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Language and Aging: Theoretical Preliminaries and Field Methods in Rural Taiwan

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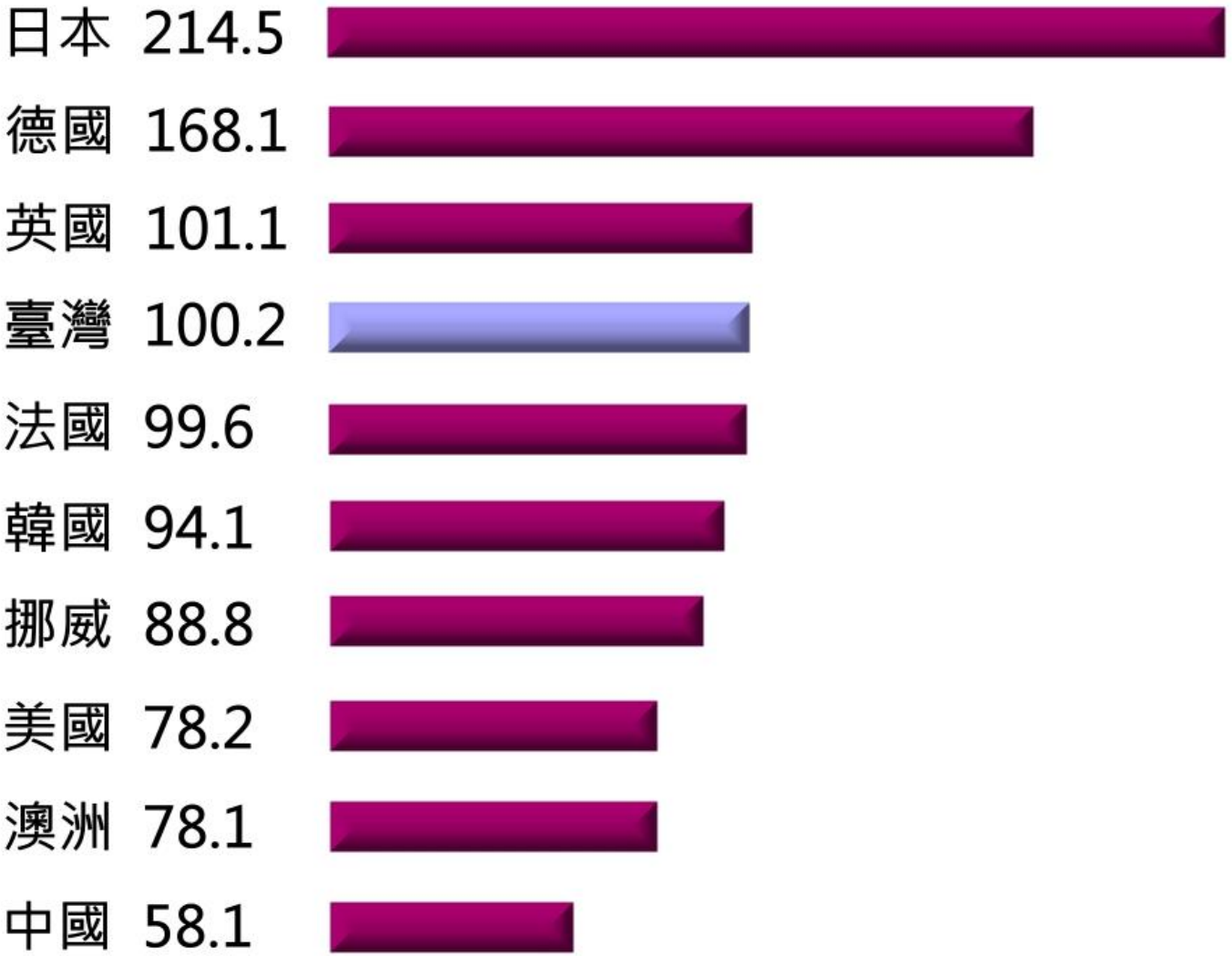
Part I

Introduction

台灣的兩個嚴峻挑戰

- 瞬息萬變的國際情勢與全球化的激烈競爭
- 少子化與急速高齡化的社會

世界各國人口老化指數



老化指數：
65歲以上高齡人口對14歲以下幼年人口比例，當高齡人口大於幼年人口時，指數便會破百。

資料來源：
行政院戶政司２０１７年１月統計資料
國家發展委員會民國１０３－１５０年人口推估報告

臺灣各縣市人口老化指數

資料來源：
行政院戶政司２０１７年１月統計資料

老化指數：
65歲以上高齡人口對14歲以下幼年人口比例，
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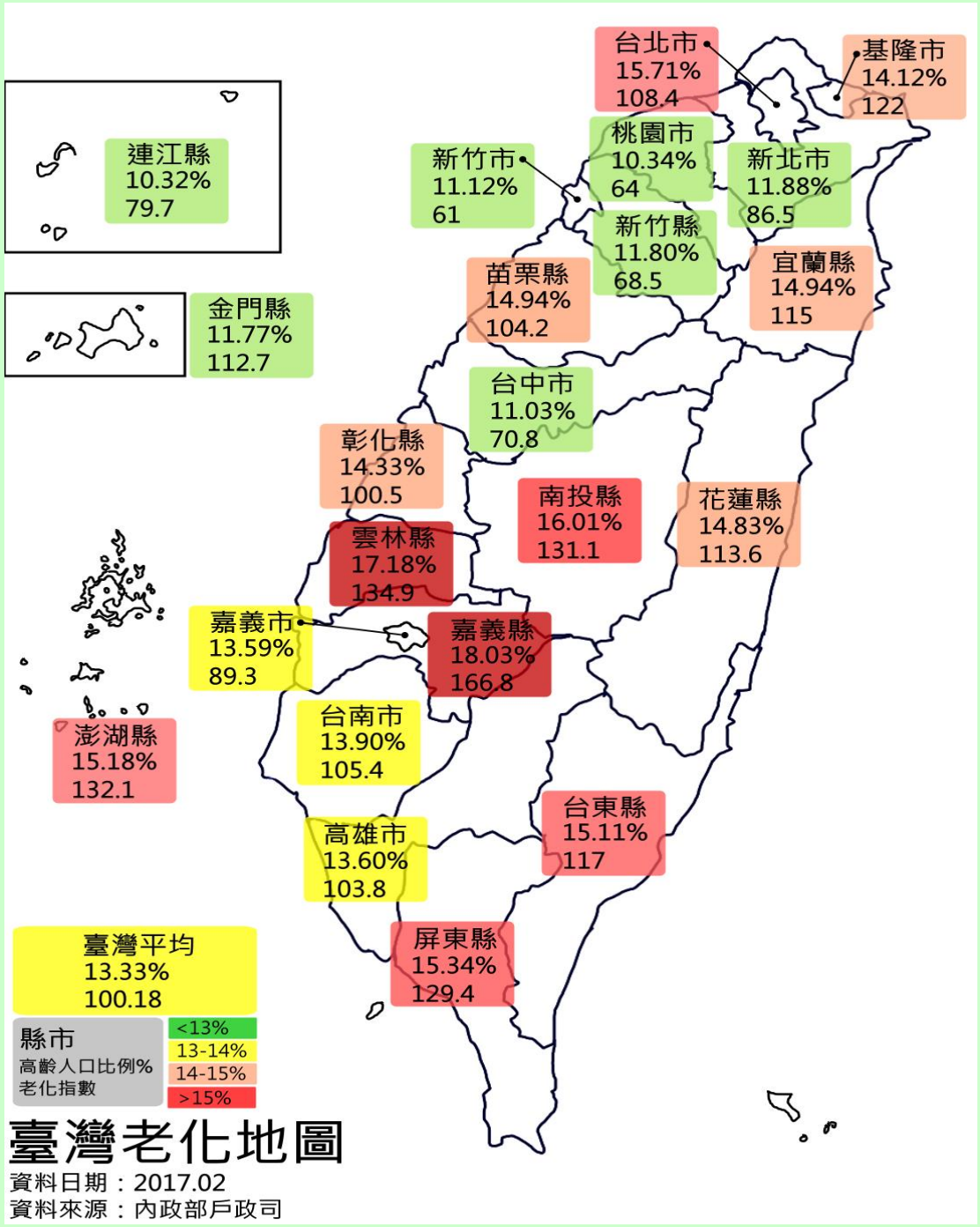


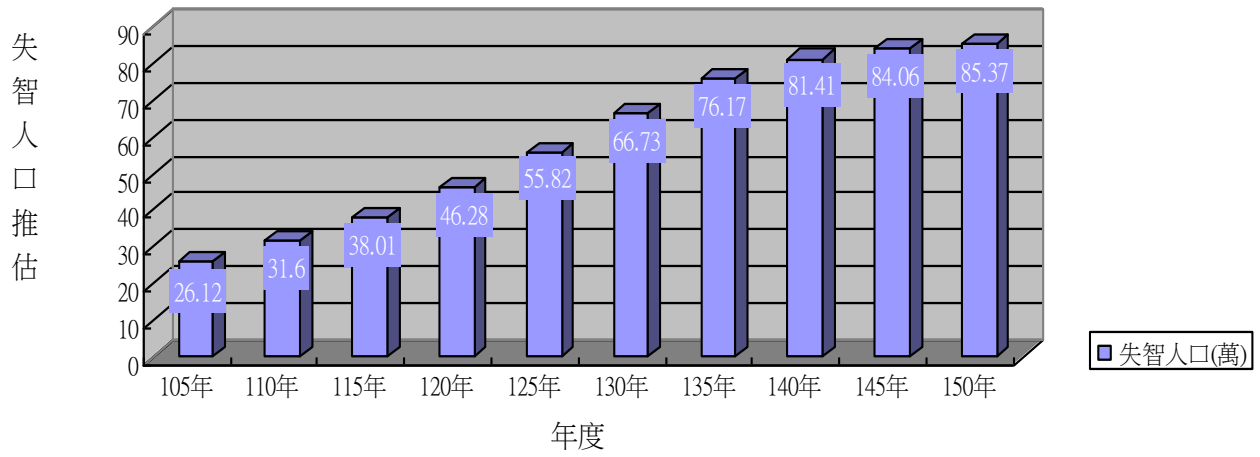
臺灣老化地圖

資料日期：2017.02

資料來源：內政部戶政司

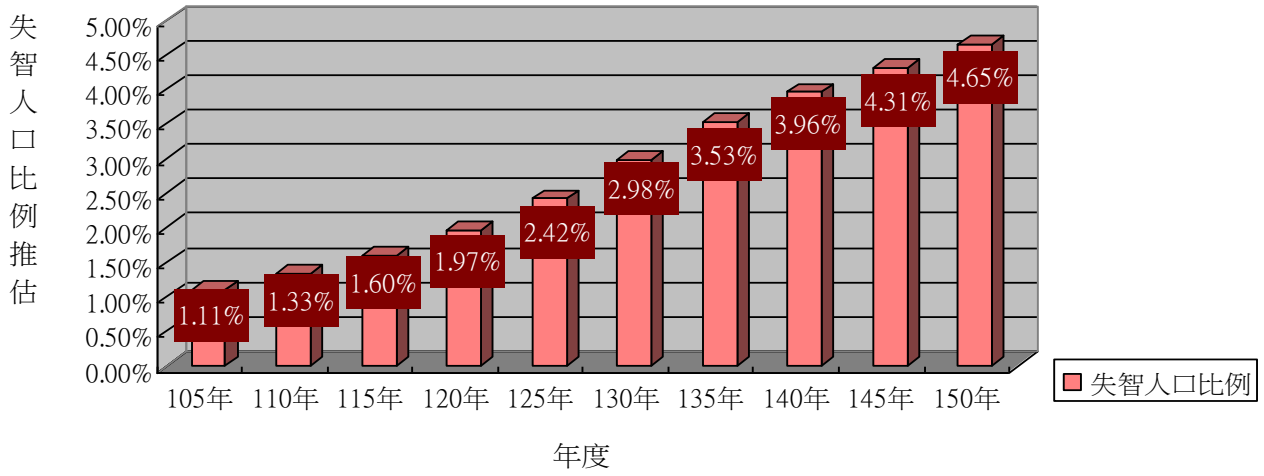
台灣失智人口推估

（資料來源：台灣失智症協會；衛生福利部科技研究計畫『失智症（含輕度認知功能障礙，MCI）流行病學調查及失智症照護研究計畫』



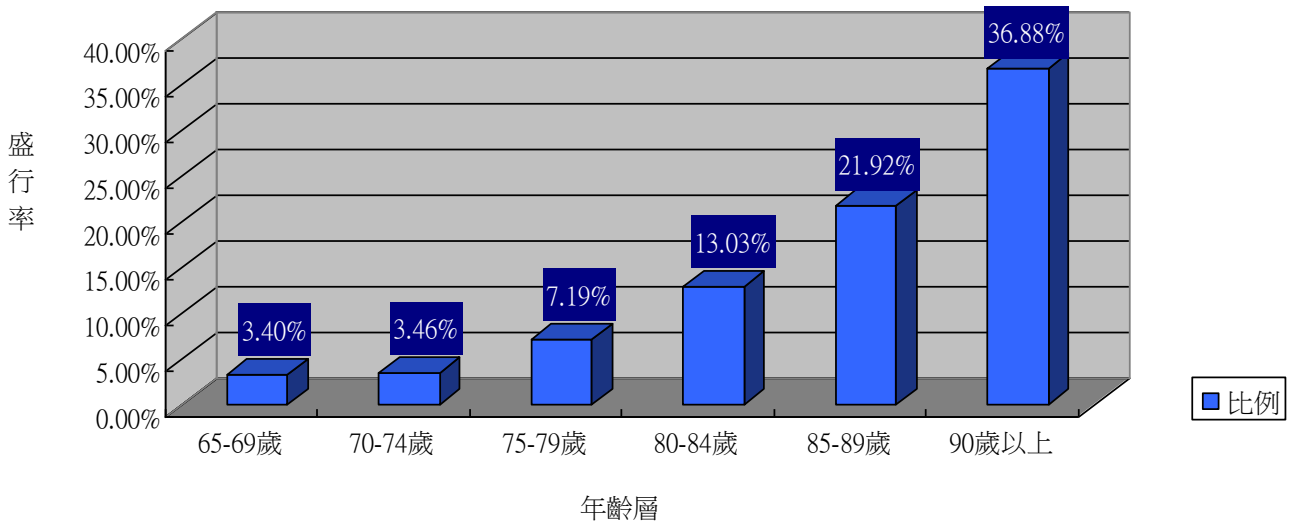
台灣失智人口比例

（資料來源：台灣失智症協會；衛生福利部科技研究計畫『失智症（含輕度認知功能障礙，MCI）流行病學調查及失智症照護研究計畫』



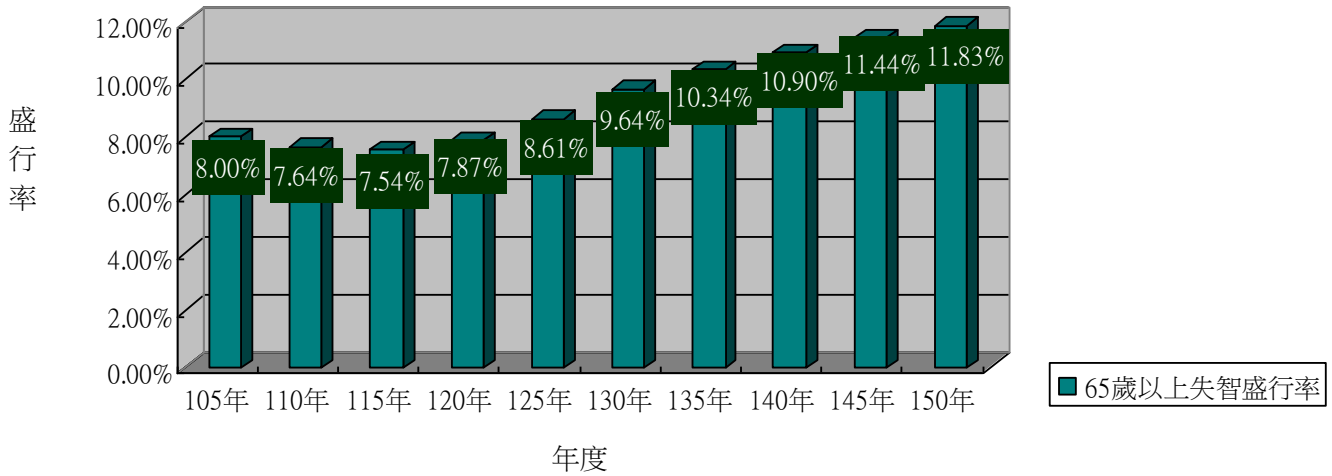
失智症盛行率

（資料來源：台灣失智症協會失智症流行病學調查結果）



65歲以上失智盛行率

（資料來源：台灣失智症協會；衛生福利部科技研究計畫『失智症（含輕度認知功能障礙，MCI）流行病學調查及失智症照護研究計畫』



Part I I

Development of Neural Substrate of Language Over the Lifespan

Development of Neural Substrate (1)

Studies in neuroscience of aging have found that systematic changes in the brain's structure as years passing by.

1. The cerebrum loses 1–2% of its mass each year as well as white matter structural integrity (Fjell, etal., 2013; Raz, et al., 2005) ; the cerebrum weight declines at a rate of around 5% per decade after age 40, with the actual rate of decline increasing significantly particularly over age 70 (Scahill, et al., 2003).
2. Evidence from behavioral studies of cognitive psychology also found aging effects on a wide range of cognitive function, such as memory, attention, executive function, and so on.

Development of Neural Substrate (2)

- Frontal lobe hypothesis:
  Cognitive deficits in older adults are primarily due to anatomical andfunctional deterioration in the frontal lobes (Cabeza & Dennis, 2013; Moscovitch & Winocur, 1995).
- Executive function is mediated by the prefrontal cortex, which is the last maturing brain region during neuroanatomical development (Casey, Galvan, & Hare, 2005) and also the region mostsensitive to degeneration in elderly (Cabeza & Dennis, 2013).

Two models for neural compensation (1)

- Posterior-Anterior Shift in Aging (PASA) phenomena (Davis, et al., 2008):

  the increased prefrontal lobe activation,

  which accompanies either decreased

  activation in posterior regions, such as middle

  temporal lobe (MTL) and visual cortex.

Two models for neural compensation (2)

- Hemispheric Asymmetry Reduction in OLDer adults (HAROLD) (Cabeza, 2002; Cabeza & Dennis, 2013):

  greater recruitment of the homologous brain regions (such as right frontal lobe).

Two brains:neural compensation

1. Posterior-Anterior Shift in Aging (PASA) phenomena (Davis, et al., 2008),

2. Hemispheric Asymmetry Reduction in OLDer adults (HAROLD) : greater recruitment of the homologous brain regions (such as right frontal lobe) (Cabeza & Dennis, 2013).

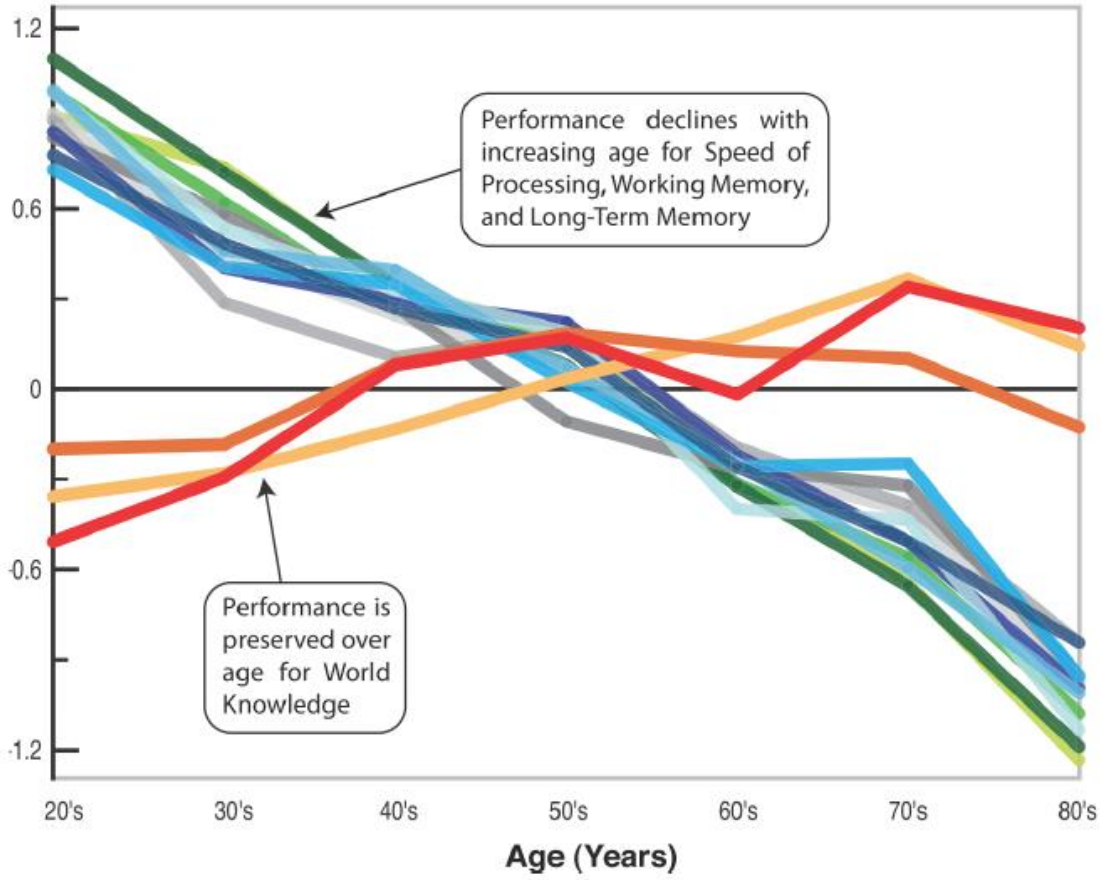
Two minds: attention top and bottom(Goleman 2013)

1. The bottom-up mind:
   Faster, involuntary, automatic, intuitive, impulsive, and habitual, ….
2. The top-down mind:
   Slower, voluntary, effortful, self-control, make new plans,….
3. Kahneman, *Thinking Fast and Slow*

Part III

Language Development Over the Lifespan

Cognitive Aging: stable crystalized knowledge & lower fluid ability



Speed of Processing
- Digit Symbol
- Letter Comparison
- Pattern Comparison

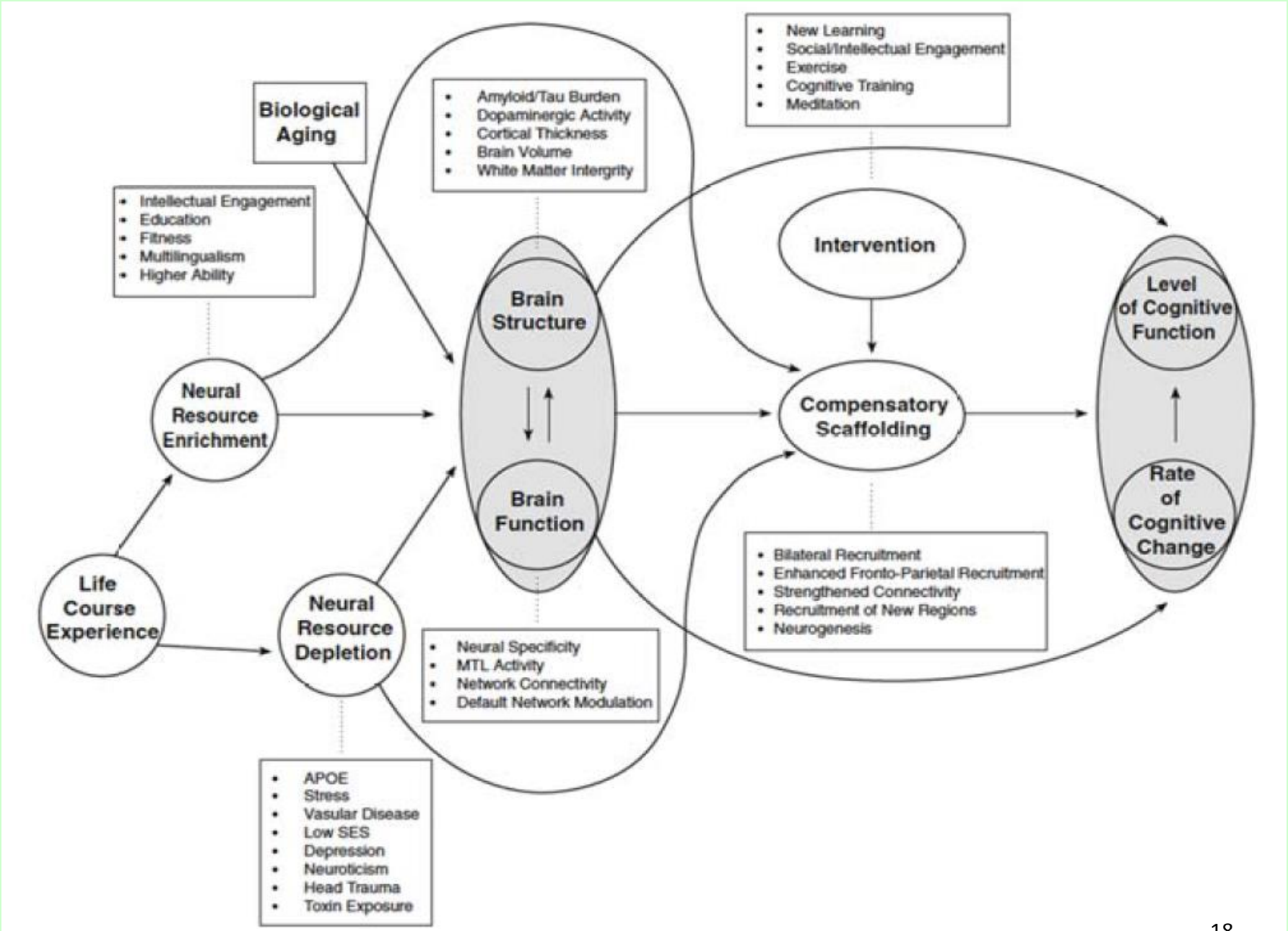
Working Memory
- Letter Rotation
- Line Span
- Computation Span
- Reading Span

Long-Term Memory
- Benton
- Rey
- Cued Recall
- Free Recall

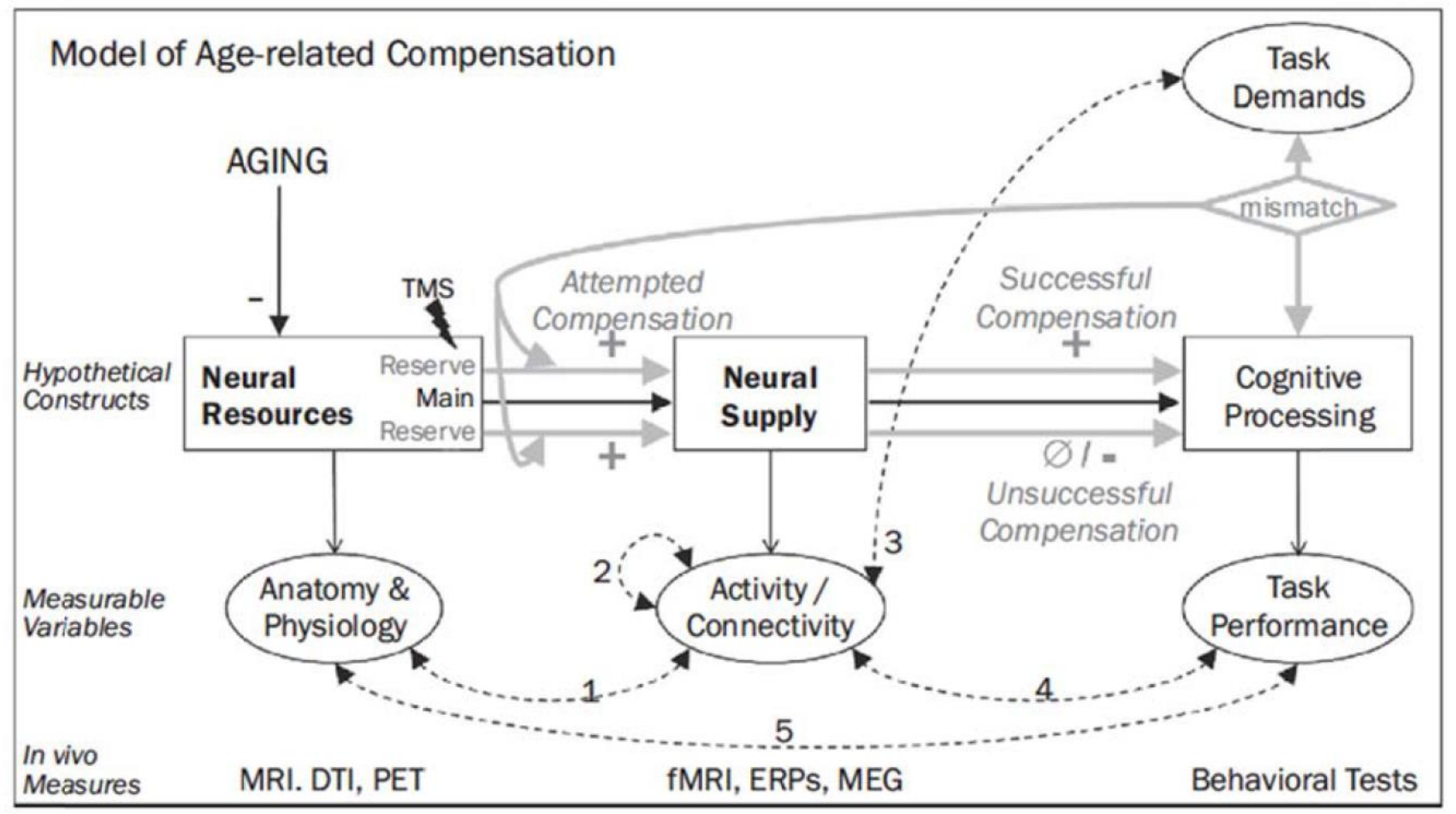
World Knowledge
- Shipley Vocabulary
- Antonym Vocabulary
- Synonym Vocabulary

Park et al., 2002

A Life Course Model of Scaffolding Theory of Aging and Cognition



A conceptual model of the scaffolding theory of aging and cognition-revised (STAC-r) adapted from Reuter-Lorenz and Park (2014).



A model of age-related compensation adapted from Cabeza and Dennis (2013).

General Principles

1) First come, last go; Last come, first go

   (analogous to brain development; embedded in the concept of ‘working languages’)

2) Use it or lose it

   (In the context of bi-multi-lingualism)

3) Means, opportunity, and motivation (MOM)

   (for both first and second language acquisition)

Cognitive Reserve: the Nun Study(1)

- An on-going longitudinal, epidemiological study of aging, investigating risk factors for the development of Alzheimer's disease and longevity with a special focus on linguistic ability (Snowdon et al., 1997)
- Linguistic ability: Idea density and grammatical complexity
- Association between Low idea density in young adulthood with suboptimal neurocogntive development.

Cognitive Reserve: the Nun Study(2)

- Idea density (propositional density)

  How much information can be packed into a sentence, relative to number of words.

- Propositions (conceptual and relational meaning) can be expressed by words, phrases, clauses, and sentences.

- People remember propositions and ultimately forget the grammatical form in which they were expressed.

Cognitive Reserve: the Nun Study(3)

- Grammatical compexity

  Tense inflection, affixation (prefix and suffix), agreement, plural marking, and number of different kind of embedded sentences.

- Embedded sentences with relative clauses are harder to process than those with complement clauses.

Cognitive Reserve: the Nun Study(4)

- Relative clauses in English are embedded with right- branching structure, example:

  I found the cat that killed a rat that ate the meat that I bought from the the person who came to sell the meat at the corner of the building….

- Chinese and Japanese relative clauses are left-branching.

Cognitive Reserve: the Nun Study(5)

- Idea density is correlated with measures of vocabulary; grammatical complexity, with measures of working memory, including digit span and reading span (Cheung & Kemper, 1992)
- Idea density: high scores reflect an economy of expression, whereas low scores, vague, repetitious and redundant expression.

Cognitive Reserve: the Nun Study(6)

- Idea density is less effected by normal aging than grammatical complexity; however, Alzheimer's disease leads to a rapid decline in idea density.
- ID scores declined from 5.35 to 3.52 propositions per 10 words. (on average)
- Compexity from 4.78 to 2.34 on a scale of 7 point scale

Part IV

Construction of a Grammatical Complexity Metrics for Chinese

The main purpose

To measure age-related language attrition of the healthy elderly and the demented elderly, and hopefully for early detection and intervention of MCI (Mild Cognitive Impairment), which is often the early symptom of incurable Alzheimer disease (AD).

Diagnostic Criteria for MCI (1)

1) The most common cause of mild cognitive impairment (MCI) is Azheimer's disease (50%), followed by vascular disease, depression, Lewy body disease, and Parkinson's disease.
2) People with clinical evidence of early cognitive decline, but who do not have dementia, meet the criteria for MCI (Sperling et al, 2011, National Institute on Aging and Alzheimer's Association).
3) Earlier detection of MCI for prevention and intervention.(the earlier, the better).

Diagnostic Criteria for MCI (2)

1) Change in cognition compared to prior level.
2) Impairment in one or more cognitive domains (memory, attention, executive function, language, and visuospatial skills)
3) Less efficient in managing daily affairs.
4) Not demented: the cognitive and behaviorial changes are mild and do not interfere social and occupational functioning significantly. (from Bayles and Tomoeda 2014).

Diagnostic Criteria for MCI (3)

1) MMSE (Mini-Mental State Examination) and CASI (Cognitive Ability Screening Instrument) have been developed and adopted to assess MCI as well as the demented by clinical psychologists and neuropychiarists.
2) Biomarkers (e.g., presence of signature proteins, loss of hippocampal volume, perfusion of temporoparietal cortex, etc.,…)
3) The majority of individual with MCI have abnormal level of beta-amyloid deposit earlier and brain degeneration later (Peterson, et., al. 2010).
4) Dementia Centers/Memory Clinics in major hospitals.

Part V

Construction of grammatical complexity metric in Chinese:

Key Components

Construction of grammatical complexity metric in Chinese (1)

(1) 明天下雨. (0 point)
(2) 明天會下雨。 （1 point）
(3) 明天不會下雨。 （2 points）
(4) 明天大概不會下雨。（3 points）
(5) 明天會下雨, 要帶傘。 （4 points）
(6) 明天會下雨, 要記得帶傘。（5 points）

Construction of grammatical complexity metric in Chinese (2)

Final particles as modals

(7) 明天會下雨嗎？ (1 point + ）

(8) 明天會下雨吧？ (1 point ++)

(9) 明天會下雨喔！ (1 point +++)

(10) 明天不會下雨嗎 ？ (2 points ++++)

(11) 明天不會下雨吧？ （2 points +++++）

Construction of grammatical complexity metric in Chinese (3)

1) Complexity of pronominal references.

   Subject Vs. Object.

   Initial Vs. medial Vs final position. （Wu and Su 2016)

2) Different types of embedded sentences.

3) Counting complexity of relative clauses.

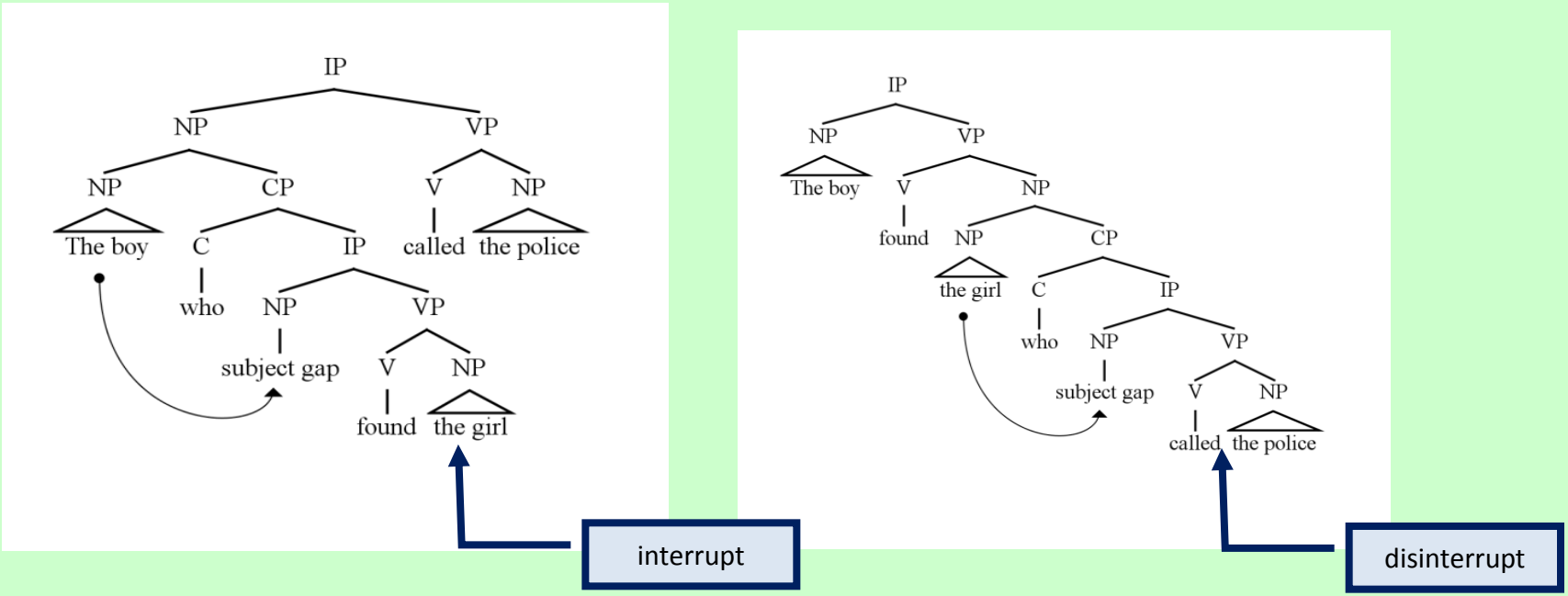
Relative Clauses in Chinese

Head- final in Chinese vs. Head-initial in English (centrally embedded issue)

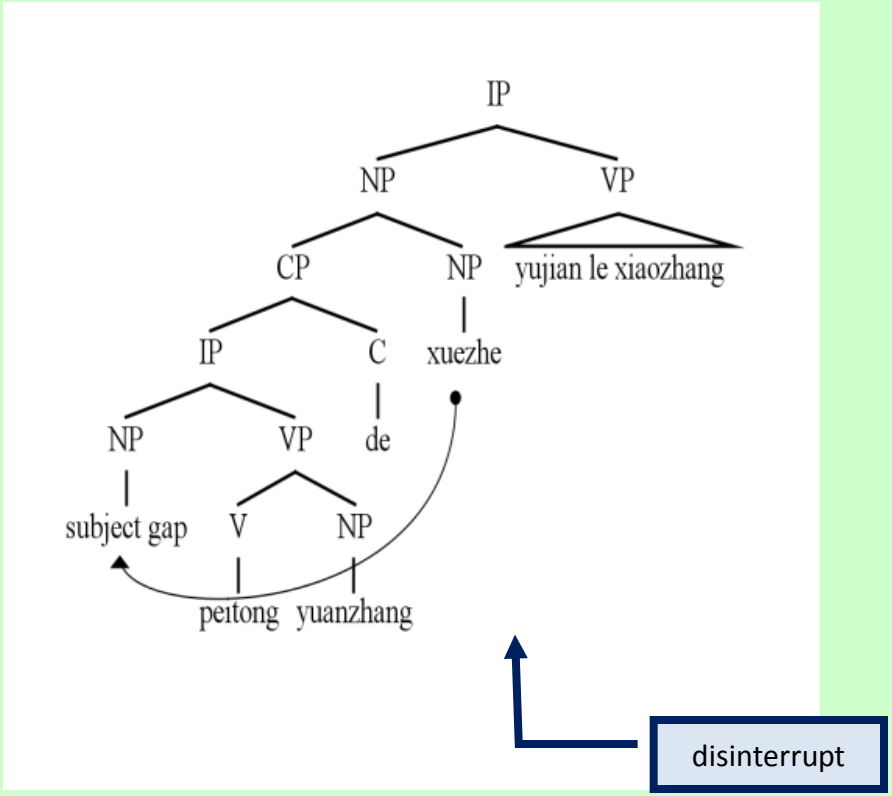
- The dog that the cat that the boy saw chased barked. (well-formed but hard to process)

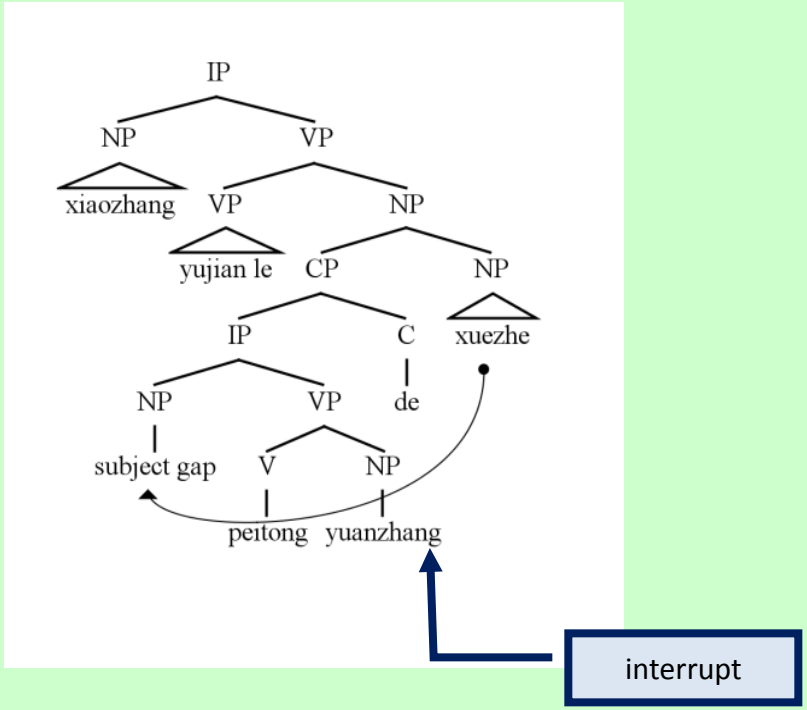
- The boy saw the cat that chased the dog that baked. (well-formed and easy to process)

Tree structure in English (Du 2013)



Tree structure in Chinese (Du 2013)





Classifier System

1) Distinction between measure words and classifiers (Tai and Wang 1990)
2) The default classifier 個 (Myers 2000)
3) Shape classifiers (Kuo 2003)
   one dimension: 條, 根, 枝 (Tai and Wang 1990)
   two dimensions: 張, 幅, 片 (Tai and Zhao 1994)
   three dimensions: 粒, 顆, 塊
4) Shape with other object properties: flexible, rigid, liquid, semisolid, etc., (Pinker 1989)

Topic chains (1)

1) Basic discourse units in Chinese are topic chain rather than sentences as in English (Tsao 1990)

2) Li (2005) has identified 10 patterns of topic chain for the purpose of teaching Chinese as a second language.

Topic chains (2)

3) Tā zuò wán shǒushù, Ø zǒuliǎo.

(Agent/Theme) -C1, (Ø,Agent/Theme)-C2

She finished surgery, Ø left.

4) Ø Shuōzhe, tā xiào qǐlái.

(Ø, Agent) — C1, (Agent) — C2

Ø Saying this, he started laughing.

Topic chains (3)

5) Wǒ wènle tāmen, ∅ dōu bù zhīdào.

(Agent) — C1, (∅, Theme) — C2

I asked them, ∅ didn’t know.

6) Māmā gěi wǒ qián, wǒ bù huā ∅.

(Agent) — C1, (∅, Patient) — C2

Mom gave me money, I didn’t spend ∅.

Topic chains (4)

7) Fàn hǎole, nǐ chī Ø ba.

(Theme) — C1, (Ø, Patient) — C2

Dinner is ready, you can eat Ø.

8) Shū, wǒ búmǎi Ø, yě bù kàn Ø.

(Patient) — C1, (Ø, Patient) — C2

Books, I don’t buy Ø and don’t read Ø.

Topic chains (5)

9) Qiáng shàng yǒu fú huà,Ø hěn piàoliang.

(Location) — C1, (Ø) theme — C2

On the wall is a picture, Ø very pretty.

10) Zhuō shàng yǒu gè hú,Ø lǐmiàn yǒu chá.

(Location) -C1, (Ø+position word, Locative) – C2

On the table there is a pot, Ø inside there is tea.

Topic chains (6)

11) Tā, rén lǎo,Ø xīn bùlǎo.

Overt Double Topic Chain

He, age is old, Ø heart is not old.

12) Wǒ kūle,Ø lèi liú mǎnmiàn.

Covert Double Topic Chain

I cried, Ø tears streaming down.

Part VI

Field Methods

Case 1: Narration and Description

研究方法

- 參與者

  總共有五十位來自於台灣**嘉義縣**民雄長壽會館的老人自願參與研究，其母語皆為閩南語，年齡介於65至85歲。在錄音進行之前，參與者需要接受訪談: (1)**基本資料**訪談，內容包含腦傷、失智、閱讀習慣、語言、聽力、視力是否正常的問題。(2) **AD-8極早期失智症篩檢量表**訪談（Liu, Chou, Lai, & Yang, 2009）。本研究對象扣除有腦傷病史及失智傾向的參與者之後，剩40位。最後隨機挑選**二十位**，一組為**65-74歲**， 另一組為**75-85歲**，控制因子為**教育程度**(不識字與受過六年小學)。

- 研究步驟

  錄音材料為Olympus LS-10數位錄音筆，錄音地點於民雄鄉長壽會館該處一個房間，錄音分為兩階段，第一階段是**個人生活經驗敘述**（narrative），第二階段為**看圖敘述**（picture description）。受試者所看的實驗材料為無字圖畫書“Frog, where are you?”（Mayer, 1969）。

- 語料轉記

  - 使用成人語料庫拼音輸入程式2.0轉記蒐集完的語料（Ruan et al., 2012）。斷句規則以教育部臺灣閩南語常用詞辭典（教育部國語推行委員會，2008/2011）為主、中央研究院現代漢語平衡語料庫3.0（中央研究院詞庫小組，1995/1998）為輔。

- 個人生活經驗敘述的語料轉記五分鐘，看圖敘述轉記到參與者故事描述結束。四十份語料轉記完成之後，由另外三位具有語言學背景的人協助檢查轉記內容是否有誤。若看法與原始轉記者的觀點有落差時，則進行討論，並在最後達到100%雙方同意。

平均語句長度與平均子句數量之計算

- 根據Brown (1973)英語平均語句長度計算規則、張顯達(1998)現代漢語平均語句長度計算規則，訂立計算**閩南語的平均語句長度**的適合規則，轉記完成的語料扣除填補詞、重複詞句(Brown, 1973)，再扣除與圖畫書不相干內容詞彙(鄒啟蓉、張顯達，2007)，最後所需要分析語料總共為1671個語句。

- 計算(1)**主要子句**(main clauses)、(2)**包孕句**(embedded clauses)以及(3)**附屬子句**(subordinate clauses)。本研究計算漢語的包孕句根據黃宣範(1983)及鄒啟蓉與張顯達(2007)可再細分為: (1)**遞繫句**(Serial verb construction)、(2)**補語子句** (Complement clause)、(3)**關係子句** (Relative Clause)、(4)**描述句**(Descriptive clause)以及(5)**軸心句**(Pivotal construction)等。**附屬子句**則依連繫詞的語意分類再細分為**時間**、**因果**、**條件**及**其它**等四類。

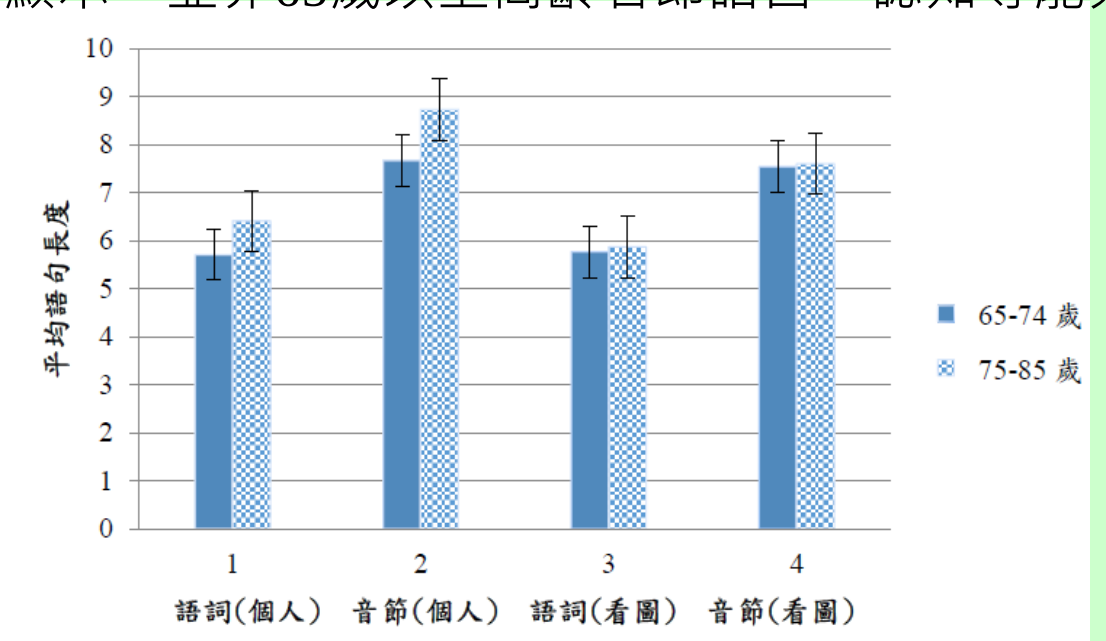
- 統計工作

  最後使用IBM SPSS statistics V.21統計軟體來分析平均語句長度與平均子句數量等的數據。

研究結果與討論

- 年齡

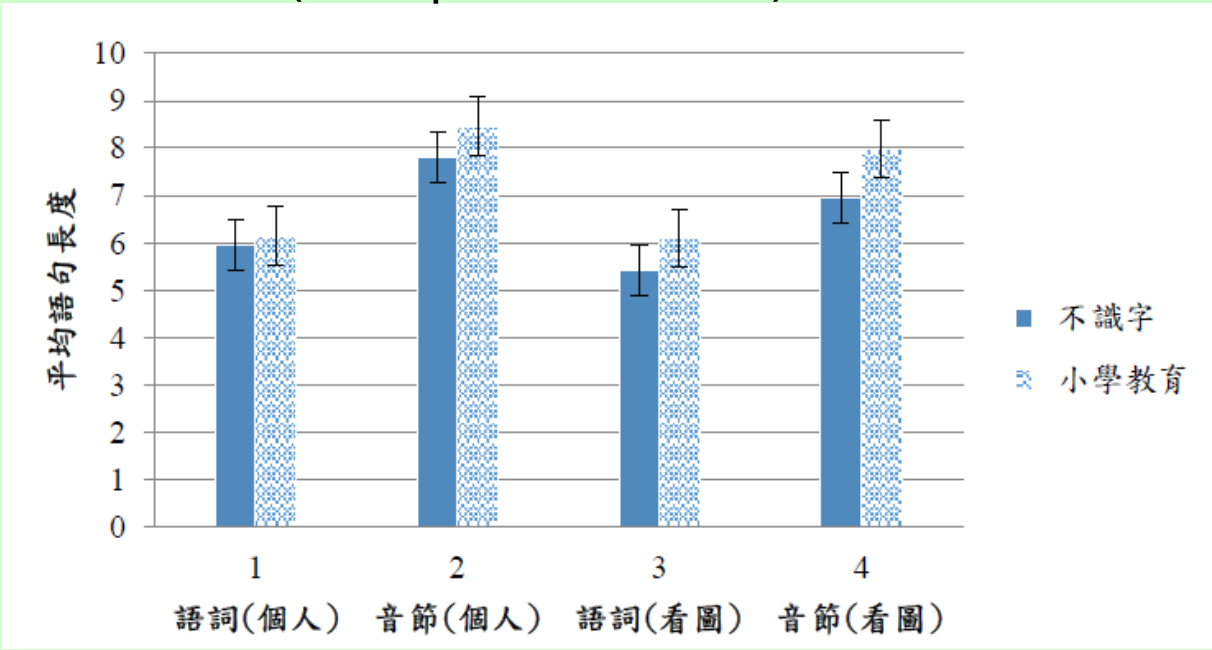
經由**二因子變異數**分析，結果如圖三，顯示**年齡**對**個人生活經驗敘述**的**平均語句長度（音節）**達到顯著性（$p < .05$），**75-85歲**的參與者在個人生活經驗敘述上，**比起65-74歲**的參與者的**語言能力來得長**。雖然聯合國世界衛生組織及所訂立的65歲高齡者年齡門檻，此研究結果顯示，並非65歲以上高齡者即語言、認知等能力開始衰退。



圖三： **65-74歲**與**75-85歲**參與者的**平均語句長度**比較

- 教育程度

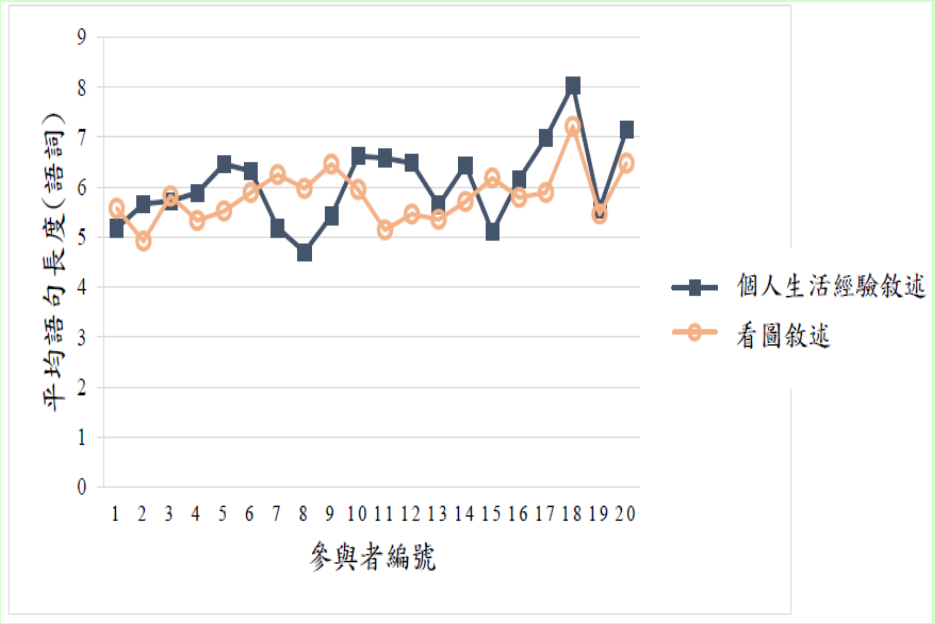
  經由**二因子變異數**分析，結果如圖四，顯示**教育程度**對**看圖敘述**的**平均語句長度（語詞、音節）**達到顯著性（$p < .05$）。受過**小學六年教育**的參與者在**看圖敘述**的**平均語句長度（語詞、音節）長於不識字**的參與者。此結果符合先前的研究成果，即教育程度越高的人，其語言表現越佳（Kemper et al. 1989）。



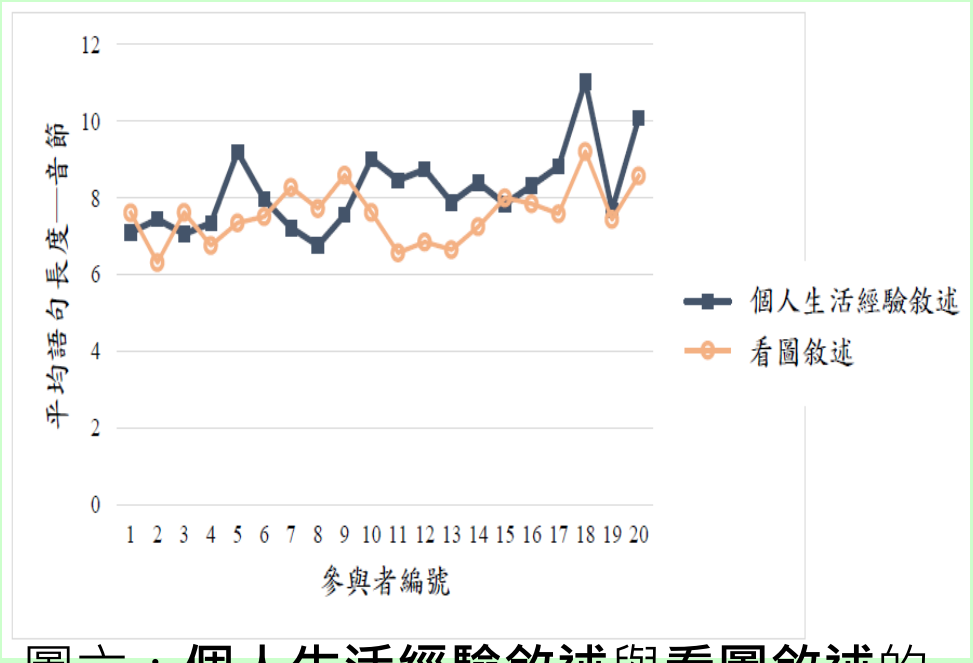
圖四：**不識字**與**受過小學教育**參與者的**平均語句長度**比較

- 敘述類型

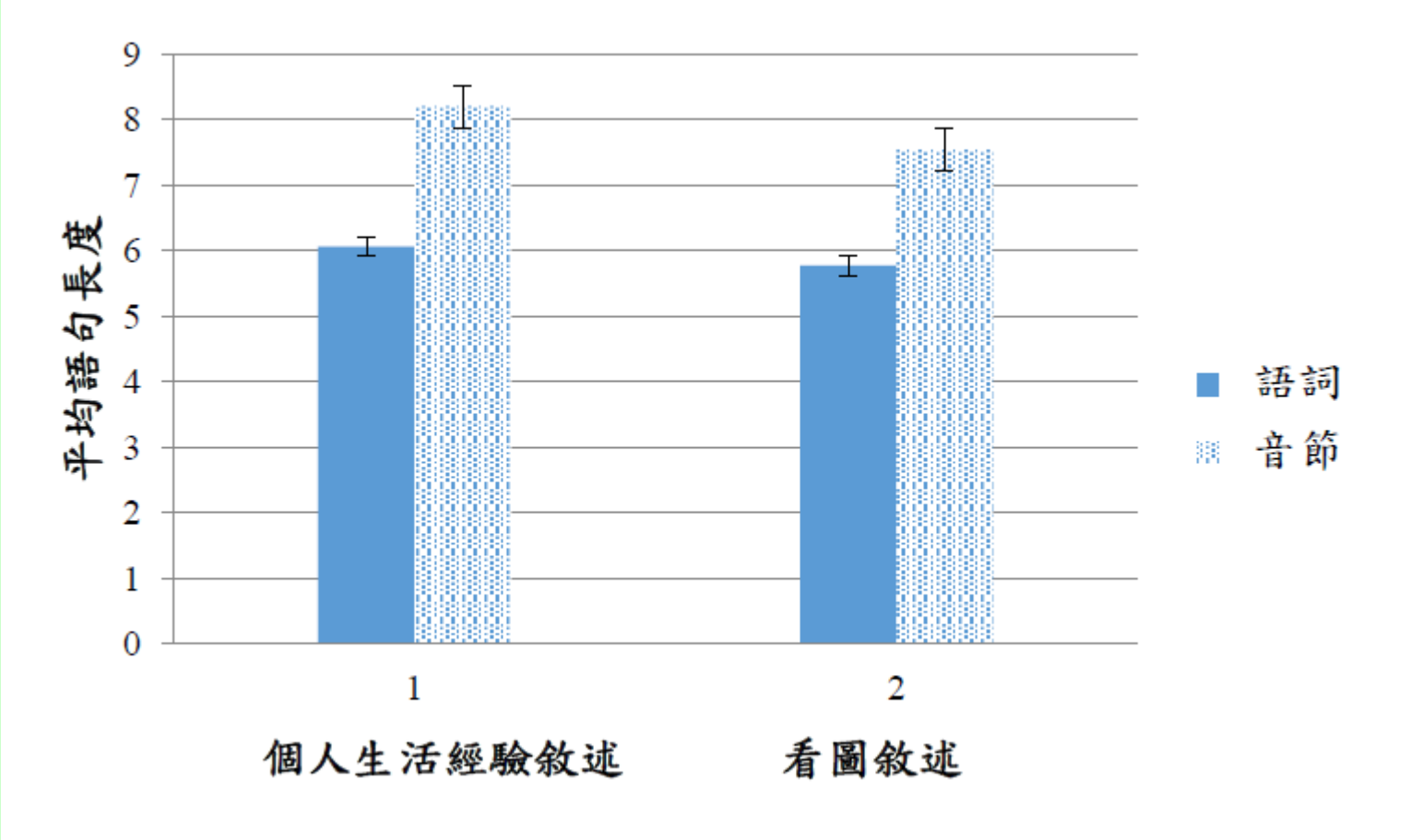
經由**成對樣本T檢定**分析，結果如圖五、圖六、圖七，顯示參與者的個人生活經驗敘述及看圖敘述有顯著差異（$p < .05$）。**個人生活經驗敘述**的**平均語句長度（語詞）/（音節） 長於看圖敘述**的平均語句長度。**看圖敘述**綜合**一般認知**、**社會認知**及**語言能力**的表現（錡寶香，1999；Berman & Slobin, 1994；Trabasso & van den Broek, 1985），參與者多了對圖畫**理解**的程序，所以**看圖敘述**的**平均語句長度較短**。



圖五：**個人生活經驗敘述**與**看圖敘述**的**平均語句長度（語詞）**之比較



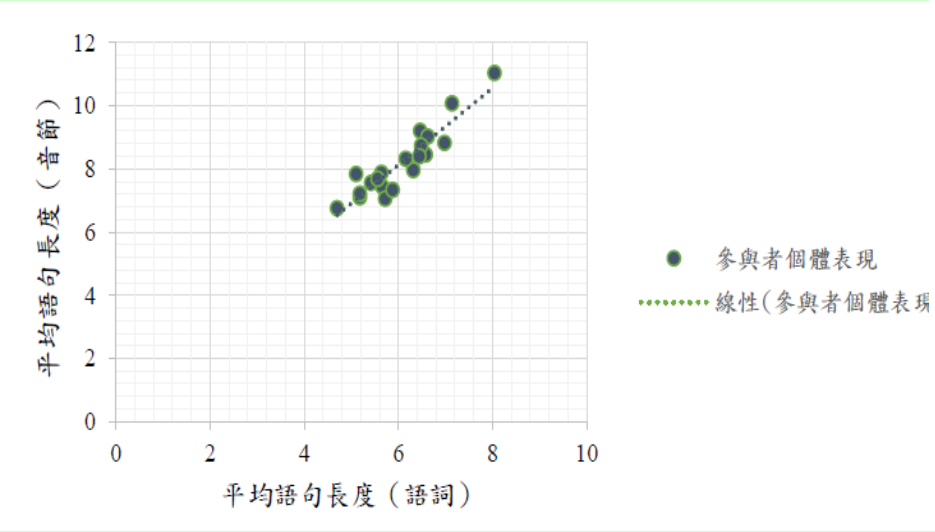
圖六：**個人生活經驗敘述**與**看圖敘述**的**平均語句長度（音節）**



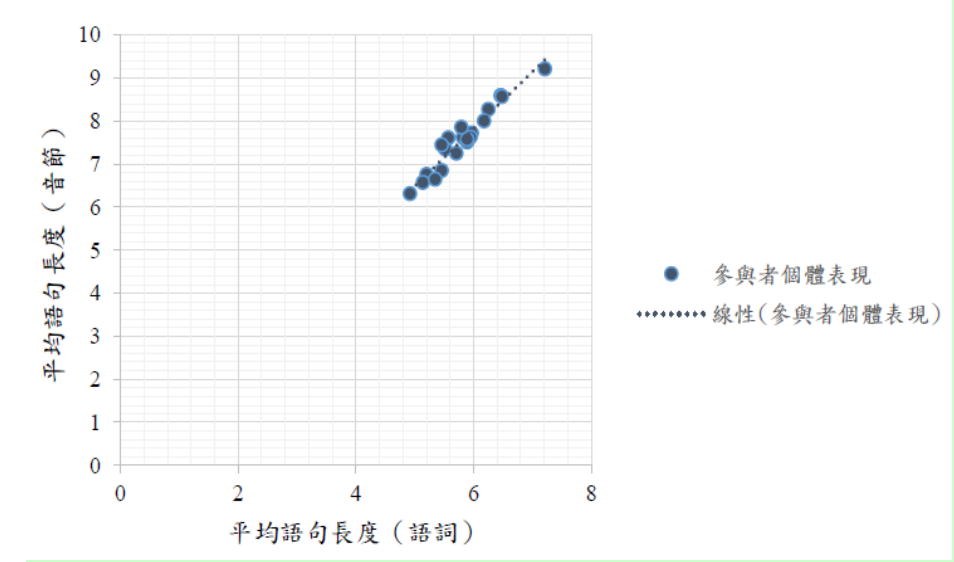
圖七：**個人生活經驗敘述**與**看圖敘述**的**平均語句長度**比較

- 平均語句長度的**語詞**及**音節**的兩個指標之間的關係

  經由**皮爾森積差相關係數**檢測，結果如圖八、圖九，顯示**個人生活經驗敘述**及**看圖敘述**皆有**高度正相關**($r > .900$)，證明**平均語句長度（語詞）**及**平均語句長度（音節）**成**正比**。即平均語句長度（語詞）越多，其平均語句長度（音節）也會越多；反之亦然，平均語句長度（音節）越多，其平均語句長度語詞）也會越多。



圖八：個人生活經驗敘述平均語句長度兩種指標的關係



圖九：看圖敘述平均語句長度兩種指標的關係

- **年齡**與**教育程度**在**平均語句長度**及**平均子句數量**表現的差異情形

  經由**二因子變異數**分析，結果如表一，顯示**教育程度**僅於**平均語句長度有顯著性**（F（1, 16）= 11.141, p < .05），即**教育程度越高**者，其**平均語句長度越多**。然而年齡在平均語句長度上，則未呈現顯著性（p > .05）。另外一方面，年齡及教育程度皆未在平均子句數量有顯著性（p > .05），其證明**年齡**與**教育程度並非是平均子句數量**的**顯著因子**。

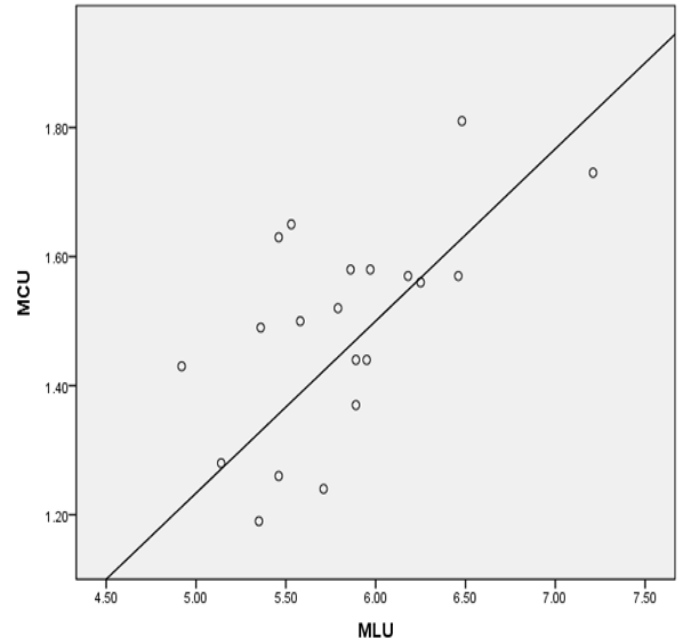
依變項	年齡（65-74 vs. 75-85）		教育年限（0 vs. 6）		年齡*教育	
	df	F	df	F	df	F
平均語句長度	（1,16）	.132	（1,16）	**11.141***	（1,16）	.192
平均子句數量	（1,16）	.962	（1,16）	3.100	（1,16）	1.847

*p < .05

表一：二分子因子（年齡、教育）在平均語句長度與平均子句數量的變異數分析

- **平均語句長度**與**平均子句數量**兩者之間的關係

  經由**皮爾森積差相關係數**分析，結果如圖十，顯示兩者呈現**正相關**。即受試者的**平均語句長度**越多，其產生的**平均子句數量**越多；抑或**平均子句數量**越多，其產生的**平均語句長度**越多。



圖十： 平均語句長度與平均子句數量關係圖

結論與未來研究

- **結論**
  - **年齡層較高（75-85歲）**的參與者在**個人生活經驗敘述**的**平均語句長度（音節）較長**。
  - **平均語句長度**與**教育程度有顯著相關**，結果顯示受過**六年小學教育**的受試者所產生的平均語句長度明顯**多於不識字**的受試者。**教育**程度**較高**的參與者在**看圖敘述**的**平均語句長度（語詞、音節）較長**。
  - 高齡參與者**個人生活經驗敘述**的**平均語句長度（音節）**比**看圖敘述**的**平均語句長度（音節）較長**。
  - **平均子句數量**似乎與**年齡**跟**教育程度未有顯著相關**。本研究結果未符合先前相關文獻的結果，主要原因推測為受試者在看圖敘述的語言表達能力方面，其句子複雜度仍呈現穩定，並未明顯受到年齡或教育程度的因子所影響。

- 高齡受試者的語言能力並未明顯衰退，其原因為他們皆為活躍於社區活動中心的長者，幾乎每天都從事不同的學習活動，例如：唱歌、國標舞等課程及旅行聯誼等活動，因此若老年人能夠**持續參與社交活動**，推測即能保有其相當的語言能力如**口語表達能力**。

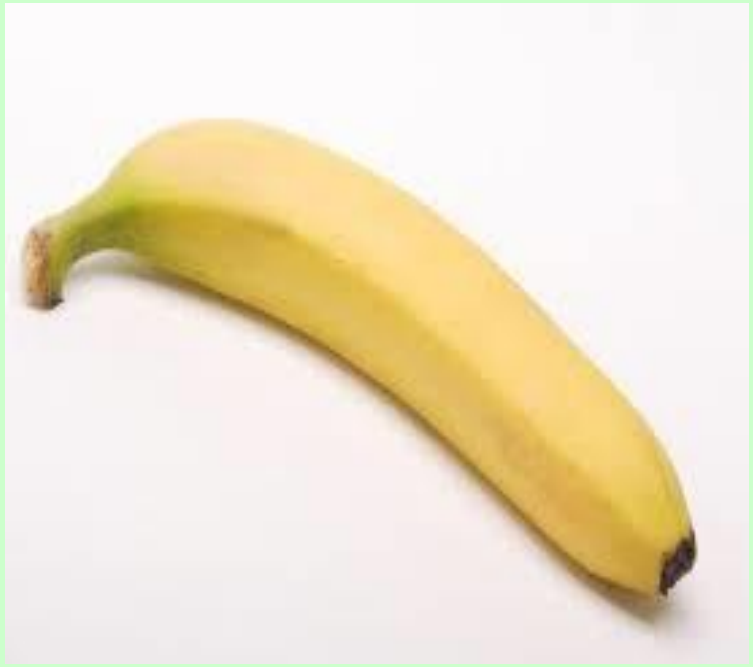
未來研究

- 此研究以**橫斷式研究**(cross-sectional study)，了解不同**年齡**及不同**教育程度**的參與者**閩南語平均語句長度**及**平均子句數量**之間的差異性，但高齡參與者**個體差異性**(individual differences)極大，參與者因為**成長背景**及**生活經驗**不同而影響語言表達能力。因此未來可採用**縱貫性研究**（longitudinal study），再次取同批參與者的語料，藉此了解高齡參與者個體的語言衰退或者進步傾向。

- 此外，**類型**（Genre）可能為重要因素之一，先前研究文獻（Kemper et al., 1989; Cheung & Kemper, 1992）所使用的語料來源皆為自發性言語（spontaneous speech），所以這次的語料也能夠延伸使用更多的檢測方式來研究參與者的語言能力，例如：比較**看圖敘述**的**平均子句數量**和**個人生活經驗敘述**的**平均子句數量**是否受到**年齡**或**教育程度**的因子所影響。

- 最後，**概念稠密度**（Idea density）以及**語法複雜度**（grammatical complexity）是測量**高齡者語言能力**以及其**語言流失**極其重要的兩種基準。膾炙人口的 “The Nun Study”就是利用這兩種基準去發現大腦神經老化與「**認知儲存**」（Cognitive Reserve）的關鍵。兩種基準的建立基本上是根據英語語法的特色。漢語語法與英語語法有相當程度的差異，因此要利用它們來測量**漢語高齡者**的語言需要大幅度的修正計算方式。未來以**漢語高齡者溝通能力研究**為起點，藉由不同面向研究高齡參與者的語料，可建立「**概念稠密度**」以及「**語法複雜度**」在**漢語語法**的計算方式，進而建立適用於台灣的**語言評估指標**，是值得探討的**語言學**議題。

Case 2: Elicitation of Classifiers



感謝聆聽、歡迎指正！

3Q!!

Discussions and Questions!!

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