Measurements

2. Cantonese tone identification test (CANTIT)

(Lee, K. Y. S., 2012)

- Research version
- 75 monosyllabic words
- Stimuli were presented through computer speaker
- Scores from aided condition

Measurements

3. Hong Kong Cantonese Oral Language Assessment Scale (HKCOLAS)

   (T'sou, B., Lee, T.H.-T., Tung, P., Man, Y., Chan, A., To, C.K.S. *et al.,* 2006)

   - Cantonese Grammar (CG)
   - Textual Comprehension (TC)
   - Word Definition (WD)
   - Lexical-Semantic Relationship (LS)
   - Story Retell (SR)
   - Expressive Nominal Vocabulary (EV)

HKCOLAS testing procedure

- Changing the presentation mode

  Audio >> Visual (to simulate the daily circumstance)

- Test instructions and test items are the same as in the original format

Adapted by Centre for Sign Linguistics and Deaf Studies (CSLDS)

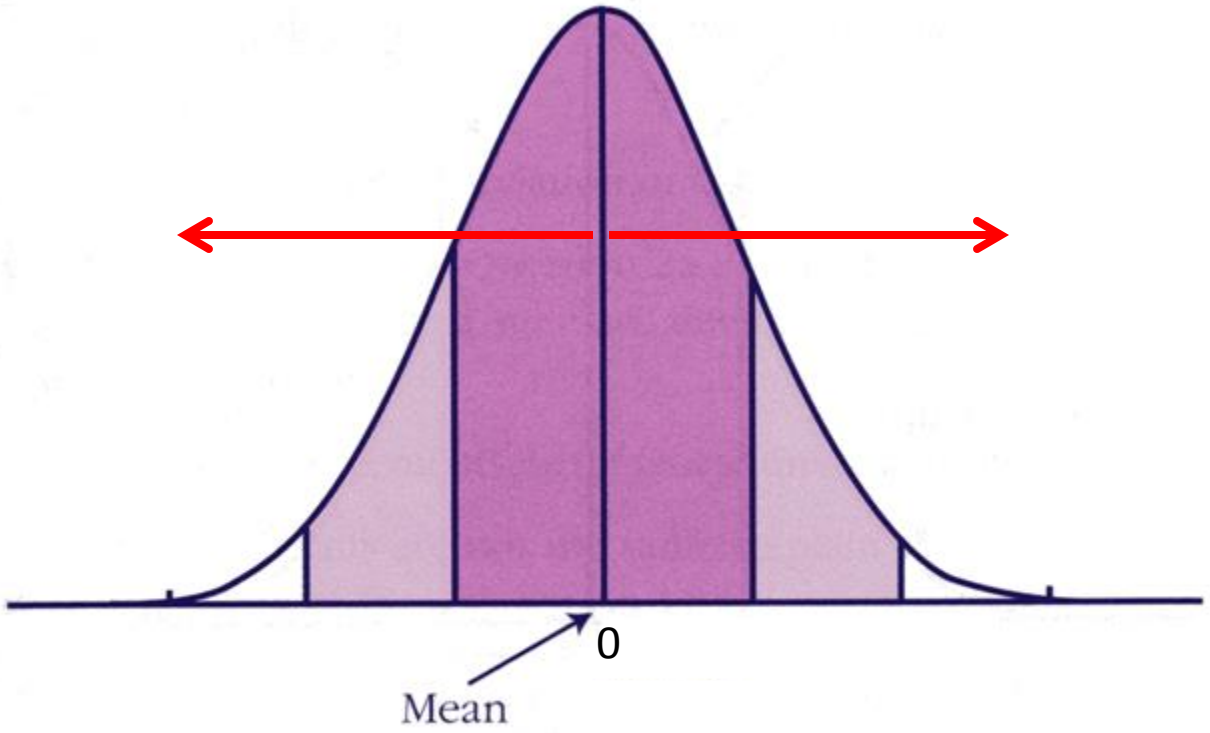
Results

Research Question 1

What is the speech perception and oral language ability of deaf children in HK?

Presentation of scores in HKCOLAS

- Norm-referenced test
- Standard score was used



Performance in each subtest

	CG (Can. Grammar)	TC (Textual Comp.)	WD (Word Definition)	LS (Lexical-semantic)	SR (Story Retell)	EV (Exp. Vocab.)
mild	-0.59	0.03	0.02	-0.65	-1.04	0.02
moderate	-0.98	-0.61	-0.36	-0.83	-0.82	-1.21
ms	-1.94	-0.99	-0.31	-1.54	-1.47	-2.05
severe	-2.45	-1.70	-1.21	-1.85	-2.16	-2.28
profound	-2.90	-2.24	-1.30	-2.10	-2.96	-2.29
average	**-1.90**	**-1.23**	**-0.71**	**-1.47**	**-1.84**	**-1.64**

*The mean is displayed in standard scores

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Statistical operation

Principal Component Analysis (PCA)

variable-reduction technique

⇩ a larger set of variables into a smaller set of 'artificial' variables

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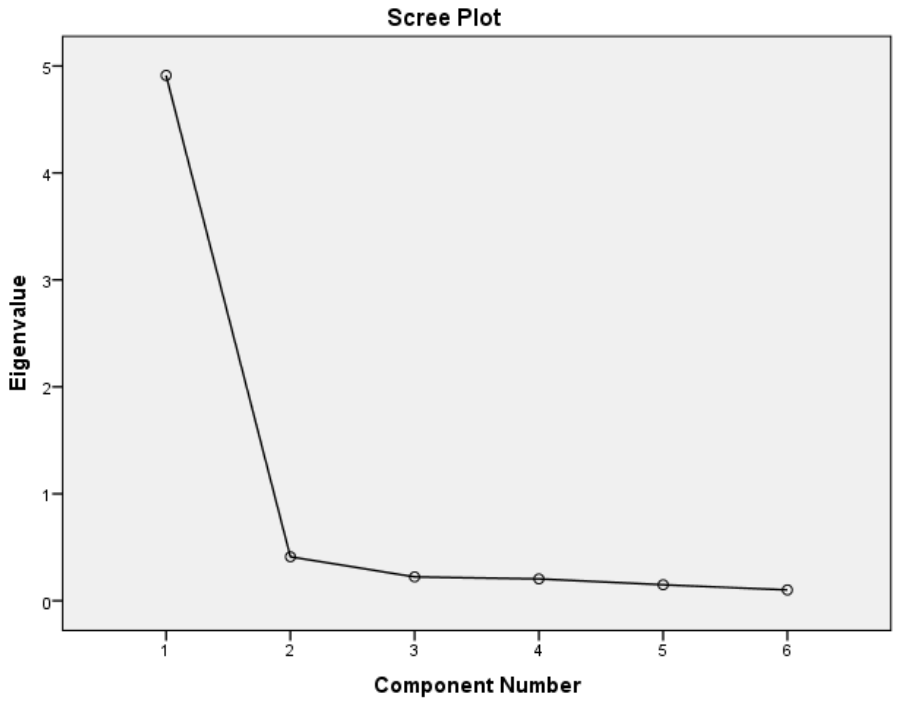


Statistical operation

Principal Component Analysis (PCA)

variable-reduction technique

⇩ a larger set of variables into a smaller set of 'artificial' variables

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
CG	4.912	81.871	81.871	4.912	81.871	81.871
TC	.411	6.851	88.722			
WD	.223	3.710	92.433			
LS	.204	3.404	95.837			
SR	.149	2.488	98.324			
EV	.101	1.676	100.000			

Statistical operation - PCA

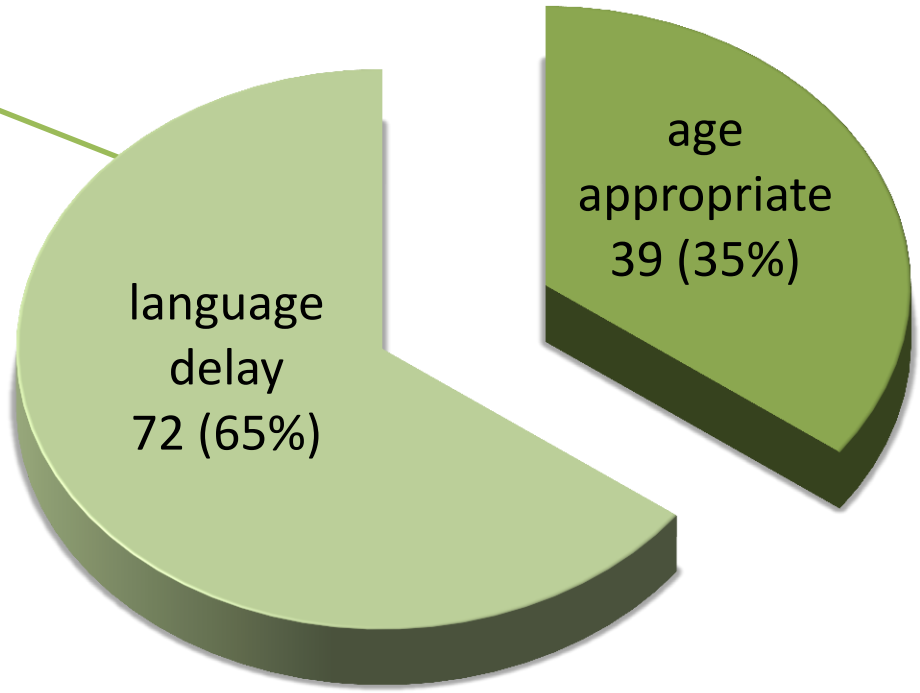
	Component 1
CG	.947
TC	.910
WD	.805
LS	.920
SR	.920
EV	.920

	SR_ss_pt1	EV_ss_pt1	LD_hkcolas	compositescore_pt1
31	-.46	-.13	.0	.91
32	-.80	.28	.0	.53
33	-1.19	-5.13	1.0	-.70
34	.59	-.18	.0	.89
35	-1.25	.63	.0	1.04
36	-.26	-1.31	1.0	.26
37	-2.38	-2.02	1.0	-.10
38	-.13	-.05	1.0	.59
39	.01	.49	.0	1.27
40	-.13	-1.34	.0	.65
41	-.86	.41	.0	.86

Defining Language Ability

1. Standard diagnostic criterion of HKCOLAS

standard score less than -1.25 in two or more subtests



Defining Language Ability

2. Cluster analysis

Model Summary

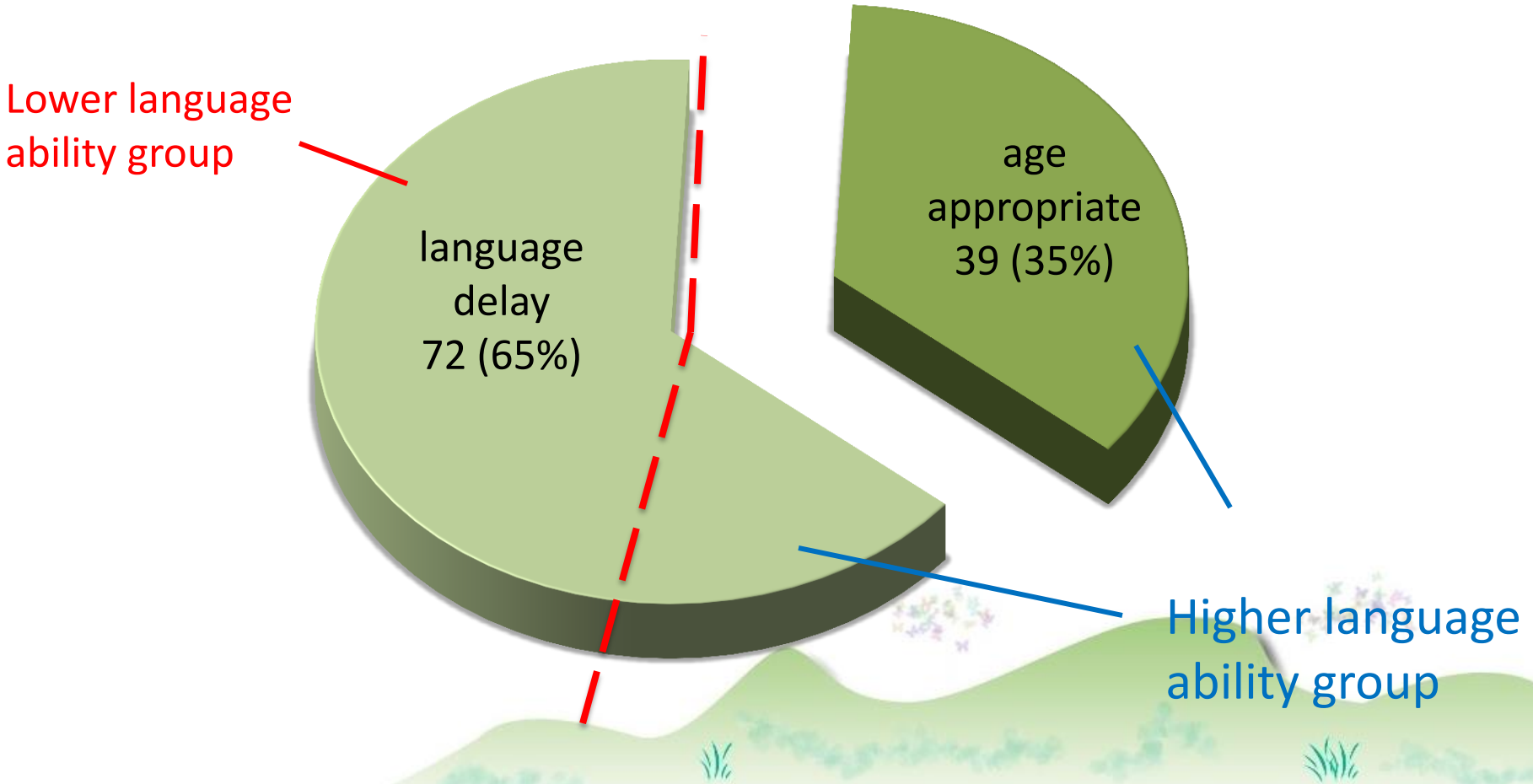
Algorithm	TwoStep
Inputs	1
Clusters	2

Two step cluster using Schwarz's Bayesian Criterion (BIC) and Euclidean estimation

Cluster Quality

Defining Language Ability

2. Cluster Analysis



Defining Language Ability

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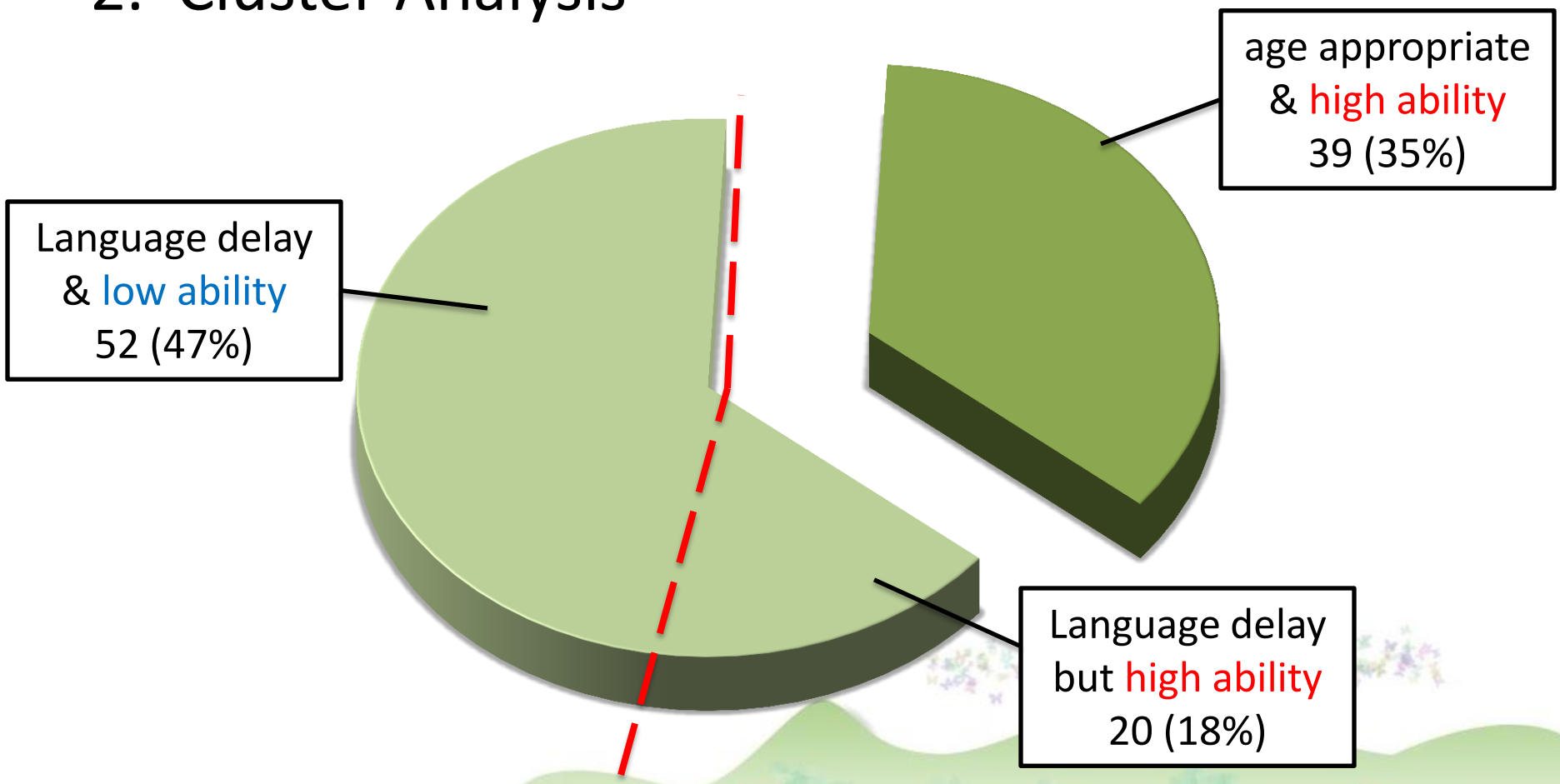
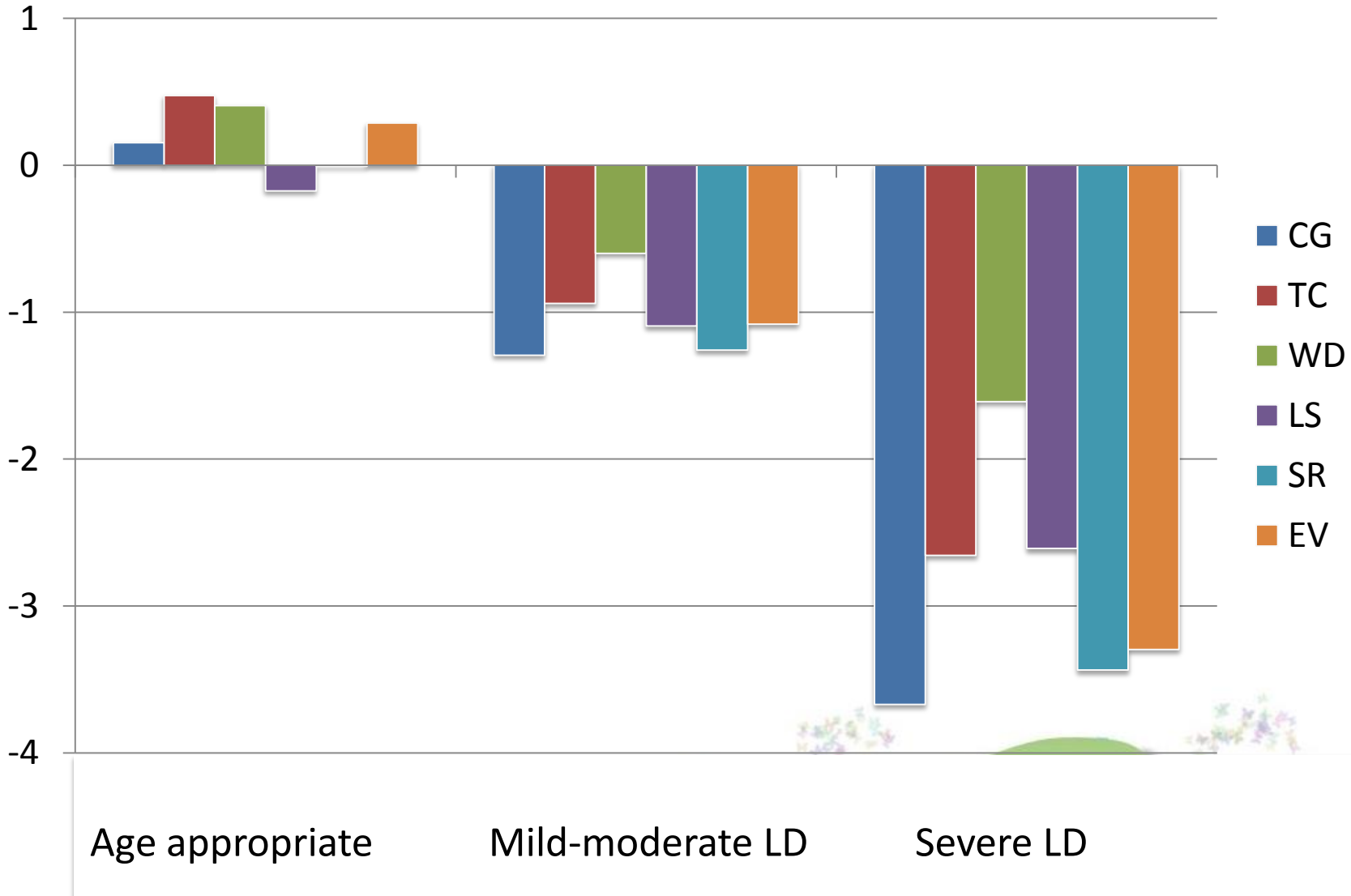
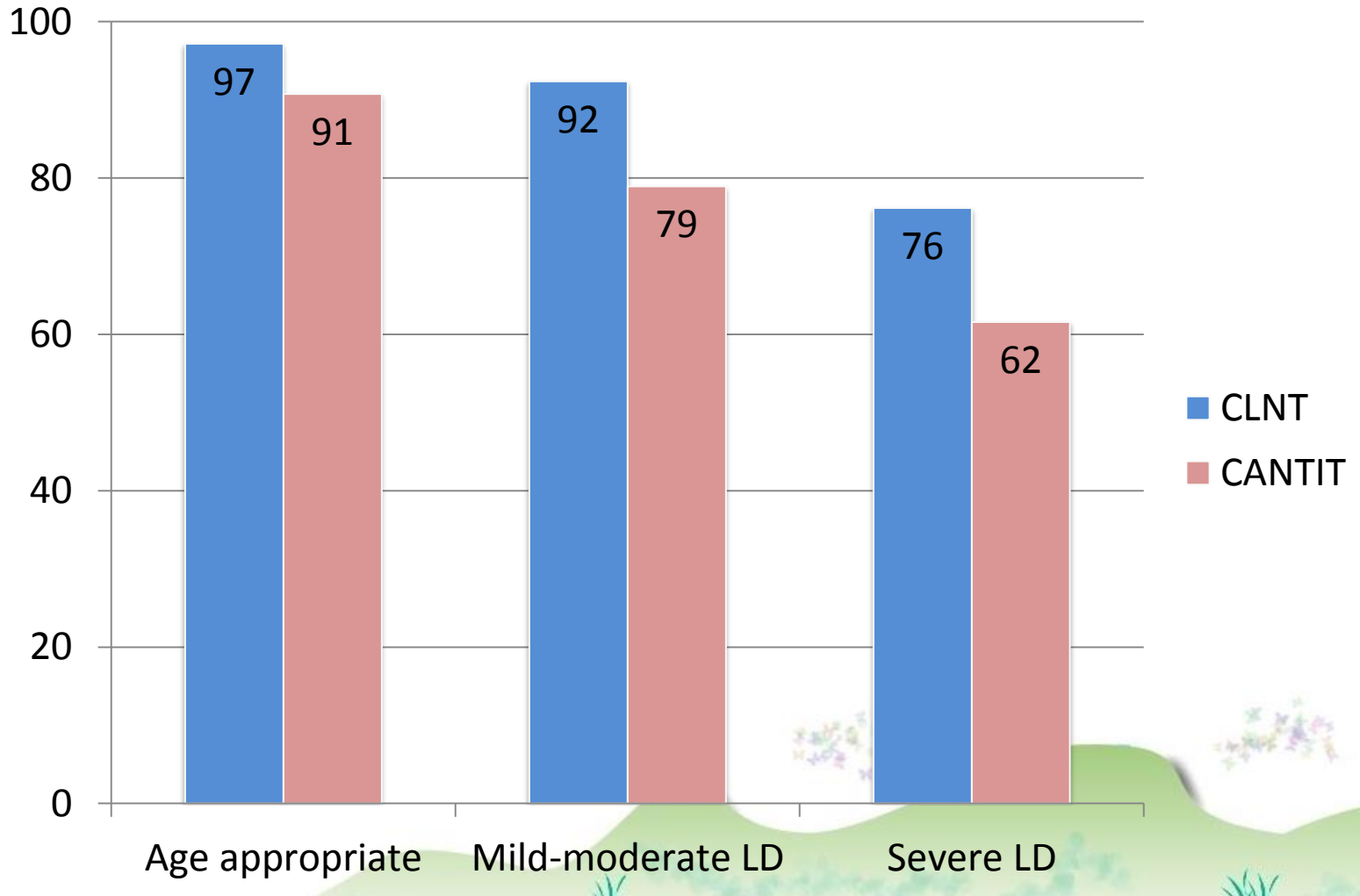


OL performance in 3 Language Ability Groups



Speech perception performance in 3 language ability groups



Research Question 2

What factor(s) may better predict oral language outcome in deaf children?

Correlation

- Dependent variable
  - composite score
- Independent variable
  - Degree of HL
  - With or without deaf parents
  - Type of hearing devices
  - Program type
  - Month of hearing diagnosis
  - CLNT scores
  - CANTIT scores

Correlation

- Spearman rank-order correlation
- Dependent variable: composite score

	Degree of HL	Deaf parents	Type of aid (HA)[a]	Type of aid (CI)[a]	Program type	Month of HL dx	CLNT	CANTIT
Correlation Coefficient	**-.470****	-.087	**.273****	**-.335****	**.307****	.131	**.571****	**.735****
Sig. (2-tailed)	.000	.364	.004	.000	.001	.171	.000	.000

[a] dummy variable indicating which hearing aid method the deaf child was using (none, HA, CI)
[b] measured on 5 levels of hearing loss (mild, moderate, MS, severe and profound)
* p< 0.05 ** p< 0.01

Multiple Regression Analysis

Variables	B	Std. Error	β	R^2 change	F(6,104)	Collinearity statistics (VIF)
Program	-.051	.221	-.018	.486***	16.421***	1.278
HL	-.051	.066	-.082			2.262
HA[a]	-.090	.415	-.042			7.723
CI[a]	-.034	.481	-.015			9.604
CANTIT	.046	.008	.688***			2.946
CLNT	-.007	.019	-.036			2.099

Note. Effect was measured by VIF = variance inflation factors (VIF with values less than 10 showed that the model did not suffer from multicollinearity problems)

[a] dummy variable indicating which hearing aid method the deaf child was using (none, HA, CI)

*** $p < 0.001$

Research Question 3

What is the development of oral language ability of deaf children over the time?

Participants in time point 2

Initial Ax
(TP1) N=111

25%
dropout

Around 3 years later –
re-assessed N=83

Still studying in primary school
(TP2) N=55

Demographics (55 participants)

	N		Age of dx		Mode of amplification				Deaf parents		program			
					nil		HA		CI				sign bilingual		Main-streaming	
mild	20	**8**	3;02	**3;03**	3		17	**8**					1	**1**	19	**7**
moderate	20	**9**	2;08	**2;04**			20	**9**							20	**9**
ms	19	**7**	2;09	**3;01**			19	**7**					1	**1**	18	**6**
severe	19	**11**	2;00	**1;03**			18	**11**	1		3	**2**	3	**3**	16	**8**
profound	33	**20**	1;01	**1;01**			9	**4**	24	**16**	3	**1**	9	**9**	24	**11**

3 Language Ability Groups

- With reference to their composite scores at TP2, participants were categorized into respective language ability groups

	Time Point 1 (N=55)	Time Point 2 (N=55)
Age appropriate	17	22
Mild-moderate LD	11	13
Severe LD	27	20

3 Language Ability Groups

- Individual change across language ability groups

Time Point 1 (N=55)	Regress (5%)	keep up (71%)	Progress (24%)
Age Appropriate (17)	1	16	
Mild-moderate LD (11)	2	5	4
Severe LD (27)		18	9

Change of scores from TP1 to TP2

		CG (Cantonese Grammar)	TC (Textual Comp.)	WD (Word Definition)	LS (Lexical-semantic)	SR (Story Retell)	EV (Expressive Vocab.)
Age Appropriate (17)	TP1	0.03	0.23	0.31	-0.49	-0.10	0.12
	TP2	0.21	0.44	0.37	0.15	0.05	0.24
Mild-moderate LD (11)	TP1	-1.59	-1.06	-0.44	-1.24	-1.47	-1.01
	TP2	-1.21	-0.10	0.06	-1.32	-1.35	-0.50
Severe LD (27)	TP1	-3.62	-2.68	-1.77	-2.48	-3.63	-3.10
	TP2	-3.02	-1.93	-1.42	-2.26	-3.45	-3.01

Change of scores from TP1 to TP2
(Repeated Measure ANOVA)

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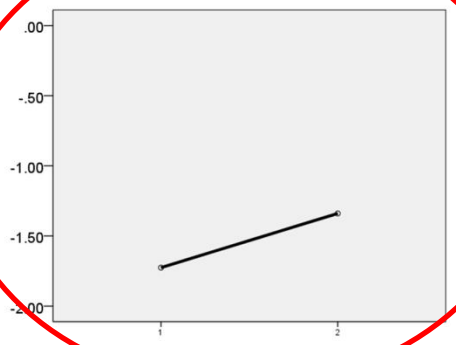
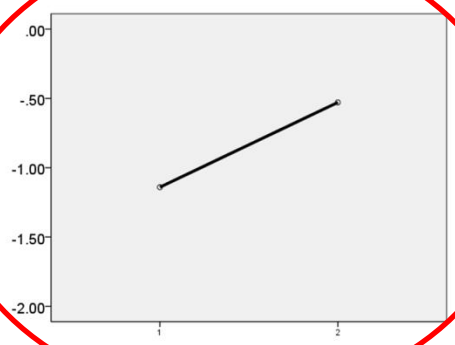
	TP2	-3.02	-1.93	-1.42	-2.26	-3.45	-3.01

* $p < 0.05$ ** $p < 0.01$

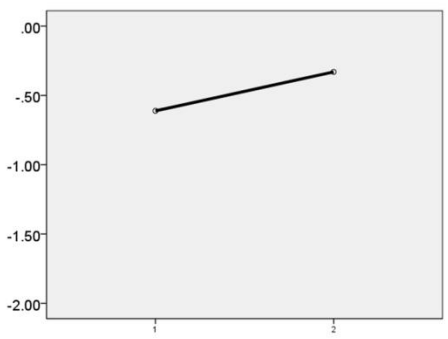
Cantonese Grammar



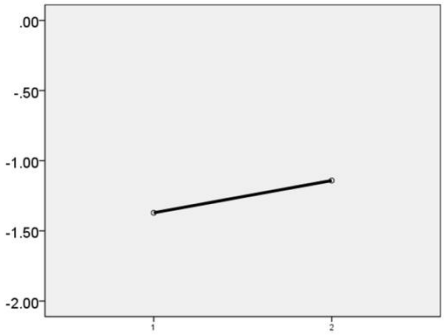
Textual Comprehension



Word Definition



Lexical-semantic Relationship



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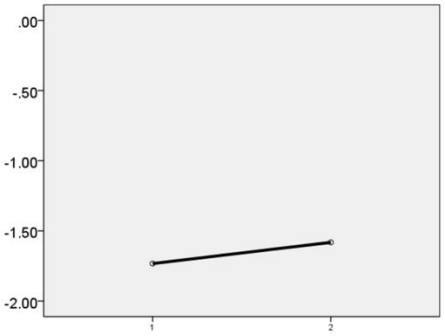
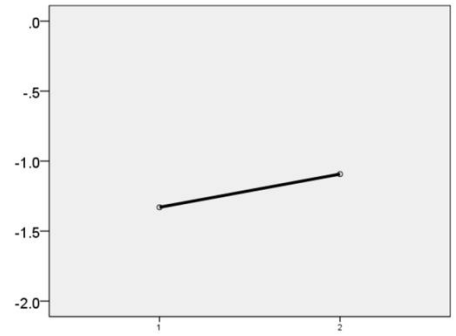
Story Retell



Expressive Nominal Vocabulary



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Conclusions

- Align with some previous findings, the performance of deaf children is behind the level of children with normal hearing in general (Blamey et al., 1998; Wake et al., 2004; Fitzpatric et al., 2011)
- Performed poorer in:
  - CG > SR > EV > LS > TC > WD
- Three language groups:
  - Age appropriate: 35%
  - Mild-moderate LD: 18%
  - Severe LD: 47%

65%

Conclusions

- Among the various predictors, tone perception was significantly correlated with oral language outcome (48.6% of variance)
  - Degree of HL
  - With or without deaf parents
  - Type of hearing devices
  - Program type
  - Month of hearing diagnosis
  - CLNT scores
  - CANTIT scores ✓

Conclusions

- Oral Language performance after 3 years time:
  - Age appropriate (40%)
  - Mild-moderate language delay (24%)
  - Severe language delay (36%)

  } 60%

- Significant improvement was seen in Cantonese Grammar and Textual Comprehension.
- What factors contribute to the improvement is left to be answered.

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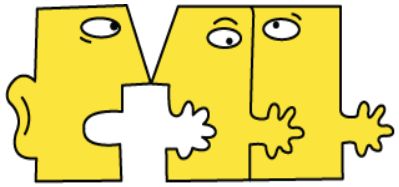

Centre for Sign Linguistics and Deaf Studies (CSLDS)
http://www.cuhk.edu.hk/cslds/jcslco/
Tel: 3943 1135 Fax: 3943 1136

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