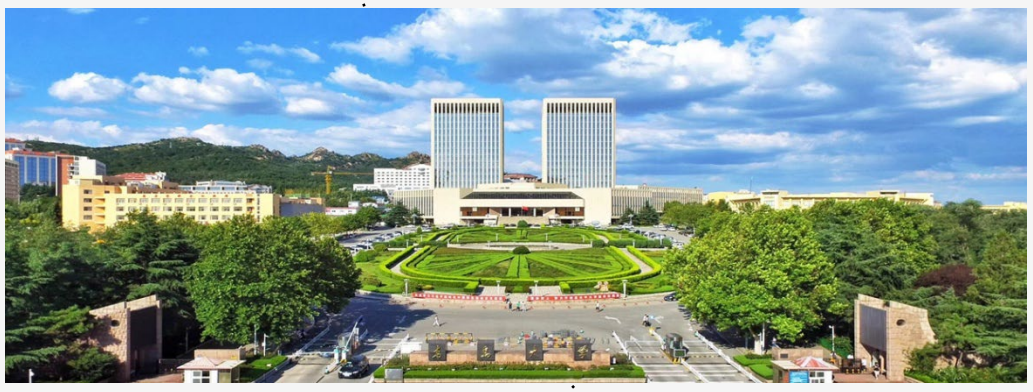
# The Speech Production of Mandarin Speakers: Monolinguals, Bilinguals and Children with Cochlear Implants

Man Wang
emilymanwang@163.com

School of Foreign Languages
Center for
Brain Cognition and Language Sciences
Qingdao University

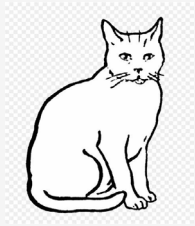


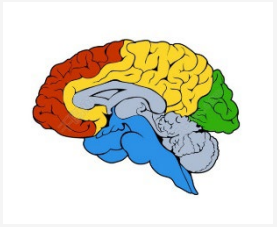

SUPER X
大專盃賽
2007/12/13 19:01

# CONTENTS

- What we did before (L1 speech production in Mandarin Chinese, L2 speech production with Chinese-English bilinguals)
- What we are doing (L1 speech production in children with cochlear implants)

## What we do



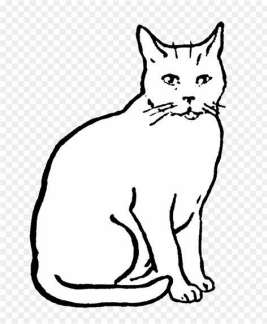


“猫
/mao1/
cat

一只猫
/yi1 zhi1 mao1/
one-*classifier*-cat

The dog chases the rabbit.
The rabbit is chased by the dog.”

# Background - Language Production



CAT

dog

animal

paw fur

conceptual level

cat + singular

Intrinsic syntactic properties:
grammatical gender, word category

lemma level

<cat>

Extrinsinc syntactic properties:
number

word-form encoding

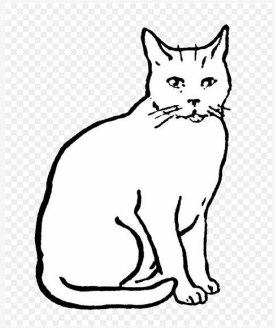
/k/ /æ/ /t/

articulation

(adapted from Roelofs, 2003)

# What we did - The case of Mandarin Chinese *Study 1*

- Languages vary in terms of the depth of orthography. (Katz & Frost, 1992)



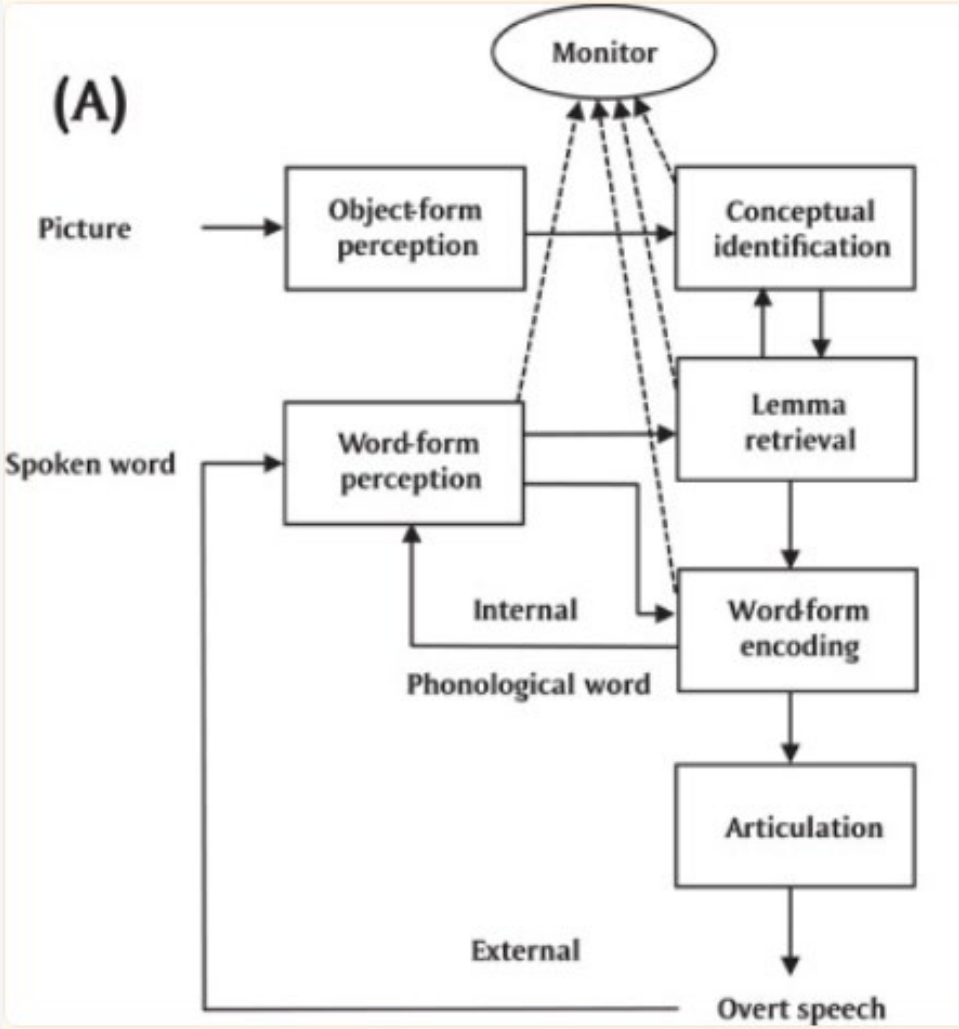
*Spanish*
gato
/ˈgato/

*English*
cat
/ˈkæt/

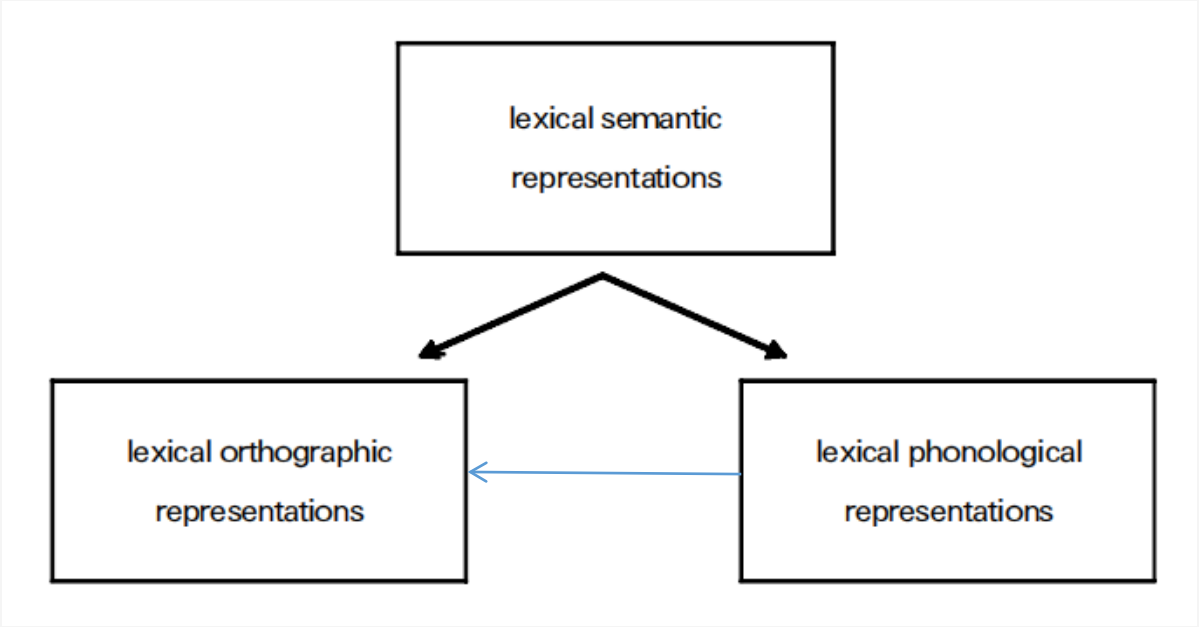
*Chinese*
猫
/mau$^{1}$/

- Can the models of speech production account for the cross-linguistic differences in terms of the representation and retrieval of orthography in speech production?

- Modality-neutral (*WEAVER++, e.g., Levelt et al., 1999; Roelofs, 2020*)
- Modality-specific (*Independent Network, e.g., Caramazza 1997*)



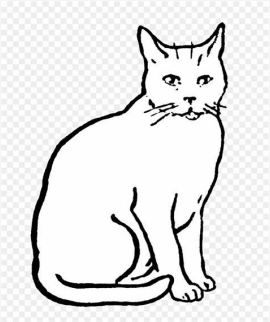

(Roelofs, 2020)




(Rapp & Caramazza, 1997)

# The orthographic effect in Mandarin speech production

- Orthographically-related distractors can facilitate speech production production. (e.g., Zhang & Weekes, 2009; Zhang et al., 2009; Zhao et al., 2012)
- Orthography can influence speech production.



猫
/mao$^{1}$/


**relatedness**

/mao$^{4}$/ phonological relatedness


犭 orthographic relatedness

# The orthographic effect in Mandarin speech production

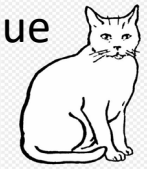

Orthography modulates speech production via an *early* lexical-semantic pathway (Zhang & Weekes, 2009; Zhang et al., 2009).

- Orthographic facilitation found at negative SOAs (−150 ms and −100 ms) without the co-occurence of any phonological effect.
- not replicated in Zhao et al. (2012)

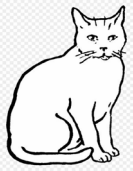
Stimulus Onset Asynchrony (SOA)

negative SOA value

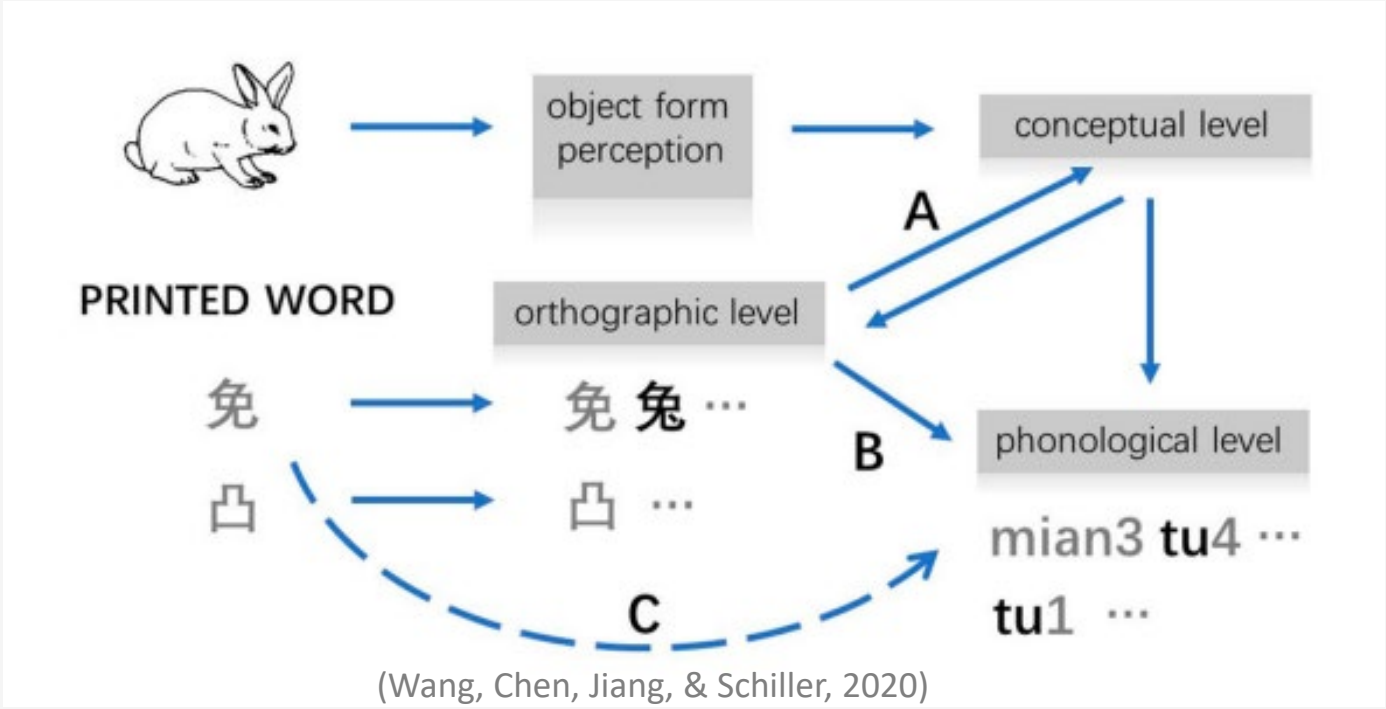
狼



positive SOA value



狼




(Wang, Chen, Jiang, & Schiller, 2020)

# The orthographic effect in Mandarin speech production

- The absence of orthographic effect at negative SOA values (Zhao et al., 2012) might be attributed to the experimental design: only the phonological relatedness and the orthographic relatedness were tested.

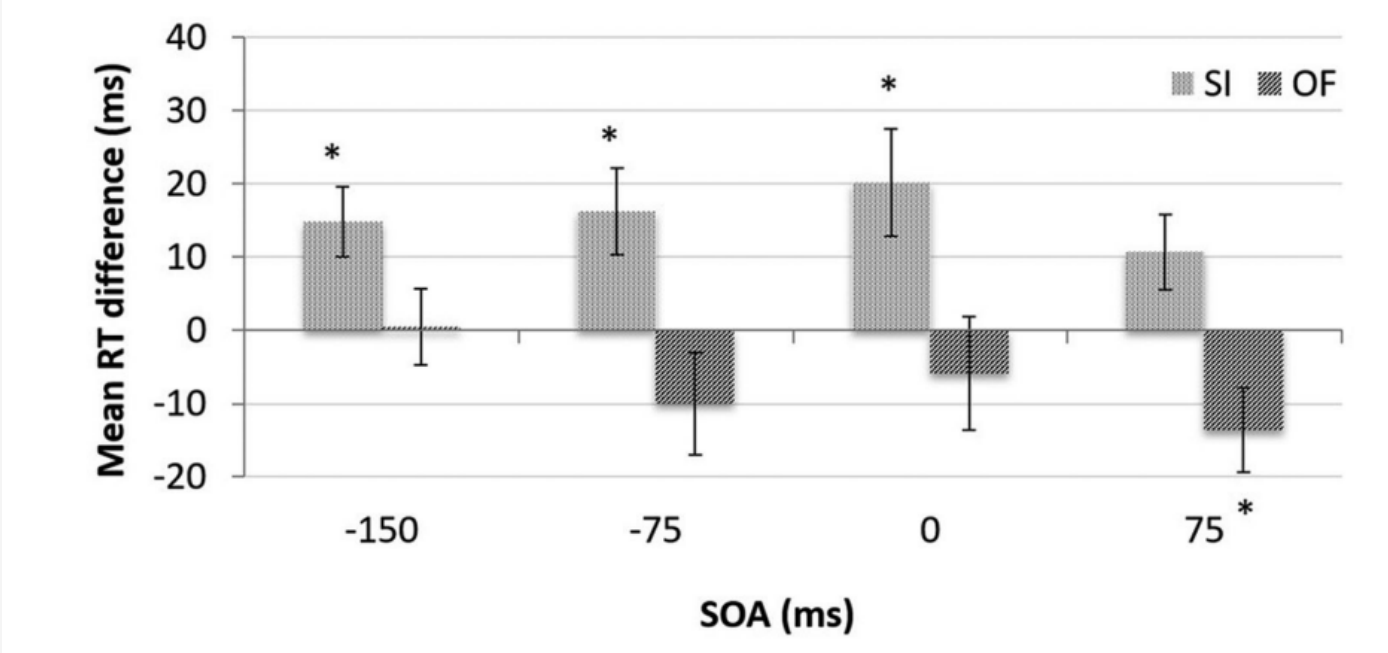
- Hypothesis: orthography may influence speech production at early stages via interaction with the semantic representation.

# The orthographic effect in Mandarin speech production *Study 1*


**Experiment 1** to see if the orthographic effect takes place via the interaction with the semantic effect

**2*2 factorial design**
- Semantic relatedness (2 levels)
- Orthographic relatedness (2 levels)

**4 conditions** (S+O+ S+O- S-O+ S-O-)

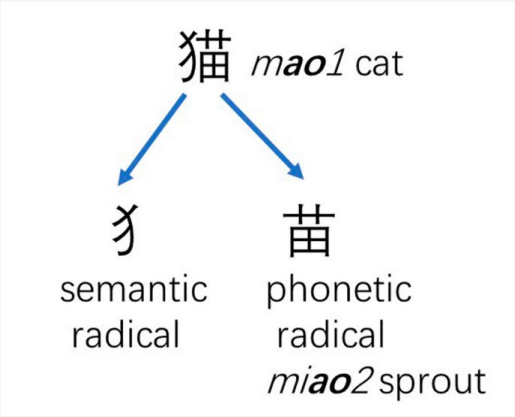



- No interaction between S and O
- Semantic effect at negative SOAs
- Orthographic effect at the positive SOA
- No overlap between the two effects in terms of SOA

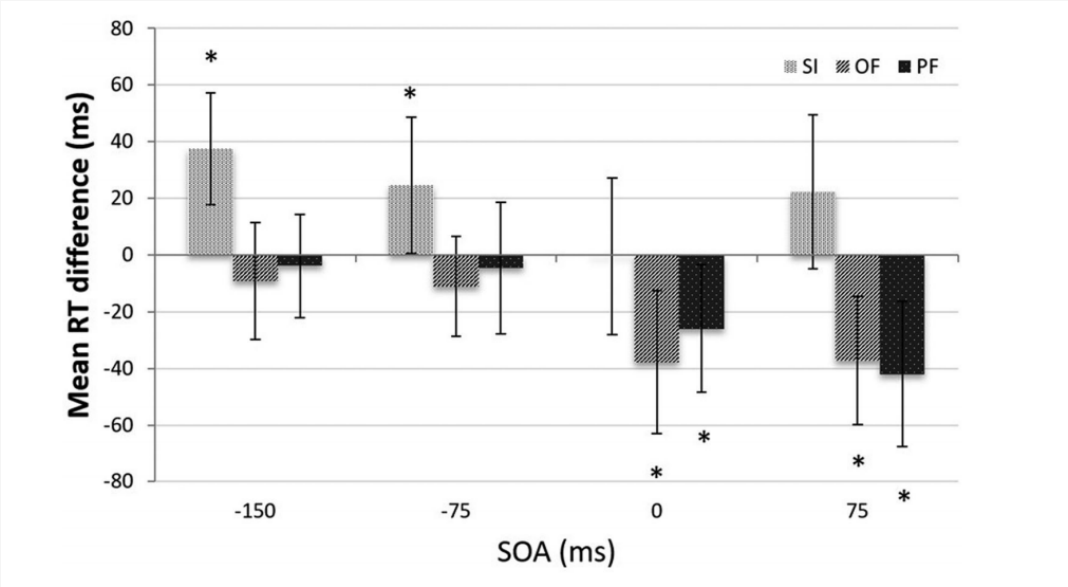
(Wang, Chen, Jiang, & Schiller, 2020)

# The orthographic effect in Mandarin speech production *Study 1*

**Experiment 2** to re-investigate the time course of the orthographic effect




- with target picture names of simplex characters only
- Only related in one aspect
  - **S+**O-P-
  - S-**O+**P-
  - S-O-**P+**
  - S-O-P-




- Semantic effect at negative SOAs
- Orthographic and phonological effects at positive SOAs
- Orthographic effect co-occurs with phonological effect, but not semantic effect

(Wang, Chen, Jiang, & Schiller, 2020)

# The orthographic effect in Mandarin speech production *Study 1*

LANGUAGE, COGNITION AND NEUROSCIENCE
2021, VOL. 36, NO. 1, 13–24
https://doi.org/10.1080/23273798.2020.1803373



REGULAR ARTICLE



## The time course of speech production revisited: no early orthographic effect, even in Mandarin Chinese

Man Wang[a,b,c], Yiya Chen[b,c], Minghu Jiang[d] and Niels O. Schiller[b,c]

[a]School of Foreign Languages, Qingdao University, Qingdao, People's Republic of China; [b]Leiden University Center for Linguistics, Leiden, The Netherlands; [c]Leiden Institute for Brain and Cognition, Leiden, The Netherlands; [d]Center for Psychology and Cognitive Science, Tsinghua University, Beijing, People's Republic of China

# The orthographic effect in Mandarin speech production


Orthography influences speech production in some paradigms, e.g., picture-word interference, form-preparation:

*sugar*–COFFEE

*coffee, camel, cushion* VS *coffee, scissors, giant*

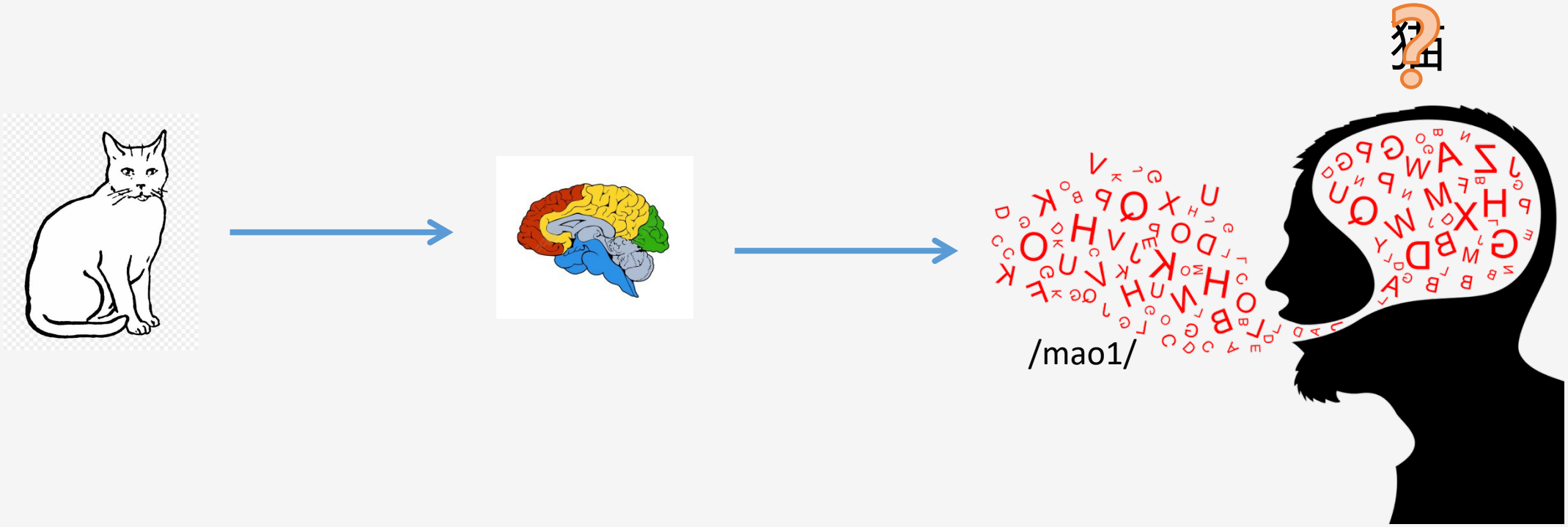
*coffee, kennel, cook* (Damian and Bowers, 2003)

(but not present in Dutch, Meyer, 1990, 1991; Roelofs, 2006; French, Alario et al., 2007; Chinese, Chen et al., 2002; or Japanese, Kureta et al., 2015).

and in reading tasks but not in tasks that don't require orthographic processing (e.g., picture naming, word generation, associative naming) (Roelofs, 2006; Bi et al., 2009)

# The orthographic effect in Mandarin speech production *Study 2*

Whether orthography is automatically activated during speaking and influences speaking.

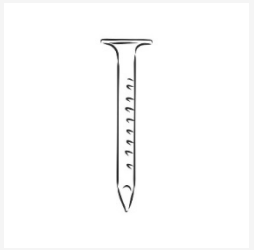


# The orthographic effect in Mandarin speech production *Study 2*

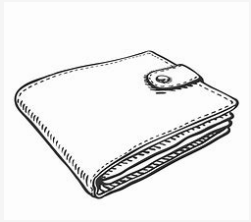
**Paradigm** blocked cyclic naming

- homogeneous block: one radical overlap at the orthographic level
- heterogeneous block: not orthographically related

homogeneous



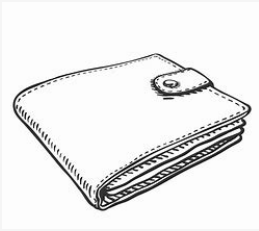
钉子
/ding1zi0/



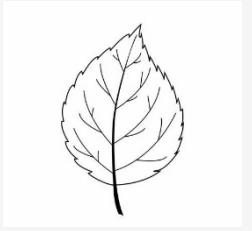
钱包
/qian2bao1/

……

heterogeneous



钱包
/qian2bao1/

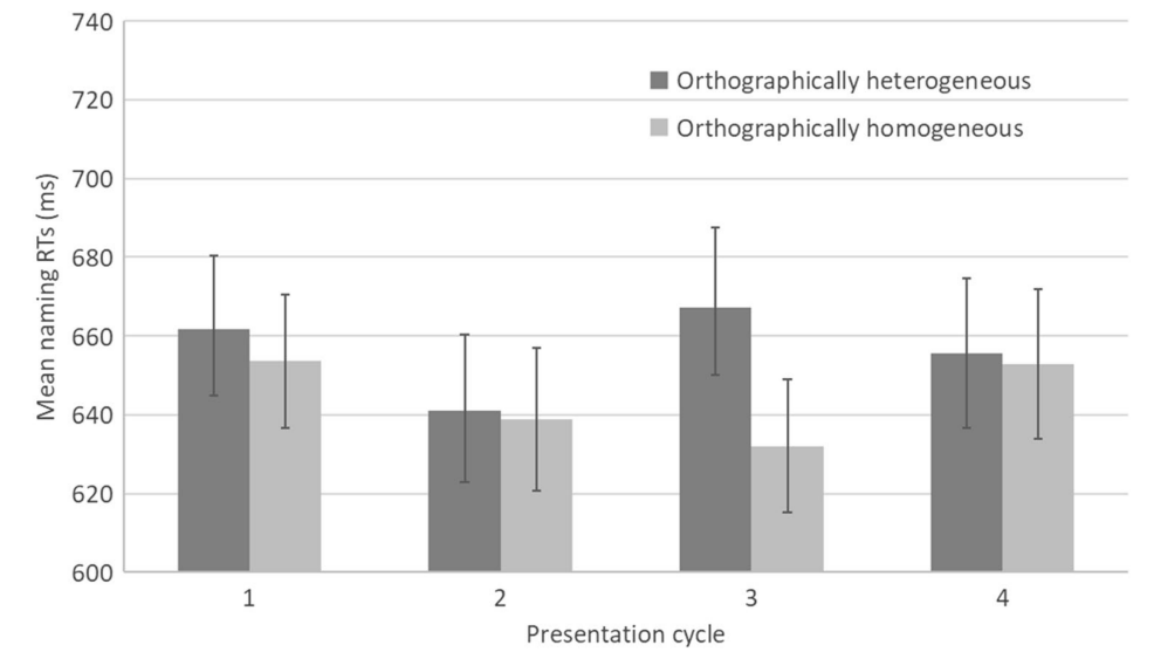


叶子
/ye4zi0/

……

# The orthographic effect in Mandarin speech production *Study 2*

## **Experiment 1** – overlap in the left radical




Orthographic relatedness can influence spoken word production in Mandarin Chinese, even when it is not relevant for production.

| Presentation cycle | | Coefficient estimate | *SE* | *t* value | *p* value |
|---|---|---|---|---|---|
| From 1 to 4 | Intercept | 6.645029 | 0.015102 | 440.01 | <.0001 |
| | Orthographic relatedness | −0.054401 | 0.009929 | −5.48 | <.0001 |
| | Cycle | −0.044960 | 0.002185 | −20.58 | <.0001 |
| | Orthographic Relatedness× Cycle | 0.015541 | 0.003082 | 5.04 | <.0001 |

## The orthographic effect in Mandarin speech production *Study 2*

## **Experiment 1** – limitations

- The left-radical overlap “钉、钱” : the initial part in the sequence of writing a character
- In similar studies that manipulate phonological relatedness, the initial-position overlap usually facilitates speech production, while the non-initial-position overlap may produce an inhibitory effect

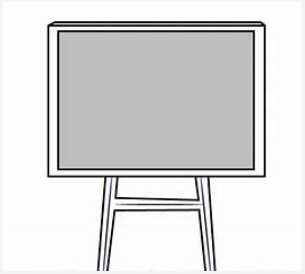
- Experiment 2 – non-initial overlap, “熊猫 /xiong2mao1/ *panda*， 黑板/hei1ban3/ *blackboard*” “灬”

# The orthographic effect in Mandarin speech production *Study 2*

**Experiment 2** – non-initial overlap

## homogeneous

熊猫
/xiong2mao1/



黑板
/hei1ban3/

.....

## heterogenous

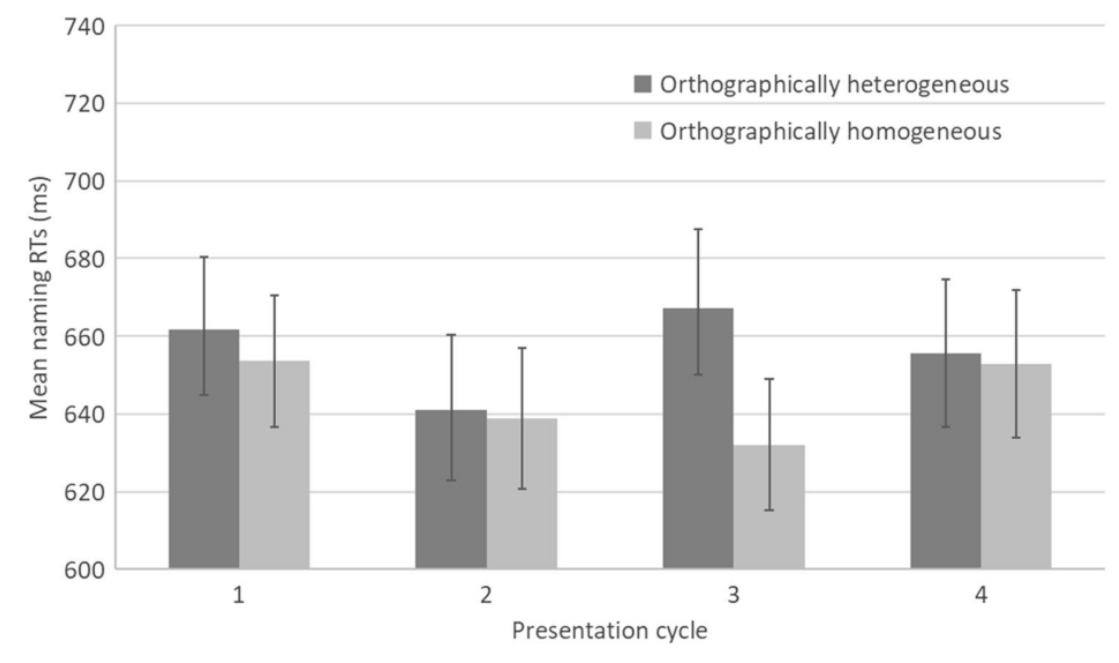
熊猫
/xiong2mao1/

国王
/guo2wang2/

.....

# The orthographic effect in Mandarin speech production *Study 2*

## **Experiment 2** – non-initial overlap




Orthographic relatedness can influence spoken word production in Mandarin Chinese, and its facilitative effect is not affected by the overlapping position (initial vs non-initial) within the character.

| Presentation cycle | | Coefficient estimate | *SE* | *t* value | *p* value |
|---|---|---|---|---|---|
| From 1 to 4 | Intercept | 6.645029 | 0.015102 | 440.01 | <.0001 |
| | Orthographic relatedness | −0.054401 | 0.009929 | −5.48 | <.0001 |
| | Cycle | −0.044960 | 0.002185 | −20.58 | <.0001 |
| | Orthographic Relatedness× Cycle | 0.015541 | 0.003082 | 5.04 | <.0001 |

# The orthographic effect in Mandarin speech production *Study 2*

Psychonomic Bulletin & Review (2023) 30:383–392
https://doi.org/10.3758/s13423-022-02123-y

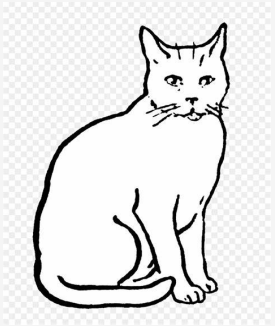
BRIEF REPORT

## Orthography influences spoken word production in blocked cyclic naming

Man Wang[1] · Zeshu Shao[2] · Rinus G. Verdonschot[3] · Yiya Chen[4,5] · Niels O. Schiller[4,5]

Accepted: 10 May 2022 / Published online: 26 July 2022

# The fundamental unit of phonological encoding in Mandarin speech production *Study 3*



CAT

cat + singular

<cat>

/k/ /æ/ /t/

*Spanish*

gato

/ˈgato/

*English*

cat

/ˈkæt/

*Chinese*

猫

/mau$^{1}$/

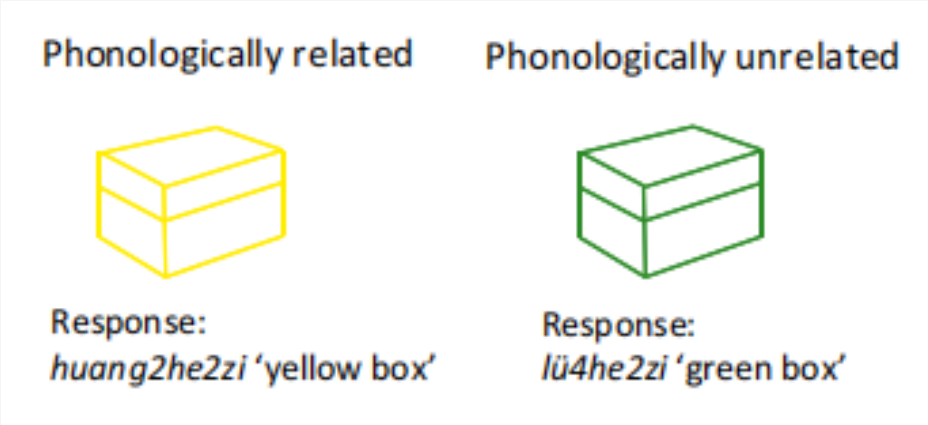
In Mandarin, the individual speech sounds are not orthographically represented.

The primary unit of phonological encoding investigated with the implicit priming paradigm

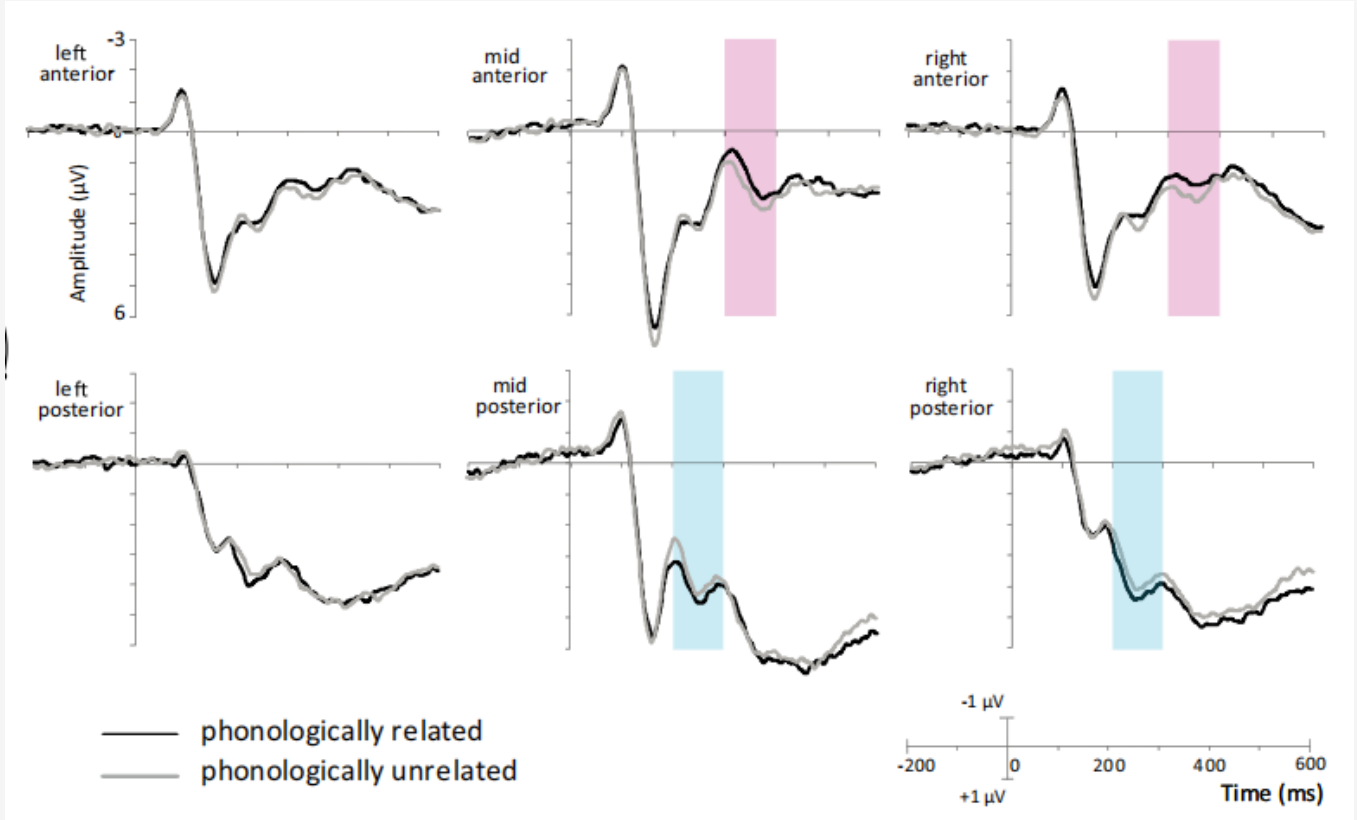
- the phonemic segment in English and Dutch (e.g., Meyer, 1990, 1991)
  - *book, bed, bus*
  - *book, cat, leg*
- minimally a syllable in Mandarin (Chen et al., 2002; O'Seaghdha et al., 2010)
- kana (a CV structure) in Japanese (Kureta et al., 2006)

# The fundamental unit of phonological encoding in Mandarin speech production

- colored-picture naming




- No significant differences were observed between the phonologically related and unrelated conditions in naming latencies;
- Significant differences observed in ERPs




(Qu, Damian & Kazanina, 2012)

# The fundemental unit of phonological encoding in Mandarin speech production

- **Evidence in Cantonese – sub-syllabic unit**
- Priming effects observed with CV or VC structure overlap with the picture-word interference paradigm（e.g., Wong et al., 2012）
  - “食”/sik$^{6}$/ - “星”/siŋ$^{1}$/
  - “境”/giŋ$^{2}$/ - “星”/siŋ$^{1}$/

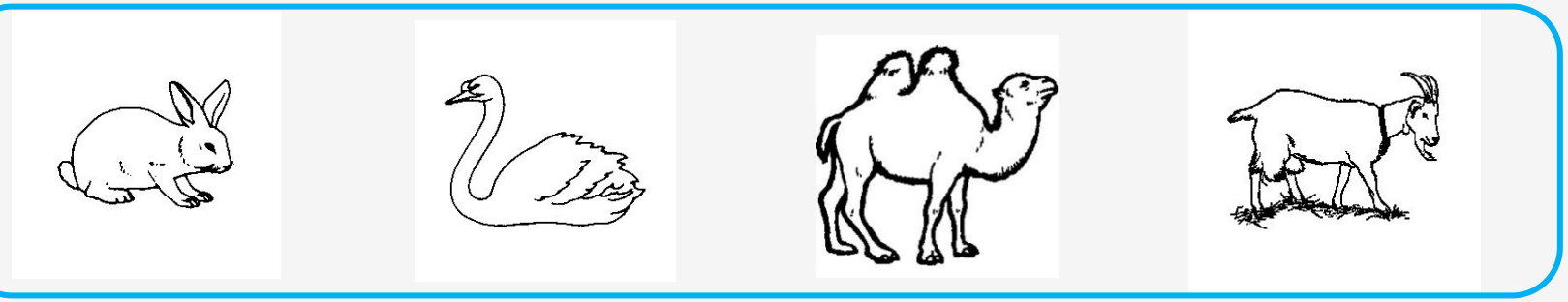
- pilot - no effect observed with onset relatedness
- Hypothesis: A unit larger than the onset only, but smaller than a syllable could also be the basic encoding unit.

  *the minimal CV structure*

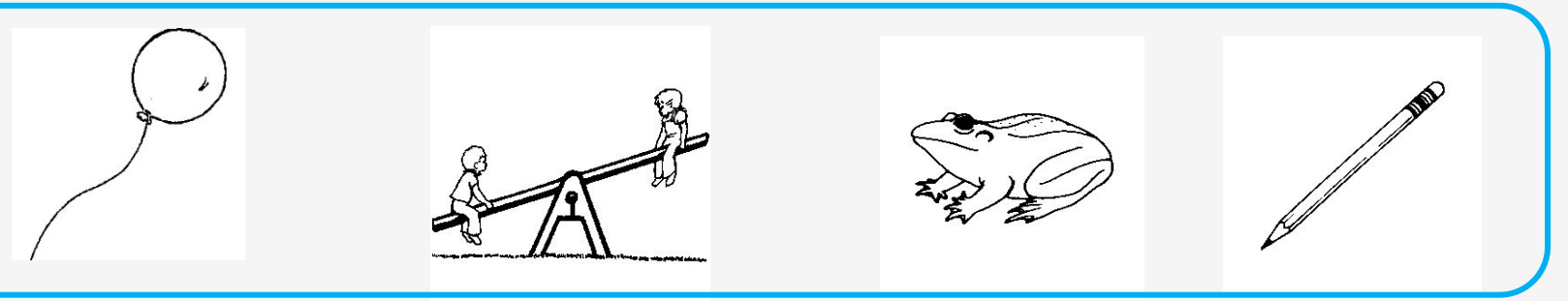
# The fundamental unit of phonological encoding in Mandarin speech production

- the blocked cyclic naming paradigm

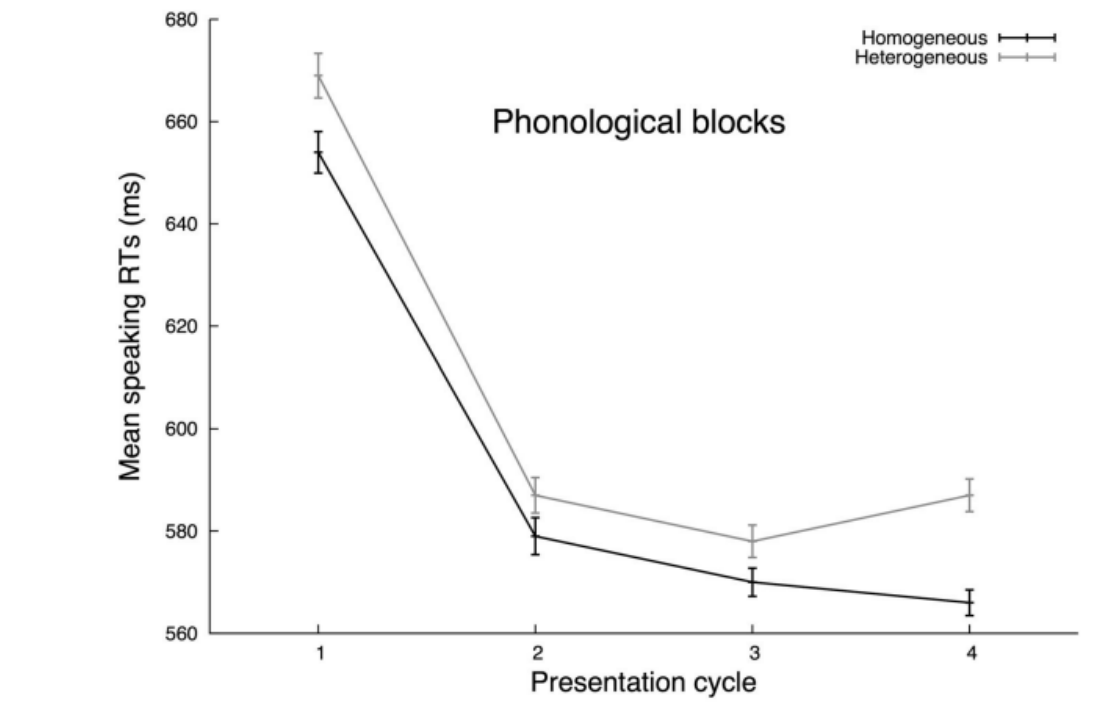
Semantically related block



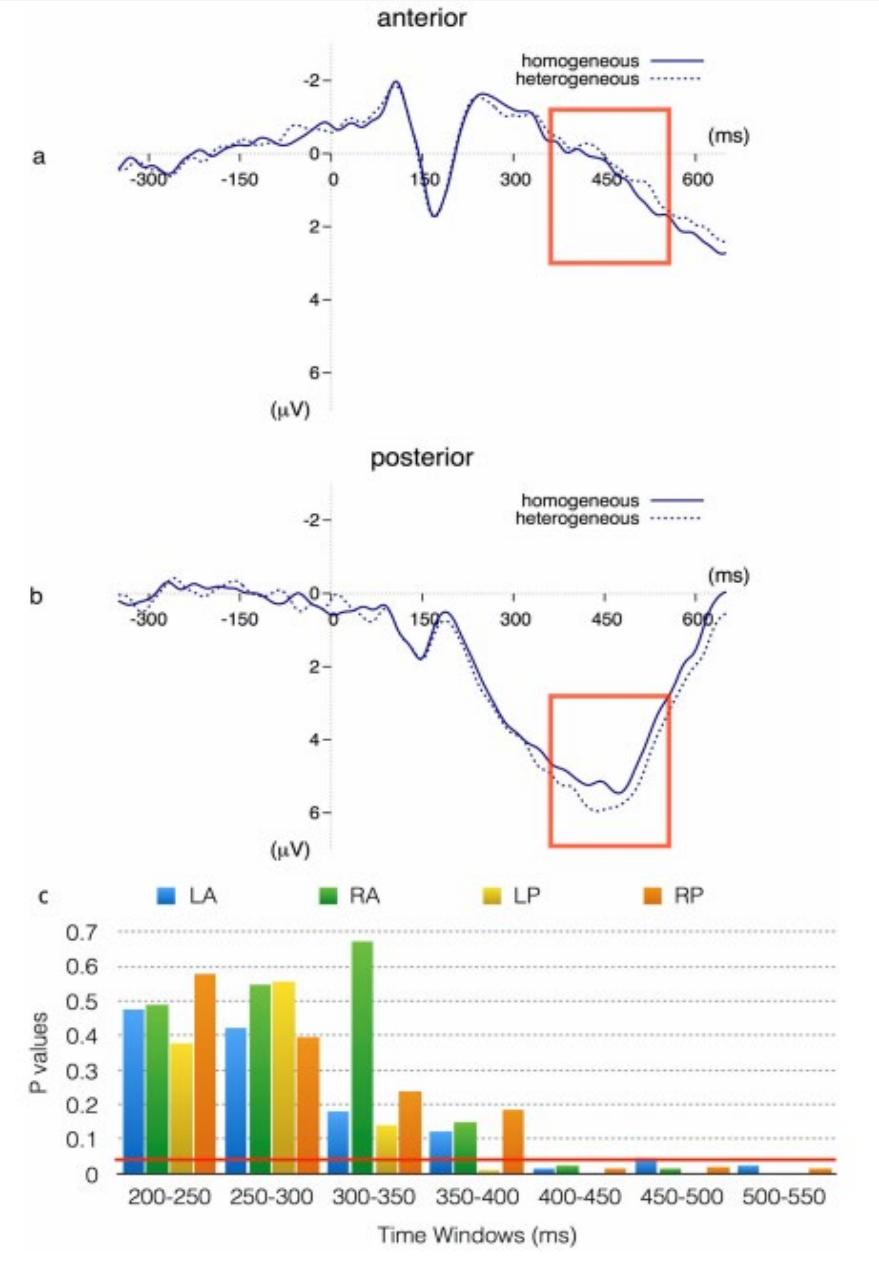
Phonologically related block



气球(qi4qiu2)　跷跷板(qiao4qiao4ban3)　青蛙(qing1wa1)　铅笔(qian1bi3)




- Significant differences were observed between the phonologically heterogeneous and heterogeneous conditions in naming latencies;
- Significant differences observed in ERPs.




(Wang, Shao, Chen & Schiller, 2018)

LANGUAGE, COGNITION AND NEUROSCIENCE, 2018
VOL. 33, NO. 5, 575–586
https://doi.org/10.1080/23273798.2017.1395467

Routledge
Taylor & Francis Group

REGULAR ARTICLE



# Neural correlates of spoken word production in semantic and phonological blocked cyclic naming

Man Wang[a,b], Zeshu Shao[c], Yiya Chen[a,b] and Niels O. Schiller[a,b]

[a]Leiden University Center for Linguistics, Leiden University, Leiden, The Netherlands; [b]Leiden Institute for Brain and Cognition, Leiden University, Leiden, The Netherlands; [c]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands

# The case of Chinese-English bilinguals

- How about bilinguals?

- shared conceptual representation (e.g., Costa et al., 2000; Roelofs, 2003)
- language specific (e.g., Costa, 2005) vs

non-specific activation of the phonological representation (e.g., Macizo, 2016)

L1 L2 being investigated - similar phonological representations

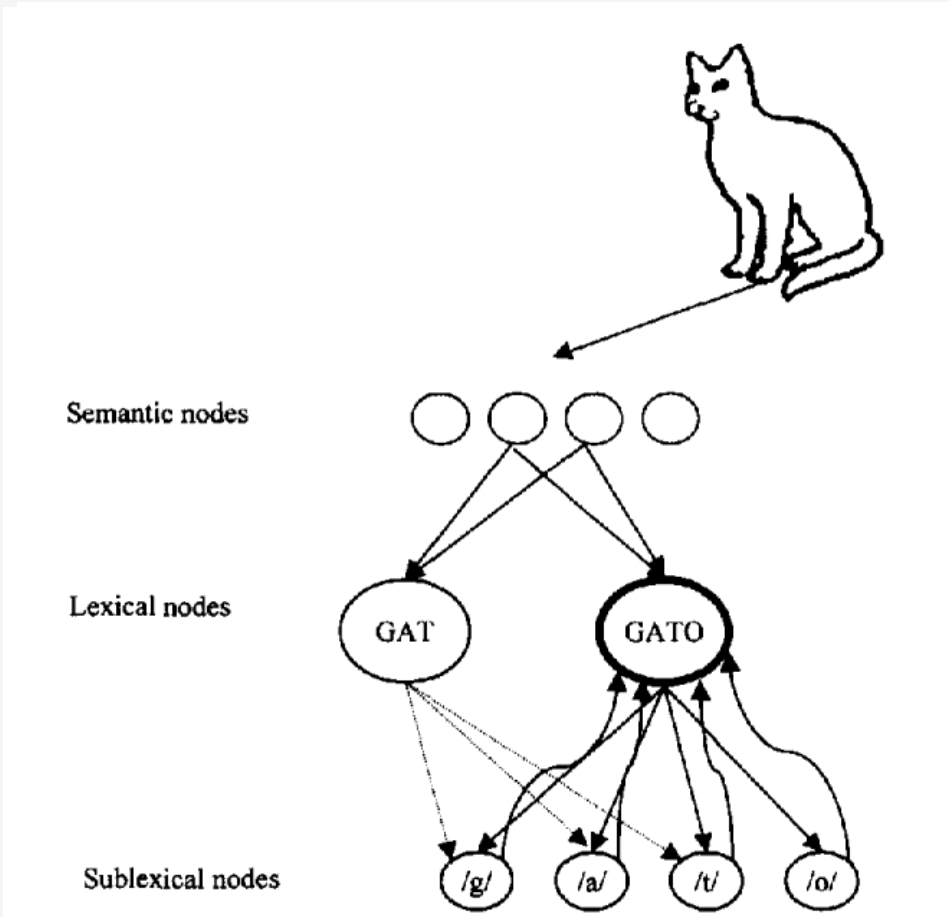
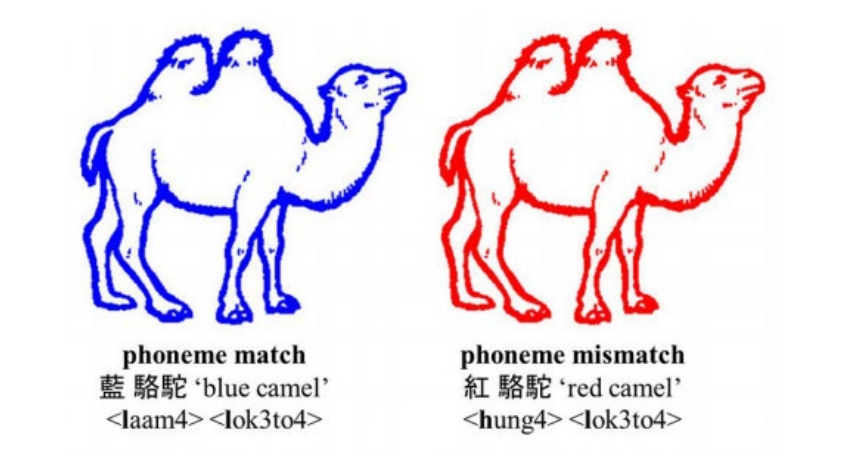



*Figure 3.* Schematic representation of lexical and sublexical access for cognate words according to an interactive model of speech production. The Catalan–Spanish pair *gat–gato* [cat] is illustrated. Activation is indicated by arrows.

(Costa et al., 2012)

# L2 phonological encoding




(Timmer & Chen, 2017)

Verdonschot et al. (2013)

- Mandarin-English bilinguals, proficient in L2
- phonemic effect

## Dutch (L1) - Cantonese (L2) bilinguals

- Phonological encoding unit:
  - phonemic segment in Dutch vs
  - syllable or sub-syllabic unit in Cantonese
- Significant differences were observed between the phonologically related and unrelated conditions in naming latencies;
- Significant differences observed in ERPs.

the proficiency in the Germanic languages of the bilinguals?

# L2 phonological encoding - the case of Chinese-English bilinguals Study 4

- Hypothesis

L2 proficiency may affect the phonological encoding unit in spoken word production.

- Evidence in Japanese-English bilinguals with the masked priming paradigm

Phonological encoding unit in L2 production:

phonemic segment for bilinguals with higher L2 proficiency vs

kana (usually a cv structure) for bilinguals with lower L2 proficiency

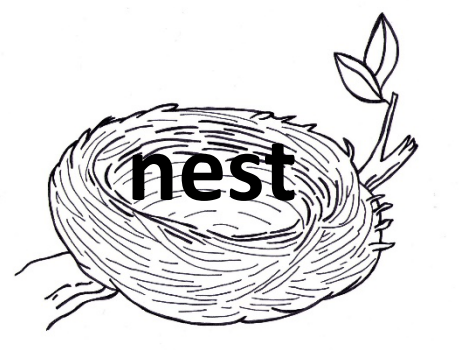
- Our study - Mandarin-English bilinguals with picture-word interference paradigm

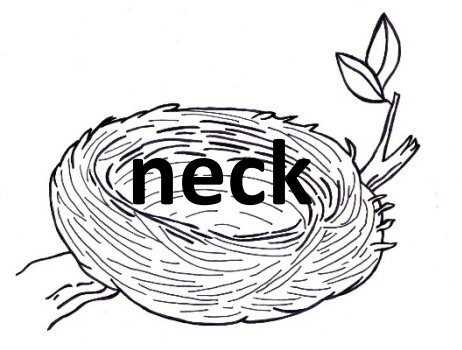
Phonological encoding unit in L2 production: (Liu, Zhang, Wang, & Schiller, in revision)

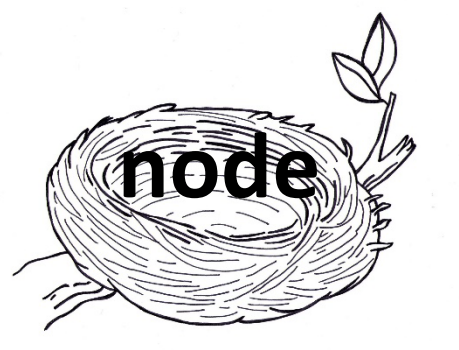
higher L2 proficiency vs

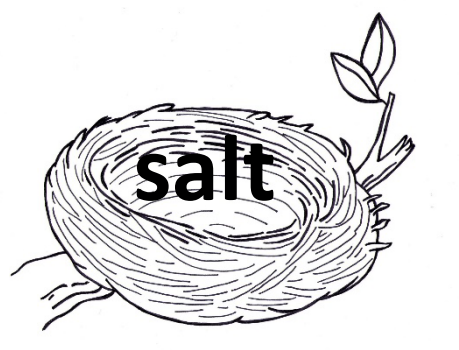
lower L2 proficiency

# L2 phonological encoding - the case of Chinese-English bilinguals *Study 4*



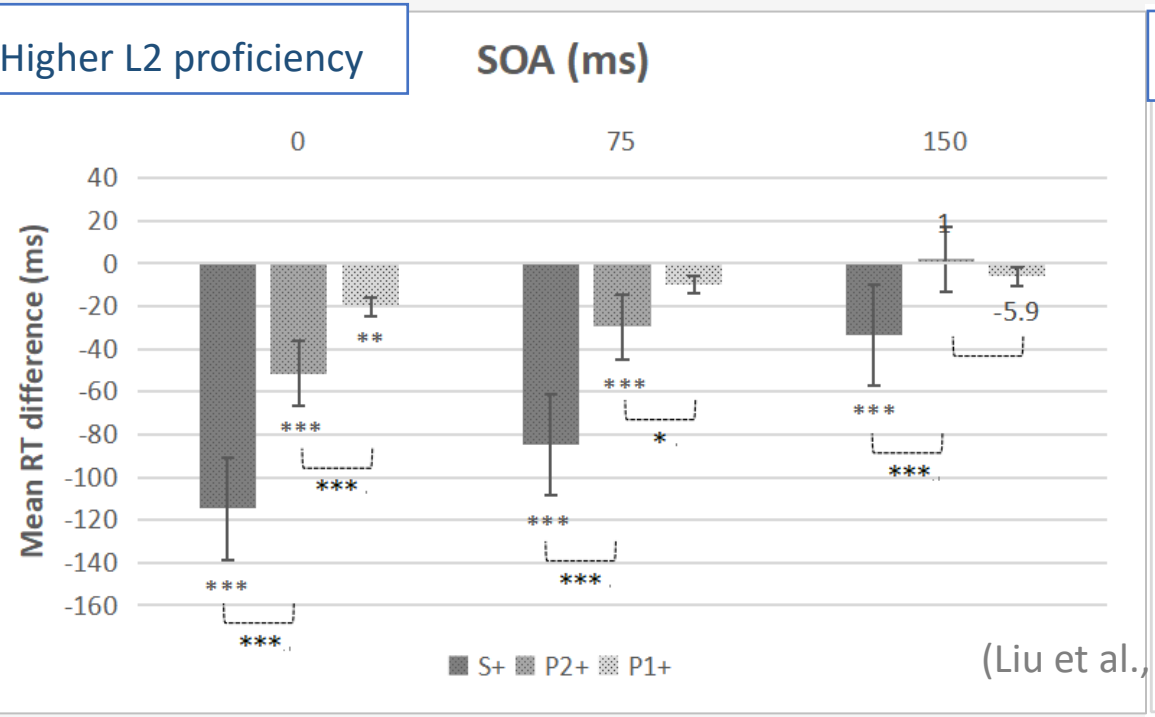




- SOA = 0， 75， 150 ms
- 25 black-and-white line drawings (CRL International Picture Naming Project; Bates et al., 2000)
- 3 SOAs * 4 distractor conditions

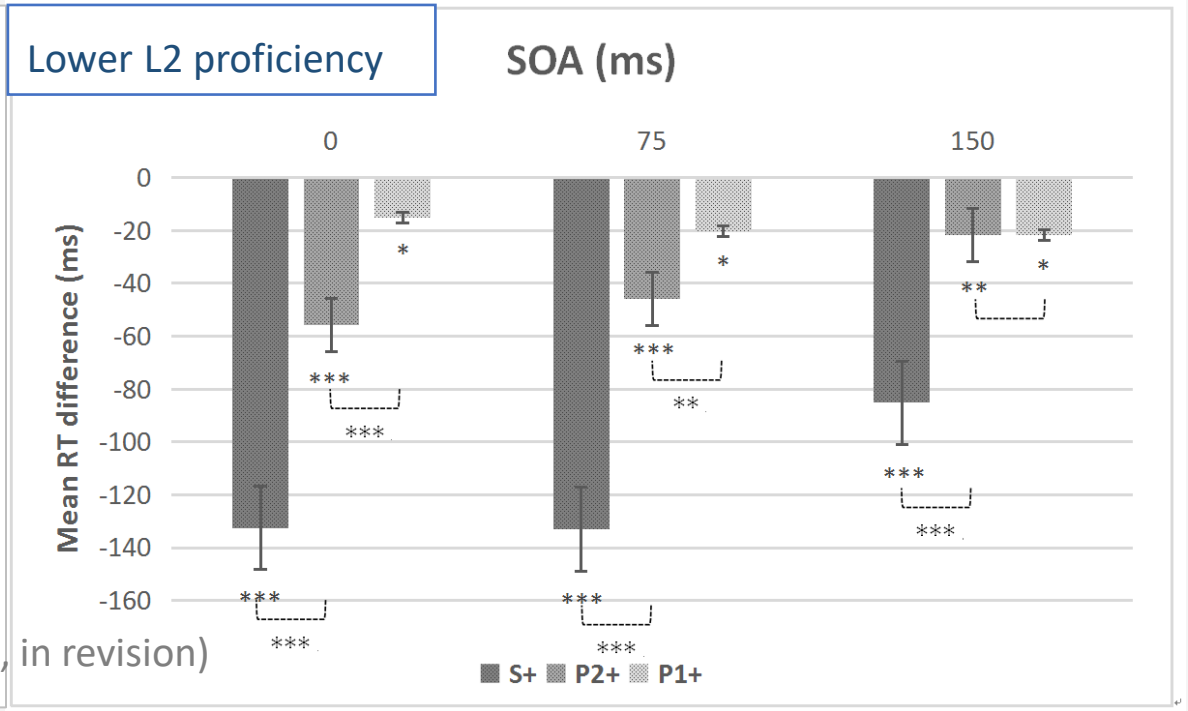
# L2 phonological encoding - the case of Chinese-English bilinguals *Study 4*

- Interactive effect between L2 proficiency, SOA and distractor type

Higher L2 proficiency




Lower L2 proficiency




(Liu et al., in revision)

- Both proficiency groups show phonemic effect;
- The more overlapping segments, the stronger facilitative effect;
- Absence of phonemic effect at SOA = 75 and 150 ms in the higher proficiency group

# L2 phonological encoding - the case of Chinese-English bilinguals

- The Chinese-English bilinguals, seem to follow an incremental manner of phonological encoding in L2 (English) production (WEAVER++; Roelofs, 2003, 2006).

- The phonemic segment acts as a fundamental unit of phonological encoding in Chinese-English bilinguals, no matter how proficient they are in the second language.

What we are doing

- Stress encoding in Chinese-English bilinguals' L2 production

# L2 sentence production - the case of Chinese-English bilinguals *Study 5*

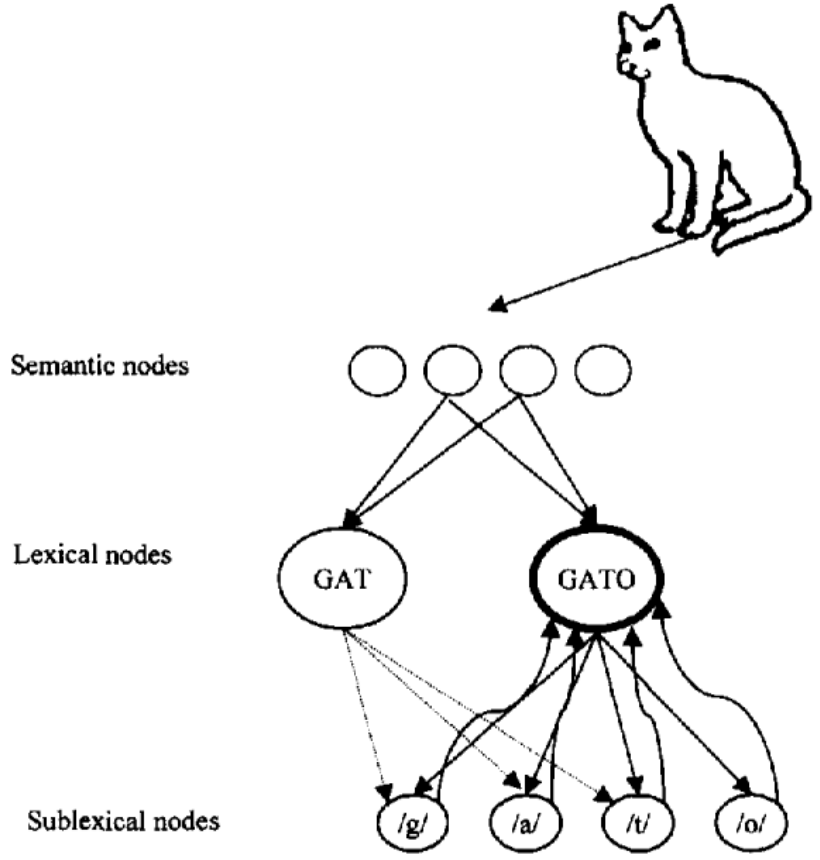


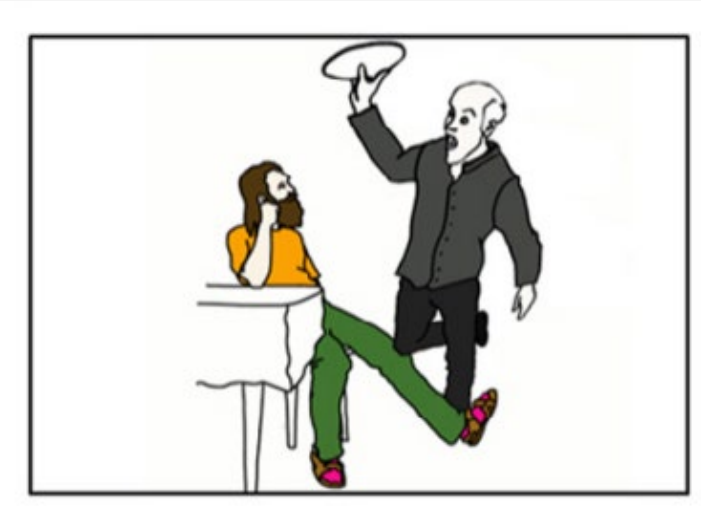

*Figure 3.* Schematic representation of lexical and sublexical access for cognate words according to an interactive model of speech production. The Catalan–Spanish pair *gat–gato* [cat] is illustrated. Activation is indicated by arrows.

(Costa et al., 2012)

- How are the representations of two languages related in memory? Shared or separate?
- Mostly at the lexical level (semantic, phonological representations)
- Are syntactic information shared between languages?

# L2 sentence production - the case of Chinese-English bilinguals

- Syntactic priming (e.g., Bock, 1983) - the tendency to re-use previously activated syntactic information



**naturalistic corpora**

(Schenkein, 1980;
Weiner & Labov, 1983)

**experimental research**

(e.g., Bock, 1986, 1989)

**Cross-linguistic syntactic priming**

(Loebell & Bock, 2003;
Hartsuiker, 2004;
Schoonbaert & Hartsuiker, 2007;
Zhang, 2012; Yang et al., 2019)

**Influencing factors**

(e.g., semantic repetition, word order)

# L2 sentence production - the case of Chinese-English bilinguals

- Is abstract structure sufficient for producing syntactic priming or does semantics have to be involved (Ziegler et al., 2019) ?

Semantic repetition

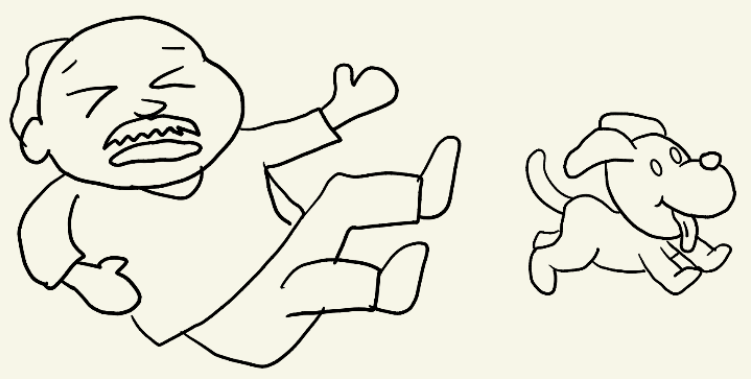
- Syntactic priming between languages in bilinguals has been taken as evidence for shared syntactic representations across languages.
- Bilinguals go through specific to shared syntactic representations as L2 proficiency improves (e.g., Bernolet et al., 2013).

L2 proficiency

- Syntactic priming is seldomly tested in Mandarin speech production.
- Most studies test active vs passive structures, but report discrepant findings.

Active vs passive

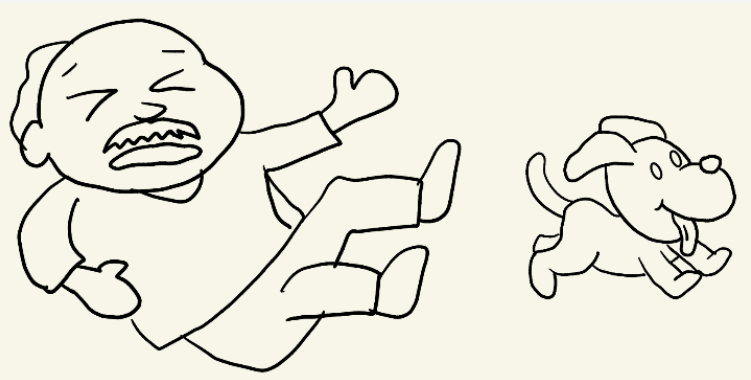
# L2 sentence production - the case of Chinese-English bilinguals



“老头　　被　　小狗　　绊倒了。”
The old man　bei　the dog　tripped
*The old man was tripped by the dog.*

让 /rang4/, 叫/jiao4/

**Experiment 1** – priming within L1



绊倒

打碎

# L2 sentence production - the case of Chinese-English bilinguals

Table 4.1 Number of Different Sentence Types Generated under Two Priming Conditions

| Prime \ Target | Active | Passive | Others | Total |
|---|---|---|---|---|
| Active | 231 | 65 | 4 | 300 |
| Passive | 268 | 330 | 2 | 600 |
| Total | 499 | 395 | 6 | 900 |

The results of the Experiment 1 show that significant syntactic priming effect in Chinese active and passive sentence constructions.

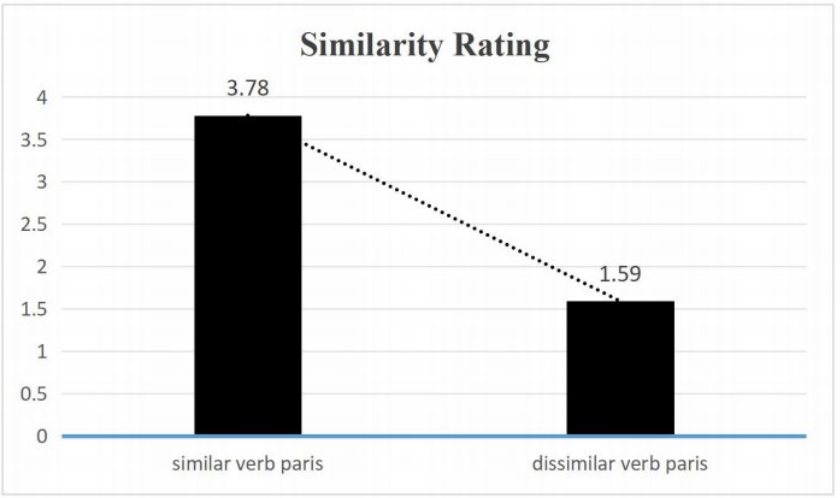
# L2 sentence production - the case of Chinese-English bilinguals

**Experiment 2** – cross-linguistic priming (L2 proficiency, semantic repetition)

咬 /yao3/
bite

扔 /reng1/
throw (away)

bite



# L2 sentence production - the case of Chinese-English bilinguals

Table 5.1 Results of Cross-linguistic Syntactic Priming in the Whole Experiment

| Priming Types | N | Produced Target Structures (Number and Percentage) | | | |
|---|---|---|---|---|---|
| | | Active | Passive | Others | Total |
| Baseline | 60 | 1431(53%) | 1107(41%) | 162(6%) | 2700 |
| Active | 60 | 2738(65.5%) | 1334(31.9%) | 108(2.6%) | 4180 |
| Passive | 60 | 1780(43%) | 2298(55.5%) | 62(1.5%) | 4140 |
| Total | 60 | 5949(54%) | 4739(43%) | 332(3%) | 11020 |

- The priming conditions had a significant influence on the cross-linguistic syntactic structures produced in the output.
- Following Hardy et al. (2017), in comparison to the baseline condition, the priming magnitude for passive sentences was higher than that for active sentences, indicating an Inverse Preference Effect (a less preferred or less common construction is more likely to be primed than its alternative counterpart). In accordance with Wei et al. (2022) but against e.g., Konopka et al., 2018.
  - The informational value of prime sentences (Scheepers, 2003).
  - The implicit learning mechanism of structural priming (e.g., Bock and Griffin, 2000; Chang et al., 2006)

# L2 sentence production - the case of Chinese-English bilinguals

Table 5.5 Repeated Measurement of Priming Rate under Semantic Repetition and Non-semantic Repetition

| | Type III Sum of Squares | df | Mean Square | F | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|
| Semantic Repetition | 3.222 | 1 | 3.222 | 20.254 | .003*** | .280 |
| L2 proficiency | 4.601 | 1 | 4.601 | 34.517 | .001*** | .261 |
| Semantic Repetition × L2 Proficiency | .100 | 6 | .017 | .115 | .974 | .000 |

*Note.* ***, **, * represents level of significance under condition of 1%, 5% and 10%. $.01 \leq \eta^2 < .06$ (little significance), $.06 \leq \eta^2 < .14$ (middle significance), $\eta^2 \geq .14$ (extreme significance).

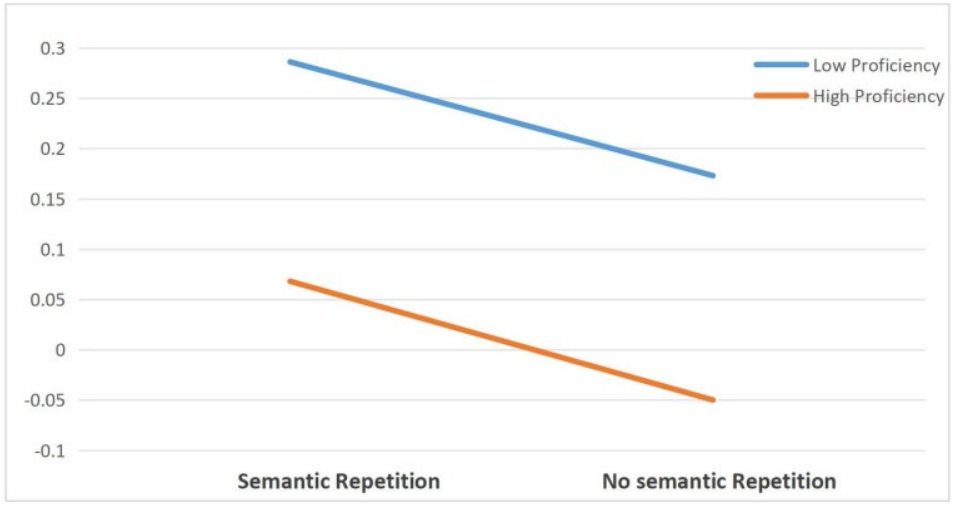



Figure 5.8 Mean of priming rate under the two factors

- The priming rate under the semantic repetition condition is higher than that under the non-semantic repetition condition. This finding supports the existence of a Semantic Boost Effect.
- The cross-linguistic syntactic priming effect for low-proficiency participants is significantly higher than that for high-proficiency participants.

# L2 sentence production - the case of Chinese-English bilinguals

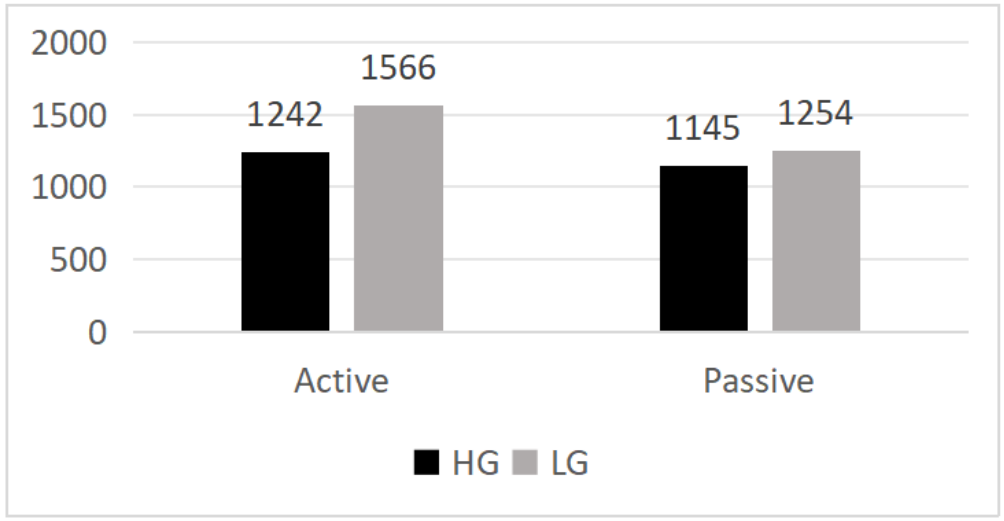



Figure 5.10 The number of matched sentences in different L2 proficiency

Table 5.8 Independent-Samples T-test of Matched Sentences

| Matched Sentences | L2 Proficiency | N | Mean | SD | Independent-Samples T Test | |
|---|---|---|---|---|---|---|
| | | | | | t | Sig. |
| Active | HG | 30 | 4.6667 | 1.04757 | -5.513 | <0.001** |
| | LG | 30 | 6.4222 | 1.06620 | | |
| Passive | HG | 30 | 4.6333 | 1.02965 | -1.853 | 0.070 |
| | LG | 30 | 5.1000 | 0.73679 | | |

*Note.* ***, **, * represents level of significance under condition of 1%, 5% and 10%.

- Matched Sentences - the syntactic structure of target sentence is consistent with that of the prime sentence.
- A significant difference between two proficiency groups only in active sentences, with no significant difference in passive sentences.

# L2 sentence production - the case of Chinese-English bilinguals

- The syntactic priming is heavily influenced by semantic repetition;
- The higher proficiency group may produce stronger inverse preference effect, which could be explained by the information value and implicit learning accounts.

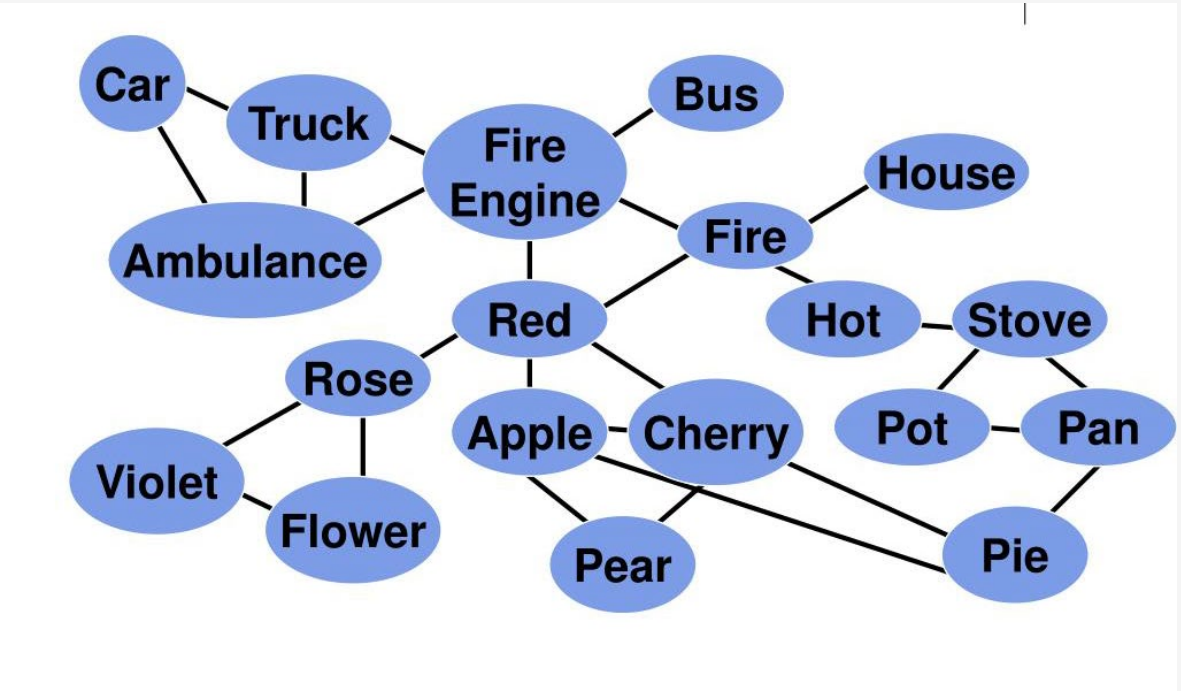
# What we are doing (L1 speech production in children with cochlear implants)

- Motivation:
  - The semantic network of children with CI is underdeveloped compared to normal hearing children (Kenett et al., 2013)
  - Children with CI display lower semantic abilities, stronger reliance on top-down predictions, relative to bottom-up language processing (stronger N400) (kallioinen et al. 2023)
  - deficiency in the automatic activation of semantic information in children with special needs
- To investigate the semantic processing during spoken word production in normal hearing children and children with cochlear implants
- Hypothesis: the semantic effect to be present in the normal hearing group but not in the CI group

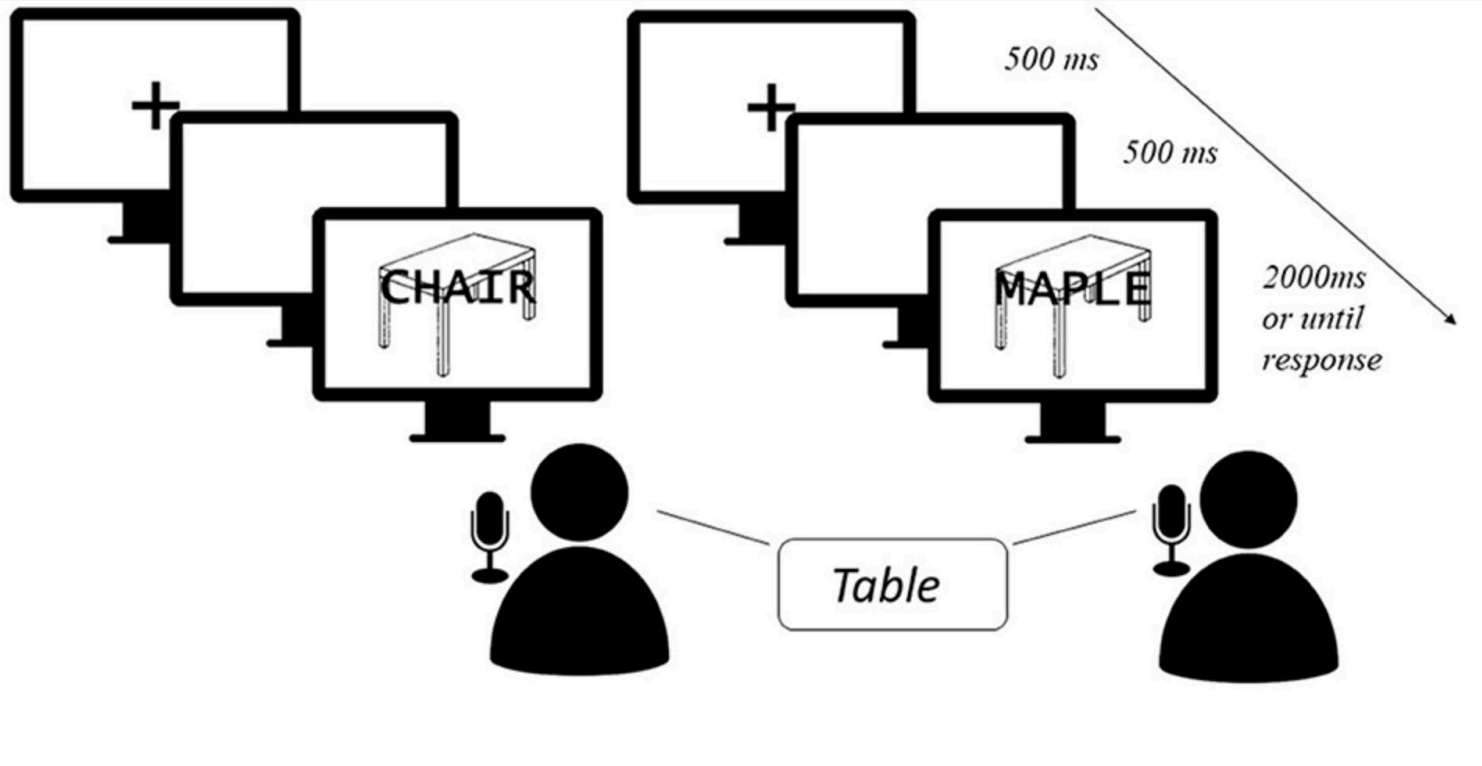
# L1 speech production in children with cochlear implants *Pilot*

Paradigm: picture-word interference

Semantic interference effect




# L1 speech production in children with cochlear implants *Pilot*



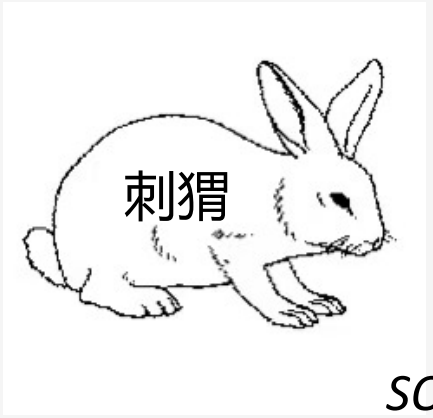

Paradigm: picture-word interference

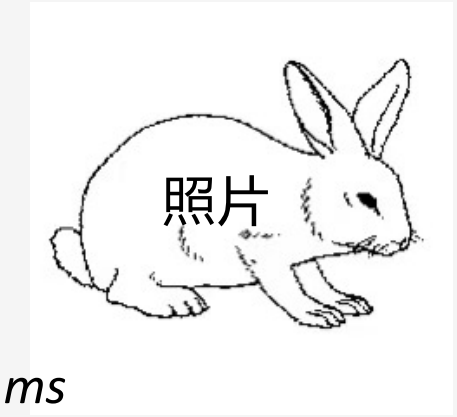
Participants:

- Hearing-impaired children group (Mean age= 10.9 yrs, SD=3.24), cochlear implanted before age 3
- Normal hearing children group (Mean age= 10.1 yrs, SD=2)

Combined Raven's Test (CRT) similar

# L1 speech production in children with cochlear implants *Pilot*



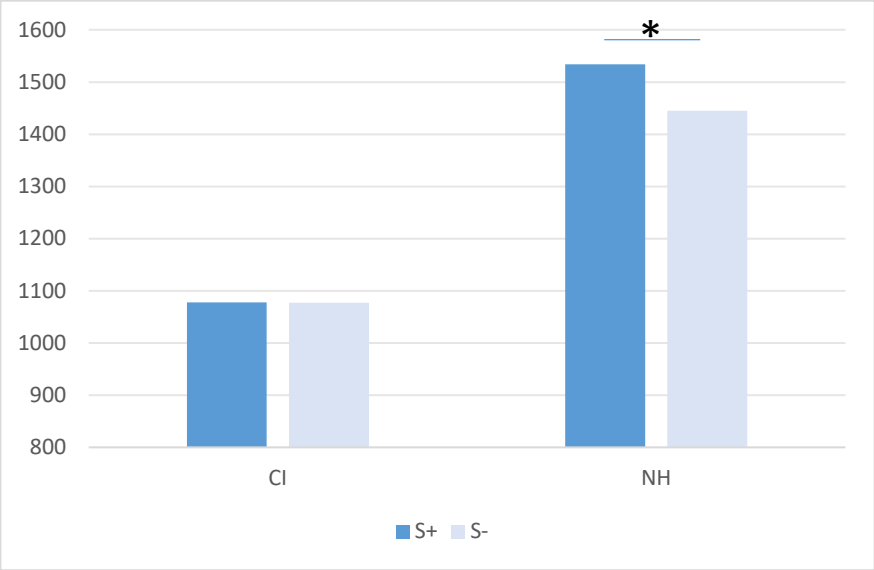




*SOA = -100 ms*

*hedgehog* *photo*

| | NH | CI |
|---|---|---|
| /nan2gua1/ pumpkin | | |
| /bi2zi0/ nose | | |

# L1 speech production in children with cochlear implants *Pilot*




- Significant semantic interference effect was observed only in the normal hearing group, but not in the CI group.
- Faster naming latencies in the CI group:
  Visual stimuli?

---

- Greater individual variance
- Much shorter attention span
- Less ‘cooperative’

# Thank you!

emilymanwang@163.com