

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

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# Speech therapy for children with written language disorders – Theory and Practice

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# Written Language Disorders

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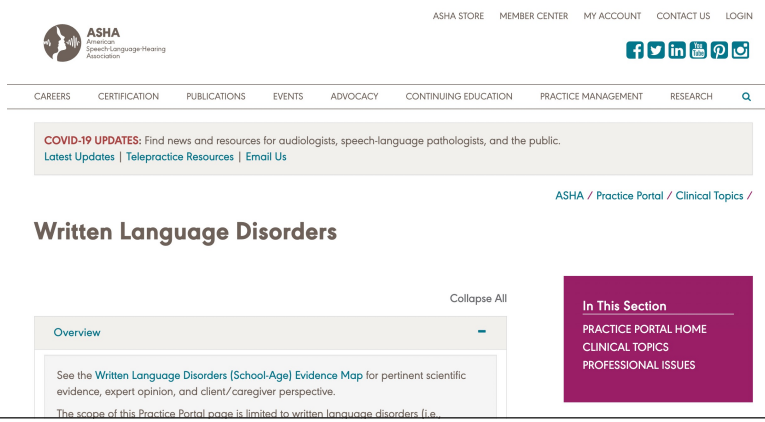
## In this webinar…

- Defining the problem
- Theories of reading and writing
- Empirical data obtained in Chinese studies
- Intervention studies
  - Theoretical basis
  - Training objectives
  - Preliminary data



## Written language disorders

- ASHA webpage…



## Reading difficulties as a “language” problem

THE JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY
Journal of Child Psychology and Psychiatry 53:5 (2012), pp 593–607 doi:10.1111/j.1469-7610.2011.02495.x

### Annual Research Review: The nature and classification of reading disorders – a commentary on proposals for DSM-5

**Margaret J. Snowling,[1] and Charles Hulme[2]**
[1]Department of Psychology, University of York, York, UK; [2]Division of Psychology and Language Sciences, University College, London, UK

This article reviews our understanding of reading disorders in children and relates it to current proposals for their classification in DSM-5. There are two different, commonly occurring, forms of reading disorder in children which arise from different underlying language difficulties. Dyslexia (as defined in DSM-5), or decoding difficulty, refers to children who have difficulty in mastering the relationships between the spelling patterns of words and their pronunciations. These children typically read aloud inaccurately and slowly, and experience additional problems with spelling. Dyslexia appears to arise principally from a weakness in phonological (speech sound) skills, and there is good evidence that it can be ameliorated by systematic phonic teaching combined with phonological awareness training. The other major form of reading difficulty is reading comprehension impairment. These children read aloud accurately and fluently, but have difficulty understanding what they have read. Reading comprehension impairment appears to arise from weaknesses in a range of oral language skills including poor vocabulary knowledge, weak grammatical skills and difficulties in oral language comprehension. We suggest that the omission of reading comprehension impairment from DSM-5 is a serious one that should be remedied. Both dyslexia and reading comprehension impairment are dimensional in nature, and show strong continuities with other disorders of language. We argue that recognizing the continuities between reading and language disorders has important implications for assessment and treatment, and we note that the high rates of comorbidity between reading disorders and other seemingly disparate disorders (including ADHD and motor disorders) raises important challenges for understanding these disorders. **Keywords:** Reading disorders, language disorders, dyslexia, reading comprehension impairment, intervention.





# Theories

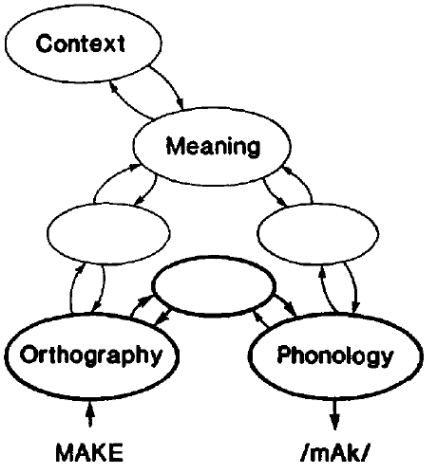


## Implications

- Speech therapists play significant role in the management of children with written language disorders
- Similar training goals as typical oral language intervention
  - Learning the items
  - Acquiring the rules behind

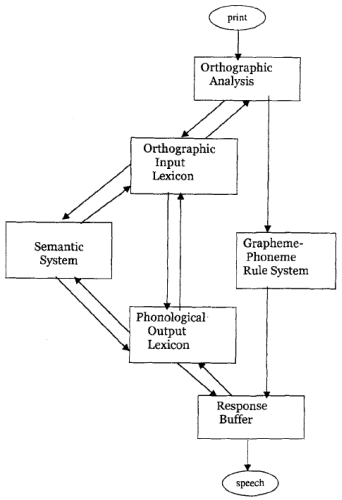


## “Triangle” model (Seidenberg & McClelland, 1989)



## Dual-route (cascaded) model (Colheart et al., 2001)

- Regular words
  - E.g. hat
- Irregular (exception) words
  - E.g. pint
- Pseudowords
  - E.g. *smat*








# Knowing the rules

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## Dual-route model of reading/writing Chinese (Weekes et al., 2006)

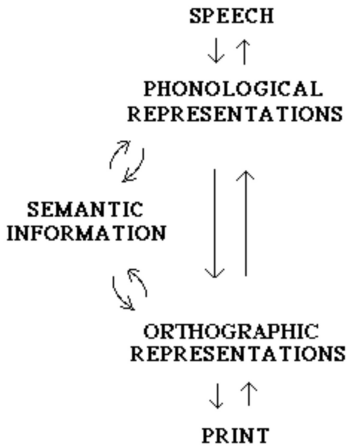



**Figure 1:** Functional model of reading and writing in Chinese



## Metalinguistic awareness

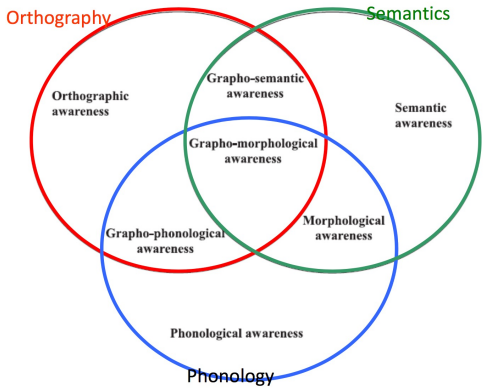
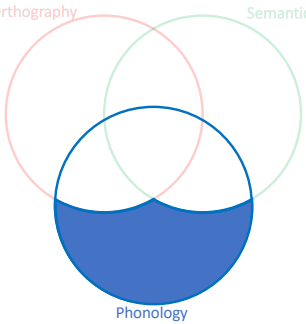



FIGURE 1 Interrelation between different aspects of metalinguistic awareness.

Kuo & Anderson (2006)

## Metalinguistic awareness

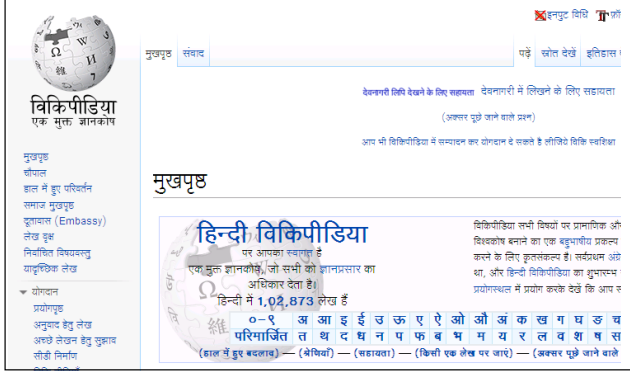
- Phonological awareness
  - "… ability to reflect on and manipulate basic phonological units of a language…" (Kuo & Anderson, 2006)
  - E.g. say the word "clear" without the /k/

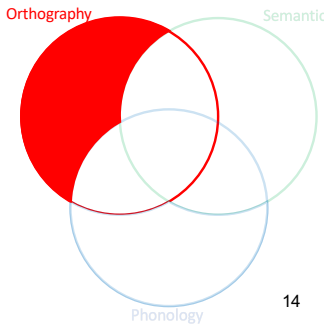





## Orthographic awareness

- Basic orthographic units of a language
- Rules: E.g. What's "legal", what's "illegal"…



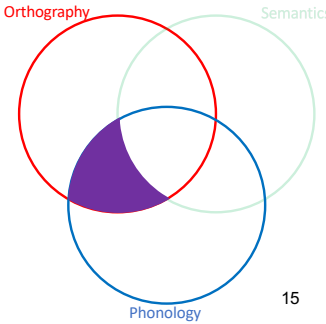






## Grapheme-phoneme correspondence (Ortho – Phono)

- E.g. hat

/ h æ t /

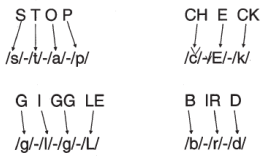




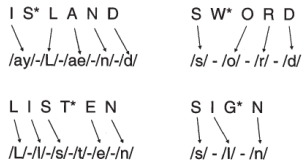

## Con't

- Not that simple actually…

Connections for Regular Words




Connections for Irregular Words

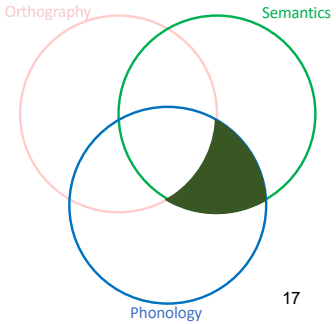



Ehri (2005)

- Orthographic "patterns"
  - E.g. "-ake" in "bake", "cake", "take", "wake"

## Morphological awareness (Phono – Semantics)

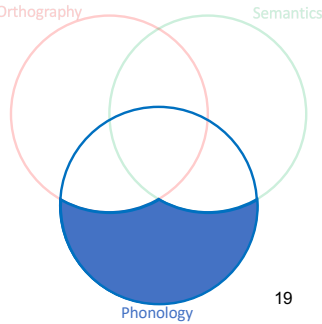
- Basic meaningful units of a language (oral)
  - dogs = dog (plural)
  - teacher = teach + -er
- Knowledge about word combinations
  - cat vs cats
  - top vs stop






## Phonological awareness (Ho et al., 2007; McBride et al., 2003)

- Syllable deletion
  - 「電單車」唔講個「車」字係咩?
- Onset-Rhyme awareness
  - /si/ - /sa/ - /ce/ 邊個唔一樣呀？
  - /baa/ - /saa/ - /di/ 邊個唔一樣呀？






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# Applications in Chinese

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## Empirical data

- McBride et al. (2003) JEP

Table 3
*Hierarchical Regression Equation Predicting Chinese Character Recognition for Kindergarten (K3), Second-Grade (P2), and Combined Sample*

| | K3 | | P2 | | Combined sample | |
|---|---|---|---|---|---|---|
| Step and variable | $\Delta R^2$ | $R^2$ | $\Delta R^2$ | $R^2$ | $\Delta R^2$ | $R^2$ |
| 1. Age | .022 | .022 | .002 | .002 | .540*** | .540 |
| 2. Visual matching, cross out | .054 | .076 | .174*** | .175 | .092*** | .631 |
| 3. Vocabulary elaboration | .188*** | .263 | .072** | .247 | .050*** | .681 |
| 4. Syllable deletion, onset phoneme deletion | .042 | .306 | .045 | .292 | .018** | .699 |
| 5. Rapid number naming, rapid object naming | .065* | .371 | .036* | .347 | .023*** | .724 |
| 6. Morpheme identification, morphological construction | .087** | .457 | .034 | .381 | .031*** | .756 |

* $p < .05$. ** $p < .01$. *** $p < .001$.

## Empirical data

- Lau et al. (2015) CLP

Table 3. Standardised coefficient ($\beta$) and $\Delta R^2$ at the two steps of HRA using accuracy scores in different reading tasks as dependent variables.

| | $\beta$ | $T$ | $\Delta R^2$ |
|---|---|---|---|
| Dependent variable: non-phonetic compounds naming | | | |
| Step 1 | | | 0.11*** |
| Raven | 0.01 | 0.24 | |
| Step 2 | | | 0.28*** |
| Phonological awareness – Rhyme | 0.15 | 2.34* | 0.08*** |
| Phonological awareness – Syllable | 0.16 | 2.74** | 0.05*** |
| RAN | −0.11 | −2.11* | 0.05*** |
| Pinyin_Iso | 0.14 | 2.29* | 0.04*** |
| Orthographic awareness | 0.16 | 3.09** | 0.03*** |
| Pinyin_Real | 0.13 | 2.00* | 0.02* |
| Morphological awareness | 0.14 | 2.33* | 0.01* |
| Dependent variable: Irregular phonetic compounds naming | | | |
| Step 1 | | | 0.16*** |
| Raven | 0.07 | 1.25 | |
| Step 2 | | | 0.30*** |
| Phonological awareness – Rhyme | 0.18 | 3.07** | 0.10*** |
| Pinyin_Iso | 0.22 | 3.91*** | 0.07*** |
| RAN | −0.12 | −2.32* | 0.05*** |
| Phonological awareness – Syllable | 0.1 | 1.86 | 0.03*** |
| Morphological awareness | 0.14 | 2.54* | 0.01* |
| Pinyin_Real | 0.1 | 1.76 | 0.01* |
| Dependent variable: Regular phonetic compounds naming | | | |
| Step 1 | | | 0.10*** |
| Raven | 0.02 | 0.29 | |
| Step 2 | | | 0.22*** |
| Phonological awareness – Rhyme | 0.24 | 3.66*** | 0.12*** |

*$p<0.05$; **$p<0.01$; ***$p<0.001$.



## Empirical data

- Yeung et al. (2011) *SSR*

TABLE 3
Standardized Betas for Regression Equations Predicting Word Reading and Word Spelling From Reading-Related Skills Measures After Controls for Differences in Age, IQ, and Oral Vocabulary

| | *Word Reading* | | | *Word Spelling* | | |
|---|---|---|---|---|---|---|
| *Final Step Predictor* | B | SE B | $\beta$ | B | SE B | $\beta$ |
| Age | −0.02 | 0.33 | 0.00 | −0.06 | 0.07 | −0.04 |
| IQ | 0.14 | 0.10 | 0.07 | −0.01 | 0.02 | −0.02 |
| Oral vocabulary | −0.03 | 0.31 | −0.01 | 0.03 | 0.06 | 0.02 |
| Phonological awareness | 0.04 | 0.60 | 0.00 | 0.22 | 0.12 | 0.10 |
| Orthographic skills | 2.63 | 0.49 | 0.29*** | 0.25 | 0.10 | 0.15* |

*$p < .05$. **$p < .01$. ***$p < .001$.

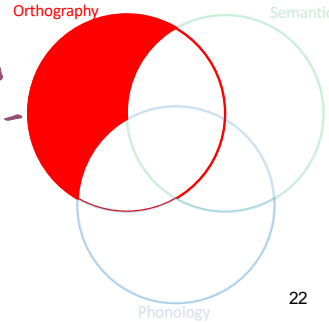
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| *Predictor* | *Word Reading* | *Word Spelling* |
|---|---|---|
| Unique contributions | | |
| 1. Age, IQ & oral vocabulary | 0.025 | 0.020 |
| 2. Orthographic skills | 0.097 | 0.027 |
| 3. Morphological awareness | 0.065 | 0.132 |
| Common contributions | | |
| Common to 1 and 2 | 0.005 | −0.001 |
| Common to 1 and 3 | 0.085 | 0.062 |
| Common to 2 and 3 | 0.023 | 0.001 |
| Common to 1, 2 and 3 | 0.069 | 0.039 |
| Sum | 0.369 | 0.280 |



## Orthographic awareness

- Basic orthographic units of Chinese
- Word 詞語 荷花
- Characters 單字 荷 花
- Radicals 聲旁 / 形旁 艹何 艹化
- Logographemes 部件 艹亻口 艹亻匕
- Strokes 筆劃 一丨ノ一小 一丨ノ丨匕一






## Empirical data

- Lau et al. (2015) CLP

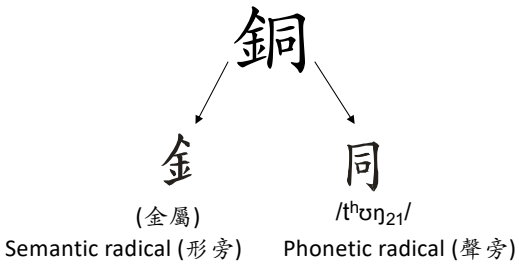
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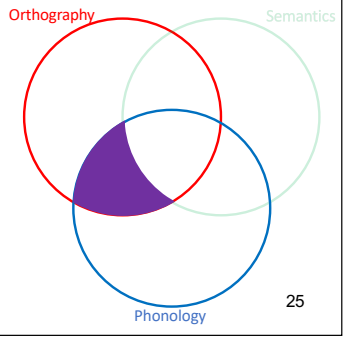
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| RAN | −0.12 | −2.32* | 0.05*** |
| Orthographic awareness | 0.18 | 3.75 | 0.03*** |
| Pinyin_Real | 0.1 | 1.76 | 0.01* |
| Dependent variable: Regular phonetic compounds naming | | | |
| Step 1 | | | 0.10*** |
| Raven | 0.02 | 0.29 | |
| Step 2 | | | 0.22*** |
| Phonological awareness – Rhyme | 0.24 | 3.66*** | 0.12*** |
| Pinyin_Iso | 0.24 | 3.66*** | 0.10*** |

*$p<0.05$; **$p<0.01$; ***$p<0.001$.

## Grapheme-phoneme correspondence (Ortho – Phono)

- Phonetic compound characters 形聲字

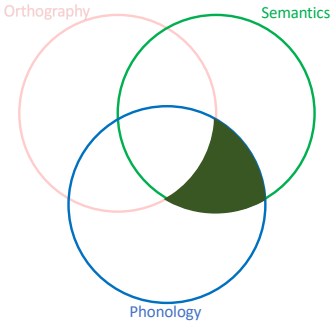



- Regularity
  - Regular 清、桐
  - Irregular 倩、洞



## Morphological awareness (Phono – Semantics)






## Empirical data

**Learning to Read Chinese Beyond the Logographic Phase**

Connie Suk-Han Ho, Peter Bryant

First published: 09 November 2011 | https://doi.org/10.1598/RRQ.32.3.3 | Citations: 154

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ABSTRACTS

This study investigated the role of phonetics for children learning to read Chinese. Participants were 45 Chinese first graders and 45 second graders recruited in Hong Kong. The study revealed that children name phonologically regular Chinese characters more accurately than irregular ones, and phonetic-related errors were the most dominant type in reading Chinese characters and words. There were statistically significant correlations among Chinese pseudocharacter reading, Chinese real character reading, and rhyme detection for the first graders. These findings suggested that Chinese first and second graders do rely on phonetics for sound cues in naming Chinese characters, and phonological awareness seemed to be important in learning these script-sound regularities in Chinese. It therefore appeared that beyond the logographic phase, there was also a phonological phase in learning to read Chinese.



## Morphemes

Smallest meaningful units of the language

- E.g. “Unchangeable”
- E.g. “月餅” /jyut6 beng2/ [mooncake]

## Words can be classified as…

Monomorphemic words
- e.g. 手、狗

Multi-morphemic words
- e.g. 手錶、耳環、狗公園



## Morphology of Chinese

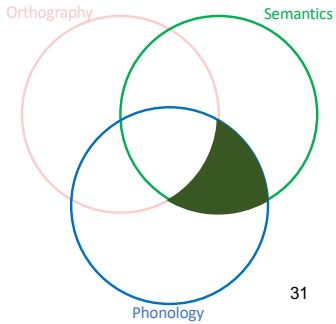
- Inflectional
  - 黃色、藍色、紅色…
  - 我們、你們、他們…
  - Aspect markers
- Derivation
  - 電腦化、羅馬化…
- Compounding
  - 手錶、凍飲…



## Morphological awareness (Phono – Semantics)

Manipulations of morphemes
- e.g. 龜、速、九十

Structure of words
- 龜|速
- 九十|後






## Morphosyntax

- Compare the following:
  - 「龜速」vs「速龜」
  - 「潮童」vs「童潮」

## Morphosyntactic structures

- Basically includes
  - 偏正 (e.g. 飛機、電腦)
  - 聯合 (e.g. 閱讀、朋友)
  - 述賓 (e.g. 出版、彈琴)
  - 述補 (e.g. 推廣、打開)
  - 主謂 (e.g. 民主、人為)



## Con't

- Lau et al. (2015) CLP

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| Morphological awareness | 0.14 | 2.33* | 0.01* |
| Dependent variable: regular-consistent compounds naming | | | |
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| Phonological awareness | 0.04 | 0.60 | 0.00 | 0.22 | 0.12 | 0.10 |
| Rapid naming | −1.70 | 0.24 | −0.34*** | −0.15 | 0.05 | −0.16** |
| Orthographic skills | 2.63 | 0.40 | 0.29*** | 0.25 | 0.10 | 0.15* |
| Morphological awareness | 2.64 | 0.57 | 0.25*** | 0.70 | 0.12 | 0.36*** |

*$p < .05$. **$p < .01$. ***$p < .001$.

TABLE 4
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## Con't

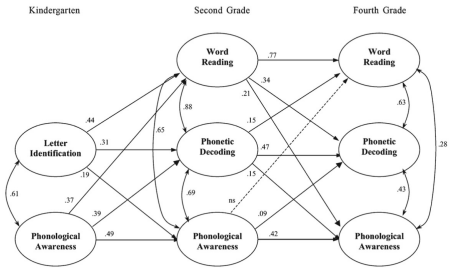
- Tong et al. (2011) JRR

**Table 4.** Hierarchical regression predicting Chinese word reading across times 1–3, and time 3 Chinese word dictation from all time 1 measures, controlling for time 1 Chinese word reading.

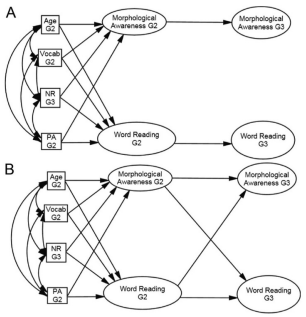
| Step and variables | T2 word reading | | T3 word reading | | T3 word dictation | |
|---|---|---|---|---|---|---|
| | $\Delta R^2$ | β | $\Delta R^2$ | β | $\Delta R^2$ | β |
| 1. T1 controlled variables and word reading | .664*** | .786*** | .413*** | .575*** | .297*** | .345*** |
| 2. T1 morphological construction | .000 | −.087 | .000 | −.060 | .001 | −.052 |
| 3. T1 homophone identification | .014** | .127** | .012† | .125* | .004 | .073 |
| 4. T1 visual–spatial relationships | .008* | .094† | .015* | .144* | .013† | .130† |
| 5. T1 syllable deletion | .012** | .141** | .006 | .099 | .010 | .130 |
| 2. T1 syllable deletion | .013** | .677 | .009† | .423 | .015† | .312 |
| 3. T1 visual–spatial relationships | .002 | .680 | .008 | .430 | .007 | .319 |
| 4. T1 morphological construction | .003 | .683 | .001 | .432 | .001 | .320 |
| 5. T1 homophone identification | .015** | .698 | .014* | .446 | .005 | .325 |
| 2. T1 syllable deletion | .013** | .677 | .009 | .423 | .015† | .312 |
| 3. T1 visual–spatial relationships | .002 | .680 | .008† | .430 | .007 | .319 |
| 4. T1 homophone identification | .014** | .693 | .013 | .444 | .004 | .323 |
| 5. T1 morphological construction | .004 | .698 | .002 | .446 | .002 | .325 |
| 2. T1 syllable deletion | .013** | .677 | .009† | .423 | .015† | .312 |
| 3. T1 morphological construction | .002 | .679 | .000 | .423 | .000 | .312 |
| 4. T1 homophone identification | .013** | .692 | .011† | .434 | .003 | .315 |
| 5. T1 visual–spatial relationships | .005† | .698 | .012† | .446 | .010 | .325 |
| $R^2$ | .698 | | .446 | | .325 | |

*Note*: The capitalised T and its numeral at the end of each variable represent the time in which it was measured.
†$p<.10$; *$p<.05$; **$p<.01$; ***$p<.001$.

## Reciprocal relationship




Hogan et al. (2005) *Lang Sp Hearing Ser Sch*




Deacon et al. (2013) *Dev Psy*





## "Rule-based" treatment in Chinese… by us

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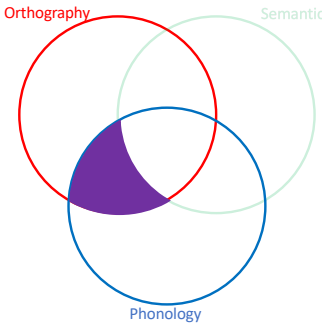
## Implications

- Shall we promote the metalinguistic awareness so that the reading performance will be promoted?
- Shall we directly work on reading instead?
- More like "chicken and egg"…



## Accelerating Reading Abilities (ARA)

- Orthography – Phonology



## Regularity

| Regularity | Character | Phonetic radical |
|---|---|---|
| Regular | 琪/$k^hei_{21}$/ | 其/$k^hei_{21}$/ |
| Irregular | 組/$tsou_{35}$/ | 且/$ts^h\varepsilon_{35}$/ |



## Consistency

| Consistency | Phonetic | Characters |
|---|---|---|
| Consistent | 肙 | 鵑 /$kyn_{55}$/ 娟 /$kyn_{55}$/ 涓 /$kyn_{55}$/ 捐 /$kyn_{55}$/ |
| Inconsistent | 艮 | 根 /$kan_{55}$/ 眼 /$ŋan_{23}$/ 很 /$hɐn_{35}$/ 限 /$han_{22}$/ |



## Regularity x Consistency

| | Regularity | Consistency |
|---|---|---|
| 蝗 | 皇 Regular | 蝗 惶 煌 凰 Consistent |
| 粗 | 且 Irregular | 粗 祖 咀 姐 Inconsistent |



## Con't

| | Regularity | Consistency |
|---|---|---|
| 返 | 反 Regular | 返 販 板 Inconsistent |
| 鈉 | 內 Irregular | 鈉 吶 納 Consistent |

## ARA

- Hypothesis
  - Children failed in reading acquisition because they are not able to establish the metalinguistic awareness of reading
- Goal of treatment
  - To assist the client to establish the metalinguistic awareness of reading



## Targeted metalinguistic awareness

- The awareness of regularity
- The awareness of consistency
- The character awareness (morphological awareness)



## Three treatment stages

- Stage 1
  - To establish the awareness of regularity
- Stimuli
  - Regular and consistent (RC) characters



## Con't

- Stage 2
  - To aware of the existence of irregularity
  - To establish the awareness of consistency
- Stimuli
  - Irregular but consistent (IRC) characters

## Con't

- Stage 3
  - To aware of the existence of inconsistency
  - To flexibly use the regularity rule and the consistency rule
- Stimuli
  - Irregular but consistent (IRC) characters, regular but inconsistent (RIC) characters and irregular and inconsistent (IRIC) characters



## Applying the principles of statistical learning Plante and Gómez (2018)

- Implicit instructions
- "Regularity" principle
  - High frequency of occurrence of the treatment targets with high consistency in the language input

  →One type of characters in each stage
- "Variability" principle
  - The use of varied elements in association with the treatment target in the presentation of language input

  → Twelve pairs of targets in each session



## Probe test

- Tailor-made to track the reading strategies used by each client
- Administered at:
  - The assessment session
  - The end of each treatment session
  - The post-Tx assessment session

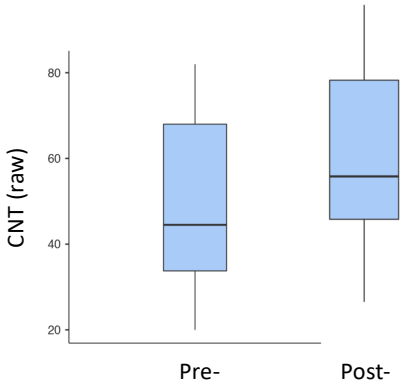


## Con't

- Contains:
  - 6 low freq RC characters
  - 6 low freq RIC characters
  - 6 low freq IRC characters
  - 6 low freq IRIC characters
  - 6 phonetic radicals
  - 6 treatment targets
- The first 4 types of characters are matched for average frequencies

## Empirical data

- Results of paired t-test: t(19) = 7.64, $p < .001$




Leung et al. (in preparation)



## The measure of "Boundedness"

Free morphemes

- Can standalone as words
- E.g. 車、手、杯、木、腦

Bound morphemes

- Can't standalone as words
- E.g. 蟑螂、玫瑰、吝嗇、徘徊



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# Accelerating Morphological Awareness (AMA)

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## Boundedness as a dynamic concept

- Is the morpheme "謙" free or bound?

| | 小一學生 | 中一學生 |
|---|---|---|
| Exposure | 謙虛 | 謙虛、謙讓、謙卑、謙遜 |
| Result | 「謙」是黏著 | 「謙」可以有獨立意思 |

## AMA

- By promoting
  - Non-productive → productive
  - Bound → Free
- To improve word learning abilities

- Some interesting observations
  - 潔 → 清 (清潔)
  - 耍樂 → 玩樂 (玩耍)
  - 捕 → 魚 (捕魚)
  - 兔 → 白 (白兔)



## In short…

- In a single session, introduce…

  車、馬、白、…

  白馬、馬車、白車、…

- Explicit instructions
- Encourage kids to “create” words and define the word meanings accordingly



## Empirical data (Lau & Leung, 2014)

- Effect on Boundedness

| | *Treatment Group* | | | | *Control Group* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Bound Morphemes* | | *Free Morphemes* | | *Bound Morphemes* | | *Free Morphemes* | |
| | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* |
| Pretreatment (max =36) | 3.8 | 1.9 | 4.7 | 2.8 | 4.0 | 1.6 | 4.5 | 2.2 |
| Posttreatment (max =36) | 8.3 | 4.7 | 13.9 | 6.8 | 4.6 | 1.9 | 4.8 | 2.5 |



## Con’t

| | *Treatment Group* | | | | *Control Group* | | | |
|---|---|---|---|---|---|---|---|---|
| | *BB Words* | | *FF Words* | | *BB Words* | | *FF Words* | |
| | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* |
| Pretreatment (max =18) | 5.1 | 3.4 | 7.5 | 3.0 | 5.0 | 3.5 | 7.2 | 2.9 |
| Posttreatment (max =18) | 8.9 | 5.0 | 13.0 | 5.4 | 6.5 | 3.9 | 7.6 | 3.4 |

## Effect on semantic transparency

- Opaque (e.g. 沙發) vs Transparent words (e.g. 沙灘)

| | *Treatment Group* | | | | *Control Group* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Opaq-Words* | | *Trans-Words* | | *Opaq-Words* | | *Trans-Words* | |
| | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* | *Mean* | *SD* |
| Pretreatment (max =24) | 8.6 | 3.8 | 11.2 | 5.0 | 8.5 | 3.5 | 10.2 | 4.5 |
| Posttreatment (max =24) | 14.8 | 5.4 | 20.1 | 6.3 | 9.4 | 3.7 | 11.4 | 4.4 |



## Effect on reading abilities

| | *Treatment Group* | | *Control Group* | |
|---|---|---|---|---|
| | *Mean* | *SD* | *Mean* | *SD* |
| Pretreatment (max =150) | 44.8 | 15.6 | 48.4 | 14.6 |
| Posttreatment (max =150) | 61.8 | 19.8 | 61.5 | 20.2 |





## Discussion

- AMA promotes morphological awareness
- Further studies on how improved morphological awareness promotes word learning and reading comprehension needed
- Book chapter available:
- https://www.researchgate.net/publication/337158854_Relationship_between_morphological_awareness_and_Chinese_reading_development_a_treatment_study

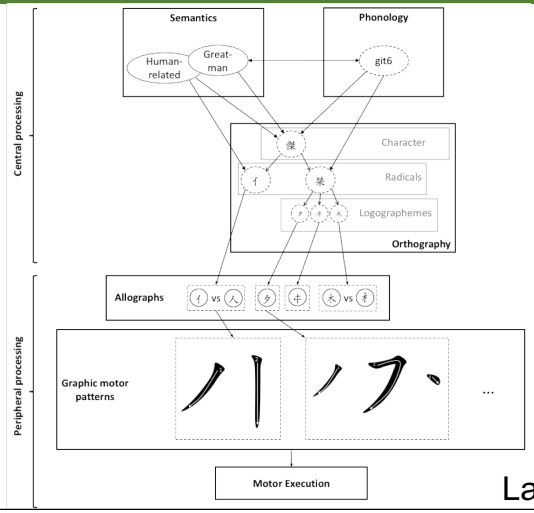


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# Accelerating Writing Abilities (AWA)

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## Central and peripheral processing of character writing




Lau (under revision)



## Roles of handwriting (Wiley & Rapp, 2021) PS

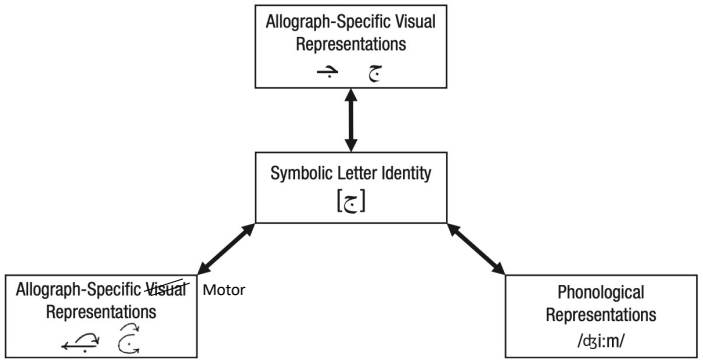



**Fig. 10.** Cognitive architecture of letter representations. Modality-specific representations (visual, motor, and phonological) are associated with one another through their common amodal representation: symbolic letter identity.



## A database (Lui et al., 2010)

- 255 logographemes → 3800 characters
- Starting point
  - 55 logographems which can compose
    - About 700 characters
    - About 600 acquired in grade 1 to 4
      - About 200 high freq
      - About 200 mid freq
      - About 200 low freq
  - Appears in 3600 characters



## Training goals

- Characters can be decomposed into logographemes
- Acquire logographemes
  - "shape" / "strokes sequence"
  - corresponding characters
- Use logographemes as writing units in copying / dictation tasks

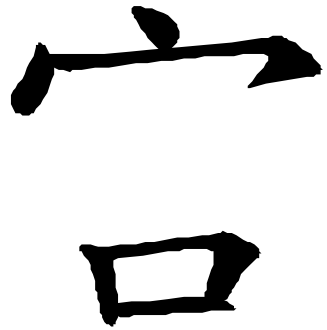
## Awareness training

- Discrimination
  - Same Different?
  - With vs Without?
- Identification
  - Divergent and convergent thinking

害 青



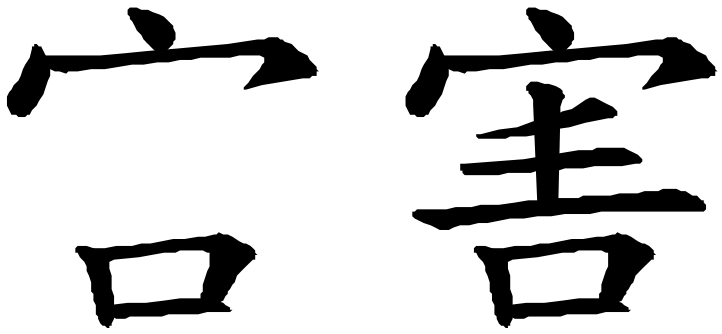
## What's missing?



害



## What's missing?





## "Production training"

- Introducing target logographemes
- Crazy copying logographemes…
- Fill in logographemes
- "Puzzle" game
- Copying or delayed copying
- (Dictation)



## Handwriting

- Make it interesting
  - Crayons
  - Blackboard / Whiteboard
  - Pen with different shapes…



## Empirical data (preliminary…)

- Single case: SYY (Session 6) – delayed copying

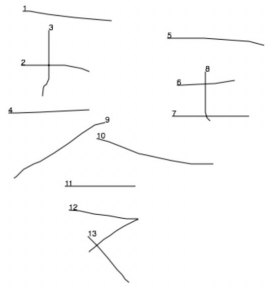
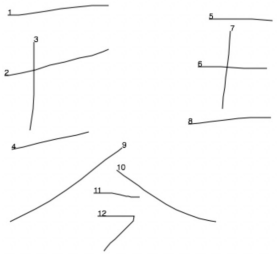
| Target | Before Session 6 | After Session 6 |
|---|---|---|
| 敗 |  |  |
| 琴 |  |  |
| 眼 |  |  |

Lau (in preparation)



## More…

- Improved allographic-specific motor representation? 🤔

| Pre-treatment | Post-treatment |
|---|---|
|  |  |

Lau (in preparation)



## SYY - Pre- and Post-treatment delayed copying

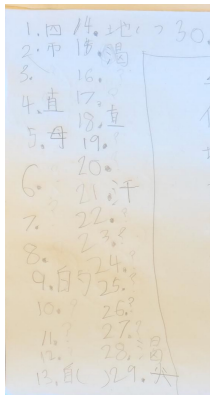
| | | Post-treatment | |
|---|---|---|---|
| | | Wrong | Correct |
| Pre-treatment | Wrong | 10 | 9 |
| | Correct | 1 | 17 |

McNemar's test = $(9-1)^2 / (9+1) = 6.4$ ($p < .05$)

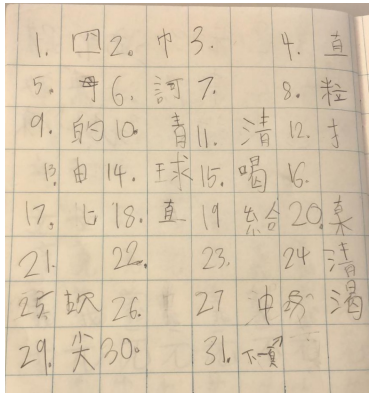
Lau (in preparation)

## LSW – Dictation

Pre-treatment



Post-treatment



| | | Post | |
|---|---|---|---|
| | | Wrong | Correct |
| Pre | Wrong | 19 | 6 |
| | Correct | 0 | 5 |

McNemar's test = $(6\text{-}0)^2 / (6+0) = 6$ ( $p < .05$)

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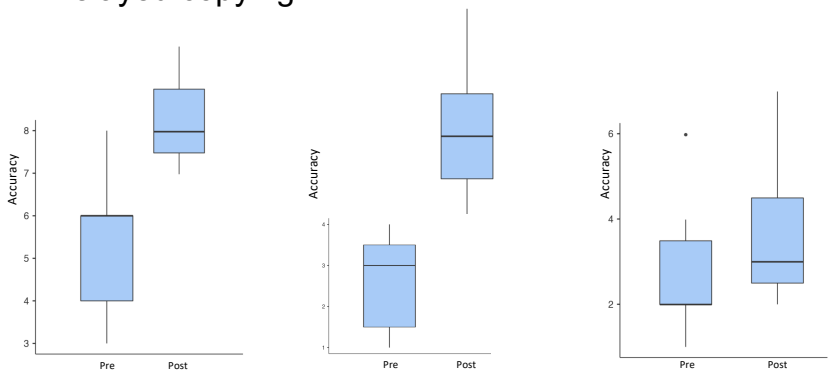
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# Summary

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## Group (n = 7)

- Delayed copying




Treated targets
$t(6) = 2.67$, $p < .05$

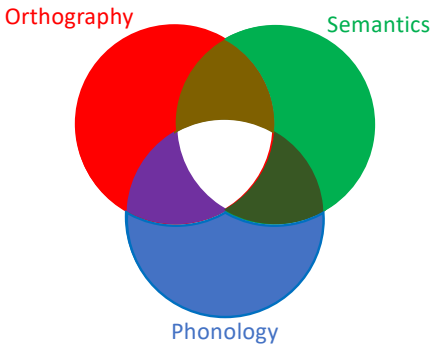
Generalization targets
$t(6) = 8.33$, $p < .001$

Controlled targets
$t(6) = 1.03$, $p = .34$

Lau (in preparation)



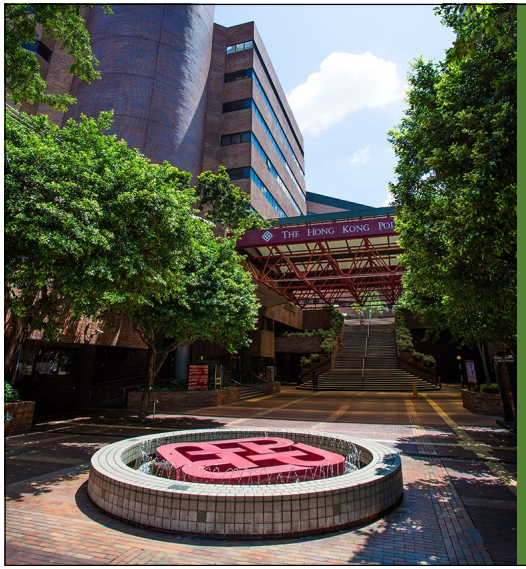
## The triangle model as a framework to guide Ax and Tx



# Written language disorders

- It's all about language
- Any concepts applied in oral language assessment and treatment are applicable in written language disorders as well!






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