

Summary of Research

With graphical-causal-model style introductions

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Outline

- **Proposal: The Expectation of Social Learning in Responsibility Attribution**
- **Chinese Adults Hold Graded Notions of Impossibility**
- **Notation-Dependent SNARC Effect**
- **Similarity-Induced Interference in Sentence Processing**

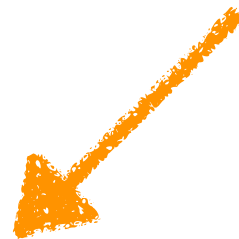
1. Learn From Others:

The Expectation of Social Learning in Responsibility Attribution — Background

- People infer the origin of actions when doing responsibility attribution.
- What if the agent's actions could be derived from others' experience?

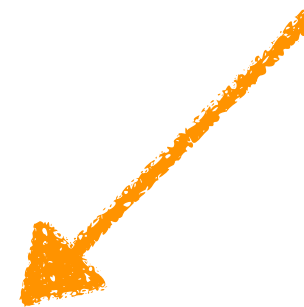
Social learning

An important way to adapt
to the environment



People are expected to learn
from others

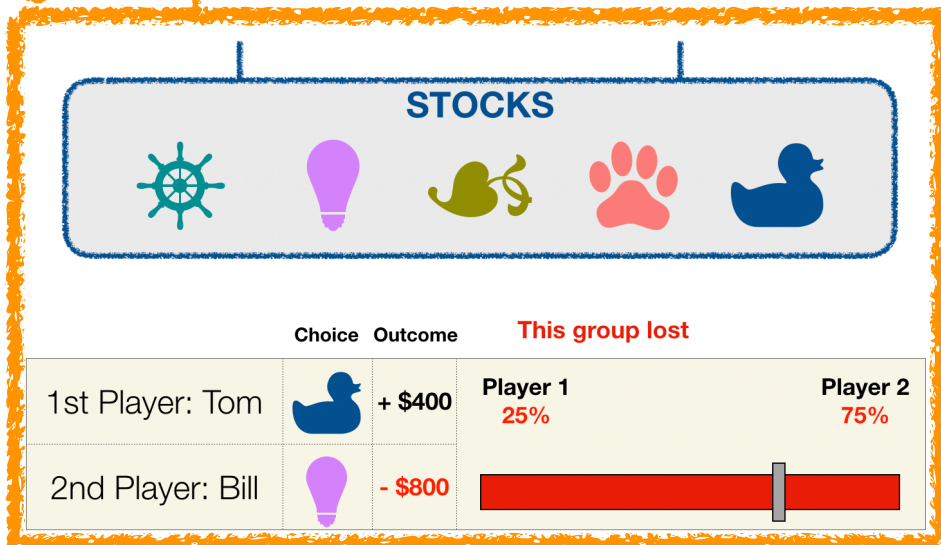
The unexpected actions will
receive more responsibility



Ignore others' experience and win -> more credit
Ignore others' experience and lose -> more blame

1. Learn From Others: The Expectation of Social Learning in Responsibility Attribution —Proposed Experiments

group situation



B	R	P1outcome (O1)	Same Choice(C)	P2outcome (O2)	Social learning	Pred.
1	1	400	✓	400	✓	45%
1	2	400	✗	400	✗	55%
1	3	-400	✓	-400	✗	57%
1	4	-400	✗	-400	✓	43%
2	5	800	✓	400	✓	28%
2	6	800	✗	400	✗	38%
2	7	-800	✓	-400	✗	40%
2	8	-800	✗	-400	✓	26%
2	9	400	✓	800	✓	62%
2	10	400	✗	800	✗	72%
2	11	-400	✓	-800	✗	74%
2	12	-400	✗	-800	✓	60%
3	13	400	✓	-800	✓	93%
3	14	400	✗	-800	✗	100%
3	15	-400	✓	800	✗	100%
3	16	-400	✗	800	✓	95%

To begin with, participants will consider how much P2's performance contribute to the final outcome.

$$\text{Performance (P2 | O1, O2)} = \text{O2}/(\text{O1}+\text{O2})$$

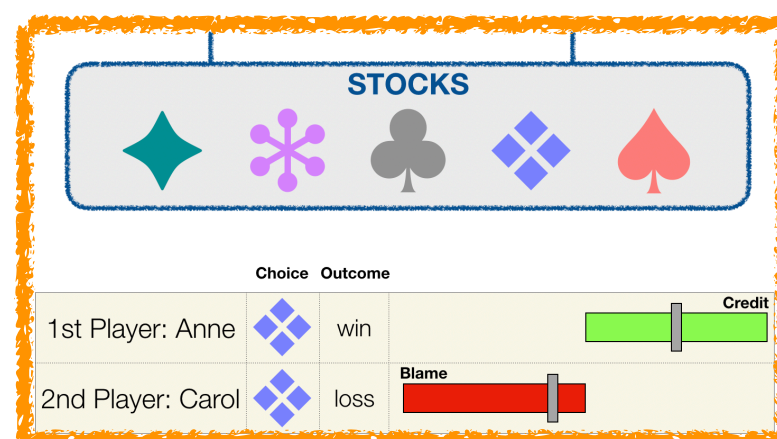
Then, participants will consider whether P2 learned from P1.

$$\text{Learning (P2 | O1, C)} = \text{C} * \text{Sgn (O1)}$$

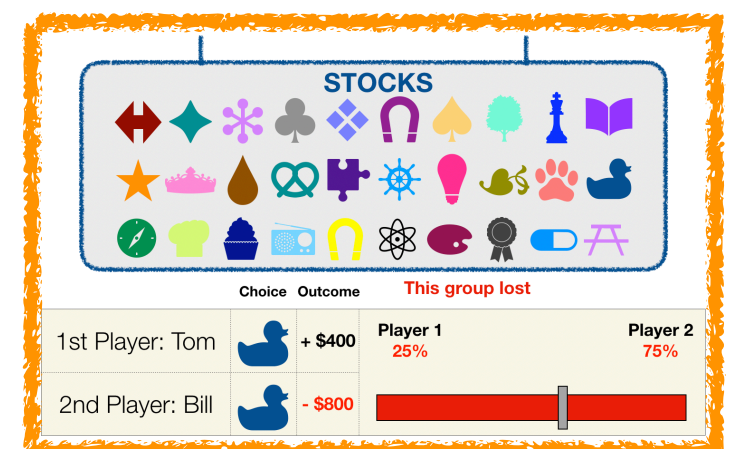
We assume that participants will combine the learning and performance factors when doing judgment.

$$\text{Responsibility} = \alpha + w1 * \text{Performance} + w2 * \text{Learning}$$

Personal situation



Strong Social Learning Cue



1. Learn From Others:

The Expectation of Social Learning in Responsibility Attribution

—Contribution and Future Studies

Contribution

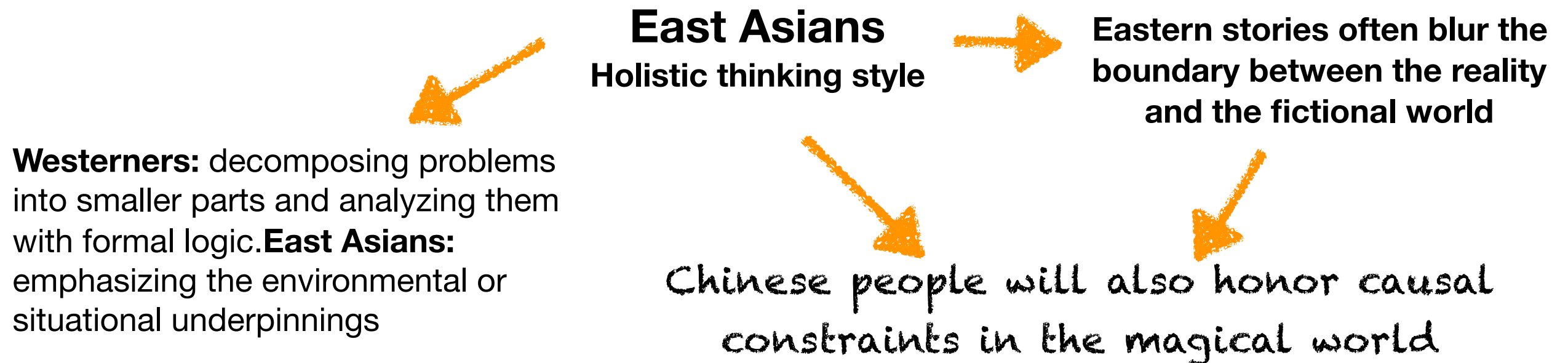
- **The inference in causal reasoning**
 - How do people combine the previous evidence with the present evidence?
 - Will the successful experience still be to blame (downward counterfactual thinking)?
- **The relationship between disposition and situation**
 - How do people treat disposition and situation information in responsibility attribution
 - How do people judge one's disposition from his behavior
- **The collective intelligence**
 - How do people represent the sources of knowledge?
 - Does knowledge are supposed to be shared by all people?

Future Studies

- **Social learning**
 - learn from failure vs. learn from success
 - epistemic statement
- **Other cues in inference**
 - attitude-behavior conflicting context
 - Prior knowledge-evidence conflicting context

2. The Plausible Impossible : Chinese Adults Hold Graded Notions of Impossibility — Background

- **There is a close relationship between imagination and causal reasoning**
 - People do causal reasoning through counterfactual simulation
 - Children model complex causal systems in their pretend play
- **In western, people honor causal constraints in magical world and hold graded notions of impossibility**
 - Walking through a wall made of wood or stone, which is more difficult?
- **Does this phenomenon also appear in East Asian people?**



Gong, T., & Shtulman, A. (submitted). The Plausible Impossible: Chinese Adults Hold Graded Notions of Impossibility.

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*, 108, 291-310.

Shtulman, A., & Morgan, C. (2017). The explanatory structure of unexplainable events: Causal constraints on magical reasoning. *Psychonomic bulletin & review*, 24(5), 1573-1585.

2. The Plausible Impossible : Chinese Adults Hold Graded Notions of Impossibility —Experiments

Material

Results: successful replication

Domain	Causal constraint	Spell
Physics	Object size	Making a (bush, tree) invisible
Physics	Object weight	Making a (basketball, bowling ball) float in the air
Physics	Object shape	Turning a broom into a (shovel, bucket)
Physics	Object complexity	Shrinking a (chair, computer) to half its size
Physics	Object density	Walking through a wall made of (wood, stone)
Physics	Object value	Turning a lump of coal into a lump of (silver, gold)
Biology	Evolutionary similarity	Turning a person into a (monkey, pig)
Biology	Developmental similarity	Turning an adult back into a (teenager, child)
Biology	Ailment severity	Curing a person's (hiccups, arthritis)
Biology	Organ size	Mending a broken (finger, arm)
Biology	Organ complexity	Growing an extra (toe, eye)
Biology	Organ plasticity	Making a person's (hair, teeth) grow longer
Psychology	Knowledge entrenchment	Making a person forget his own (phone number, name)
Psychology	Knowledge complexity	Teaching a monkey to do (arithmetic, calculus)
Psychology	Skill difficulty	Teaching a cow how to (skip, tap dance)
Psychology	Affect intensity	Making someone (smile, laugh)
Psychology	Trait stability	Increasing a person's (memory, intelligence)
Psychology	Language comprehension	Teaching a person to (read, speak) a foreign language

Exp1: Forced choices (n=100)

- Which one is more difficult?
- People's judgments are aligned with casual constraints ($t(49) = 10.97, p < .001$), even when given the “equally difficult” option ($t(49) = 2.40, p < .05$).

Exp2: Reason generation (n=50)

- Why you think A is more difficult than B?
- People generated reasons with correspondent causal constraints (72% of the time).

Exp3: Likert-type scales (n=150)

- Please rate the difficulty of each spell.
- People's ratings are aligned with causal constraint when they saw spells paired together ($t(49) = 6.03, p < .001$) rather than the single version of the spells ($t(98) = -1.72, p = .089$).

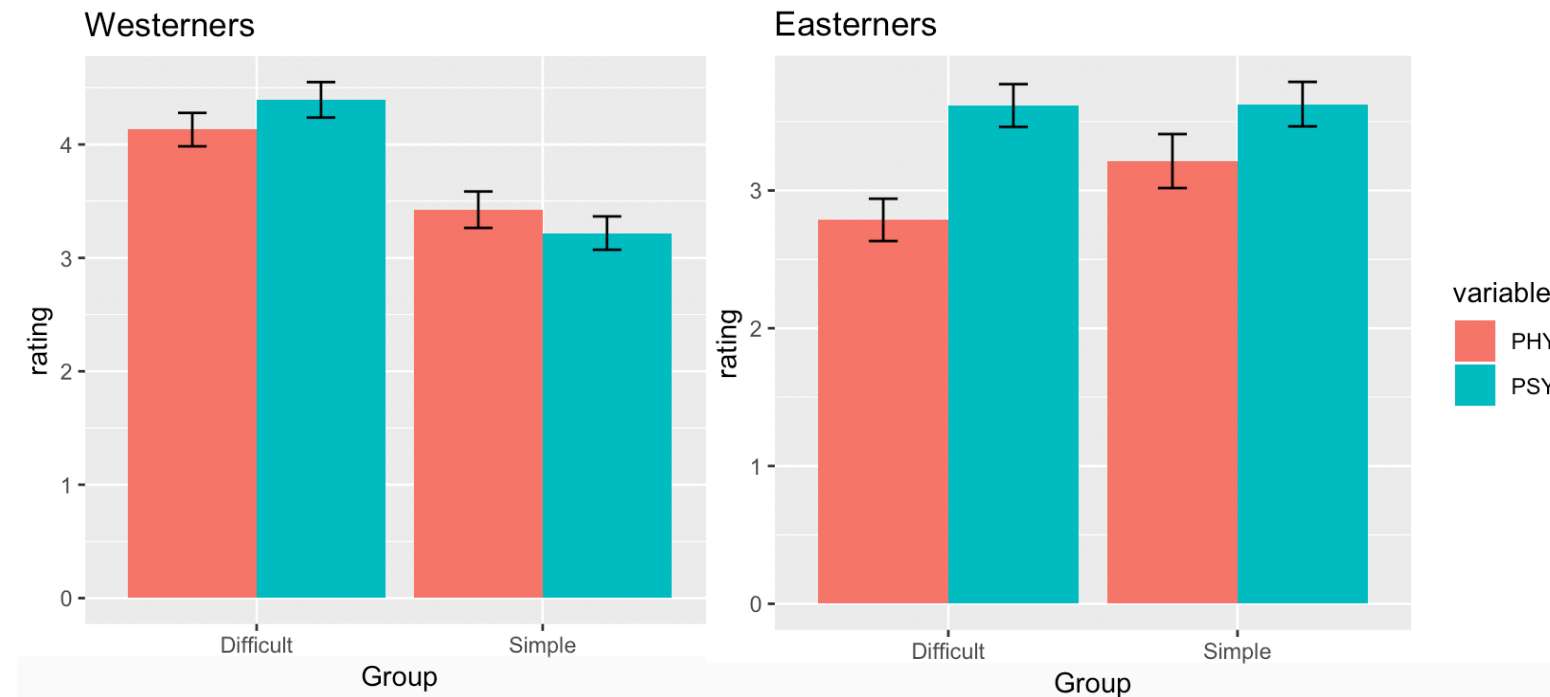
Exp4: Items generation (n=166)

- Please design spells in increasing difficulty.
- Conjuring a ___ out of thin air (object)
- Typical answers: tree, moon, sun

2. The Plausible Impossible : Chinese Adults Hold Graded Notions of Impossibility —Contribution and future studies

Interesting results in study 3

- Holistic thinking style -> easterners compare spells across different areas
- How people regard physical world differential from psychology world?
- Why people consider psychological spells as more difficult while they think physical classes are more difficult to learn in the reality?



Contribution and future studies

- **Intuitive theory of knowledge**
 - How do people rate the difficulty when exploring physical/psychological worlds?
- **Causal Reasoning**
 - Graded notions of impossibility are shared across cultures, possibly because they are a byproduct of the interconnectedness of causal knowledge.
 - How does the dynamic process of causal reasoning and imagination look like?

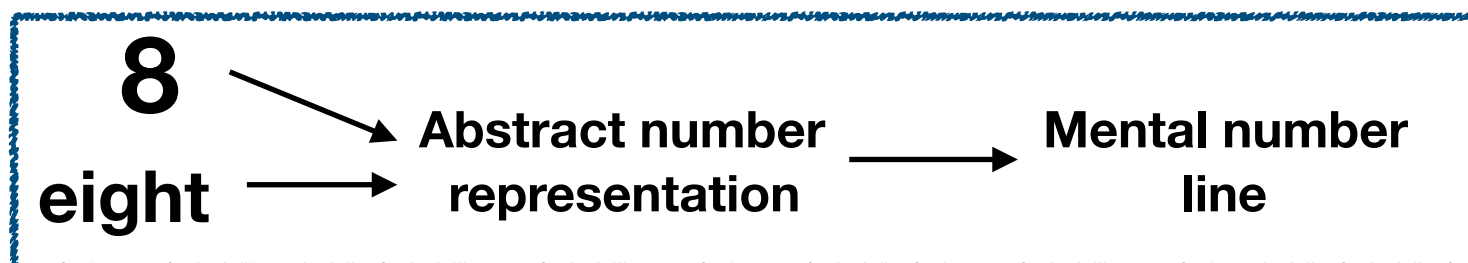
3. Notation-Dependent SNARC Effect — Background

- **Spatial-Numerical Association of Response Codes effect (the SNARC effect)**
 - The mental number line is from left to right generally
 - Responses to relatively larger numbers are faster for the right hand, those to smaller numbers for the left hand, even when number magnitude is irrelevant to the task (e.g., judging the parity of numbers)
- **The notation-independent SNARC hypothesis**

The previous model

Different notations
trigger the same
SNARC

Additive-factors Design
says that if there is no interaction
between two factors, then two factors
are processed in different stages



Problems

- Additive-factors Design only refer to sequential processing while SNARC is a dual-route processing
- The reaction time for Arabic digits and verbal words are varied. **We don't know what would happen when the reaction time difference is eliminated**

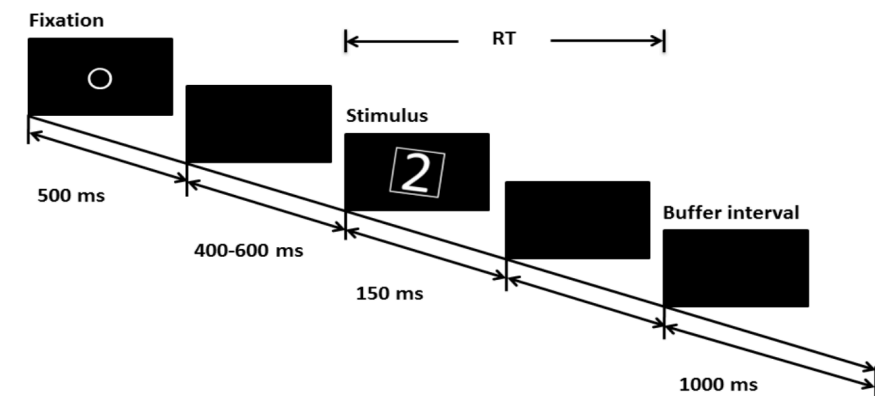
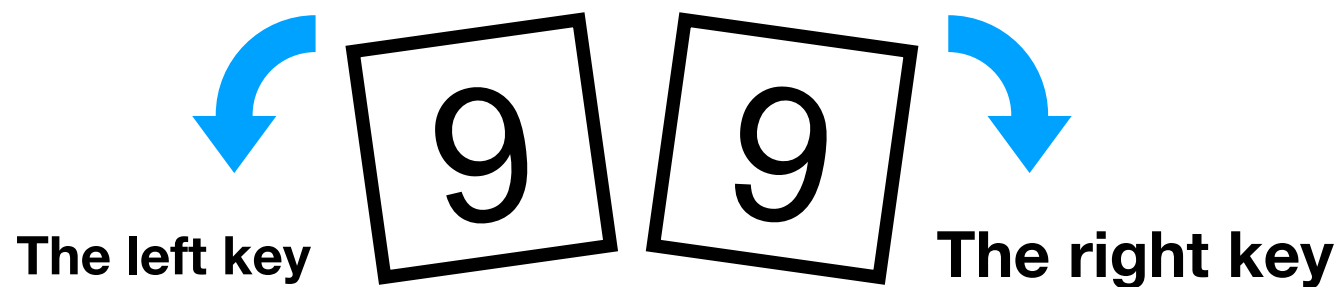
Gong, T., Li, B., Teng, L., Zhou, Z., Gao, X., Jiang, T. (in press). The Association between Number Magnitude and Space is dependent on notation: Evidence from an adaptive perceptual orientation task. *Journal of Numerical Cognition*.

Fias, W. (2001). Two routes for the processing of verbal numbers: evidence from the SNARC effect. *Psychological Research-Psychologische Forschung*, 65(4), 250-259.

Nuerk, H. C., Wood, G., & Willmes, K. (2005). The universal SNARC effect - The association between number magnitude and space is amodal. *Experimental Psychology*, 52(3), 187-194.

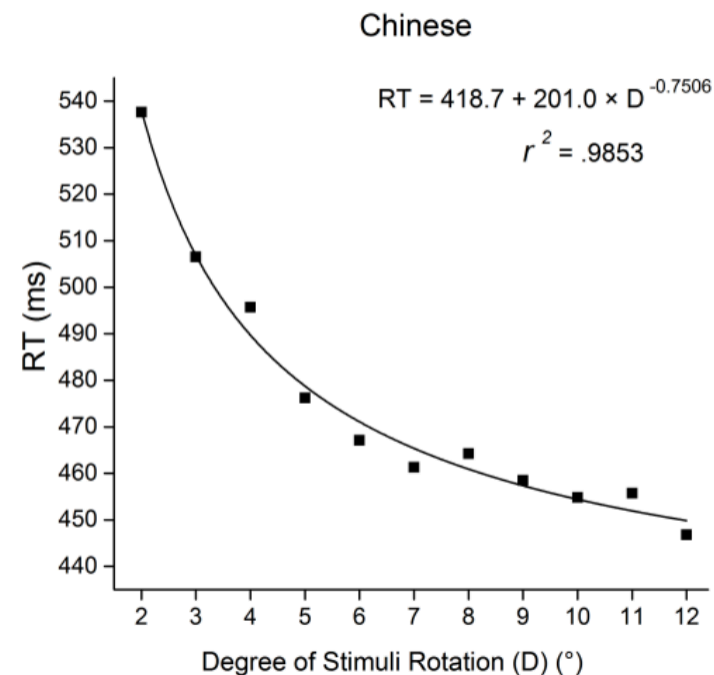
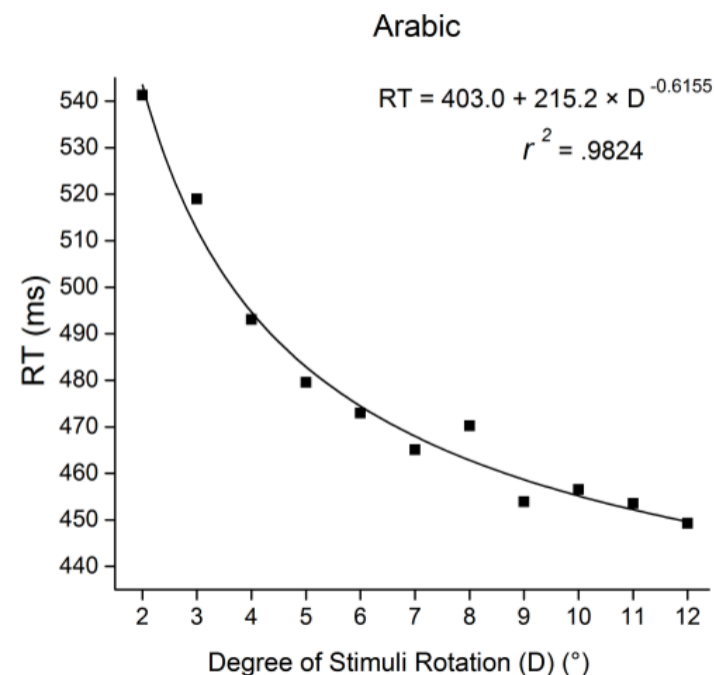
3. Notation-Dependent SNARC Effect —Method

- A novel simple perceptual task to test SNARC effect



Arabic	1	2	3	4	5	6	7	8	9
Chinese	壹	貳	叁	肆	伍	陆	柒	捌	玖

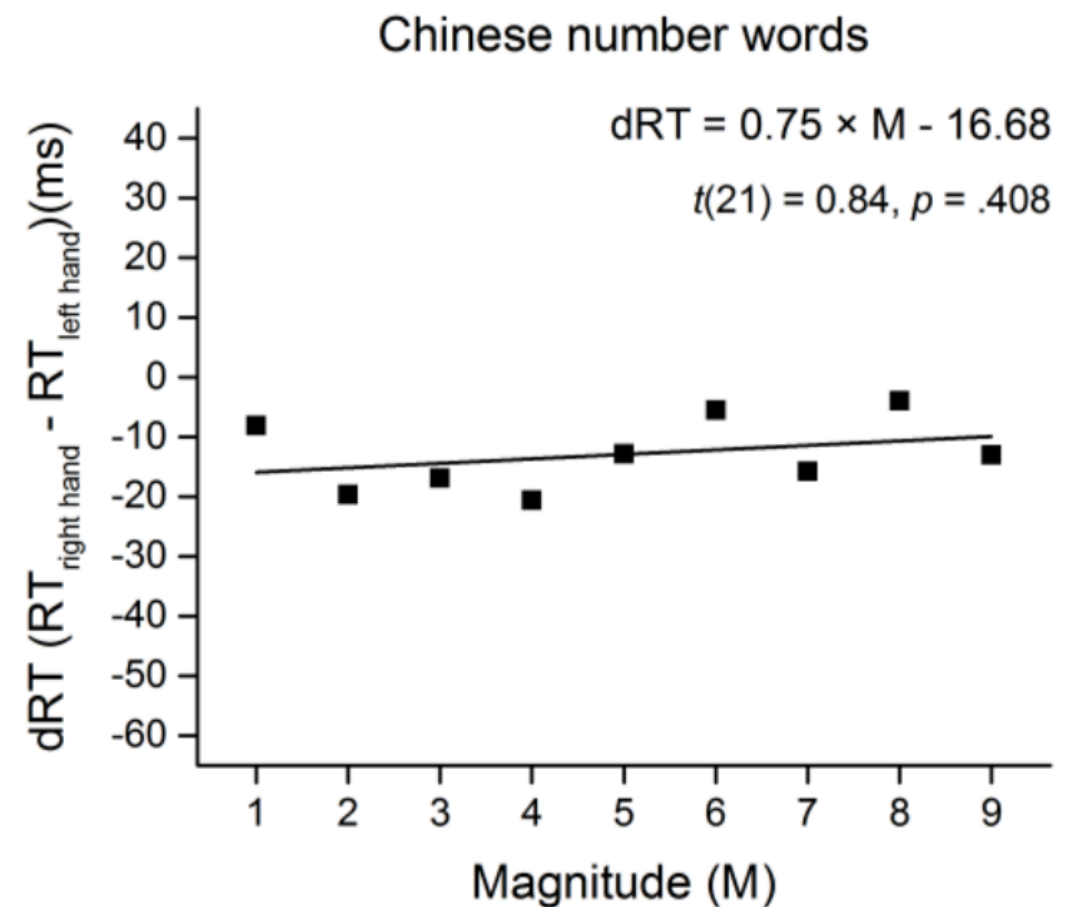
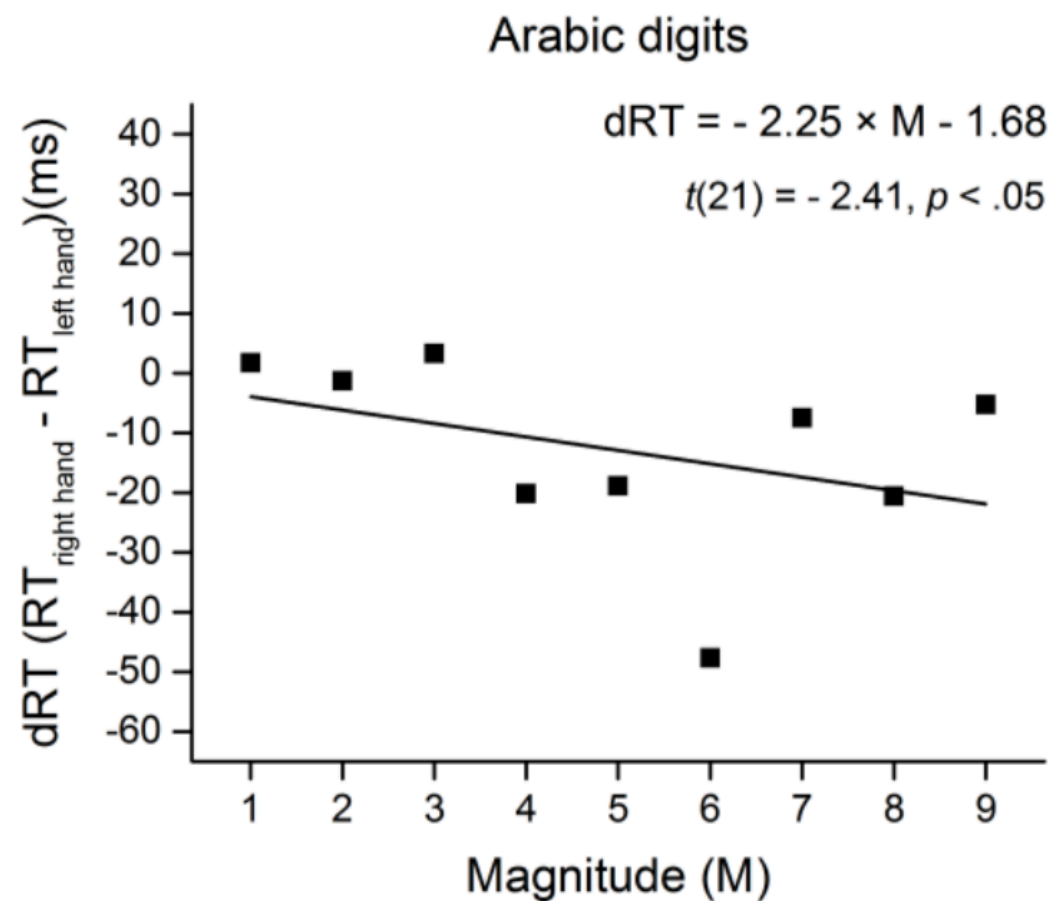
- Using the angle of frame to adjust reaction time



- reduce the degree of Chinese stimuli When $RT_{Chinese} < RT_{Arabic}$
- add the degree of Chinese stimuli When $RT_{Chinese} > RT_{Arabic}$

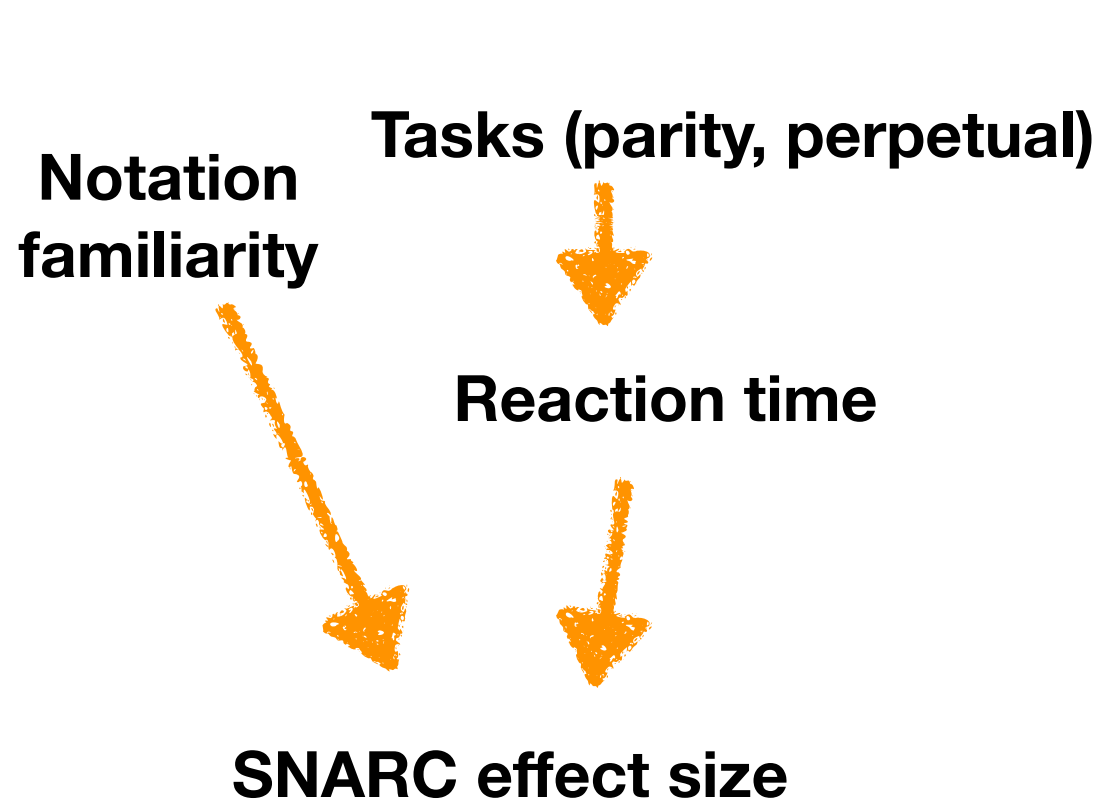
3. Notation-Dependent SNARC Effect — Results

- SNARC effect was observed for Arabic digits, but absent for verbal numbers
- $n=22$
- Followed by a similar replication, $n= 22$



3. Notation-Dependent SNARC Effect — Implication

- Offer a inclusive explanation of SNARC effect



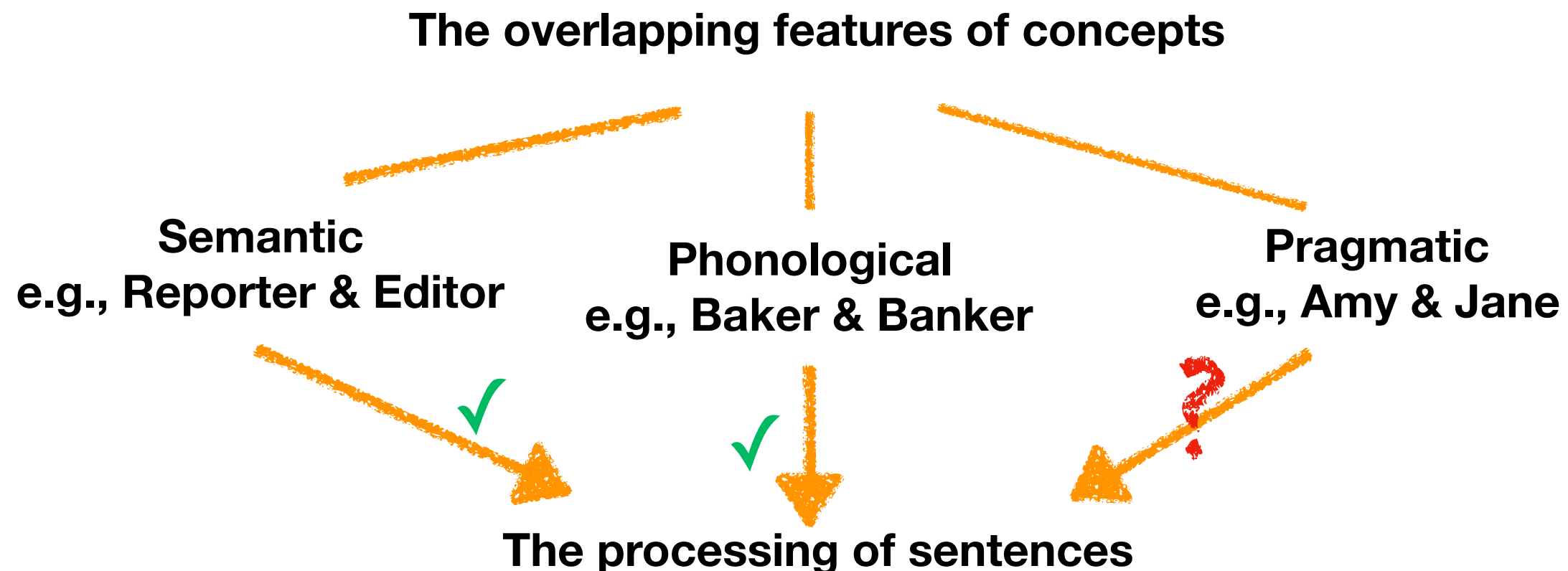
Evidence

	Notation familiarity	Reaction time	SNARC effect size
Fias, 2001	Arabic > verbal	Arabic > verbal	Arabic > verbal words; but we don't know which factor domains this process.
Nuerk et al., 2005	Arabic > verbal	Arabic < verbal	Arabic = verbal words; two factors cancel out with each other
The present research	Arabic > verbal	Arabic = verbal	Arabic > verbal words; familiarity influence the automatic process, aligning with other research in numerical cognition

- **Inspiration for me**
 - Notice the causal relation between different factors
 - Build graph models
 - Mind the information processing of cognitive phenomena

4. Similarity-Induced Interference in Sentence Processing: The Role of Pragmatics —Background

- **Similarity-based theories of language processing**
 - the overlapping features of the to be integrated concepts in sentence could cause processing difficulties during online language understanding, particularly when the syntactic structure is complicated
- **Previous studies focus on the features of phonological and semantic, while we are curious about the impact of pragmatic information**



Gao, X., & **Gong, T.** (2018). Similarity-Induced Interference in Sentence Processing: The (Missing) Role of Pragmatics. Poster was presented at the 30th APS Annual Convention. San Francisco, CA, USA.

Gordon, P.C., Hendrick, R., Johnson, M., & Lee, Y. (2006). Similarity-based interference during language comprehension: Evidence from eye tracking during reading. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 32, 1304-1321.

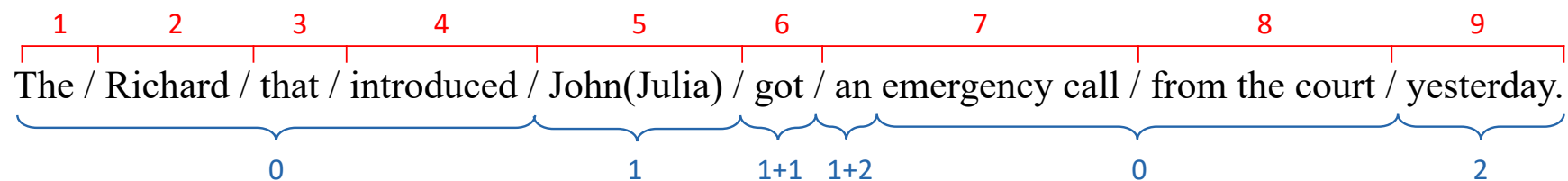
Hsiao, F. P. F., Gibson, E. (2003). Processing relative clauses in Chinese. *Cognition*, 90, 3-27

4. Similarity-Induced Interference in Sentence Processing: The Role of Pragmatics —Experiments

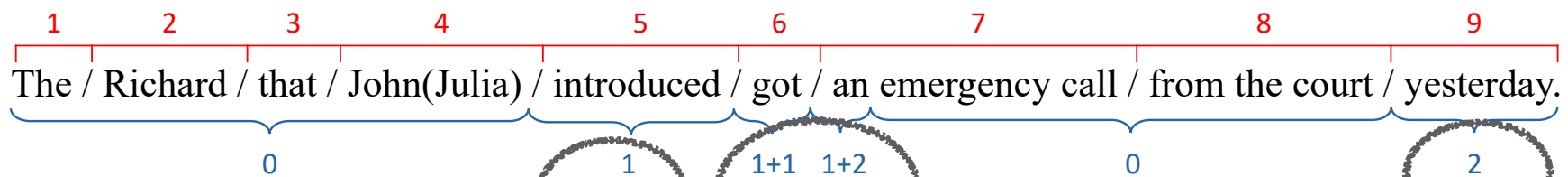
Material

Subject Relative Clause: Similar (vs. Dissimilar)

segmented by region/by clause boundary



Object Relative Clause: Similar (vs. Dissimilar)



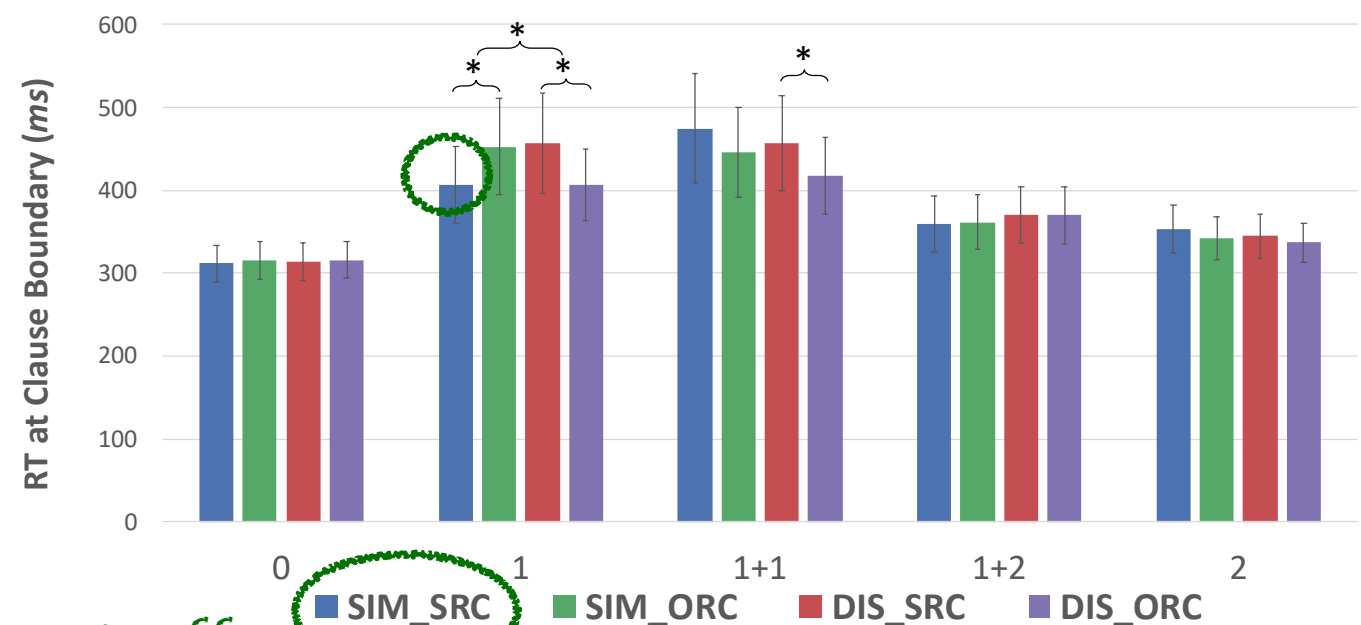
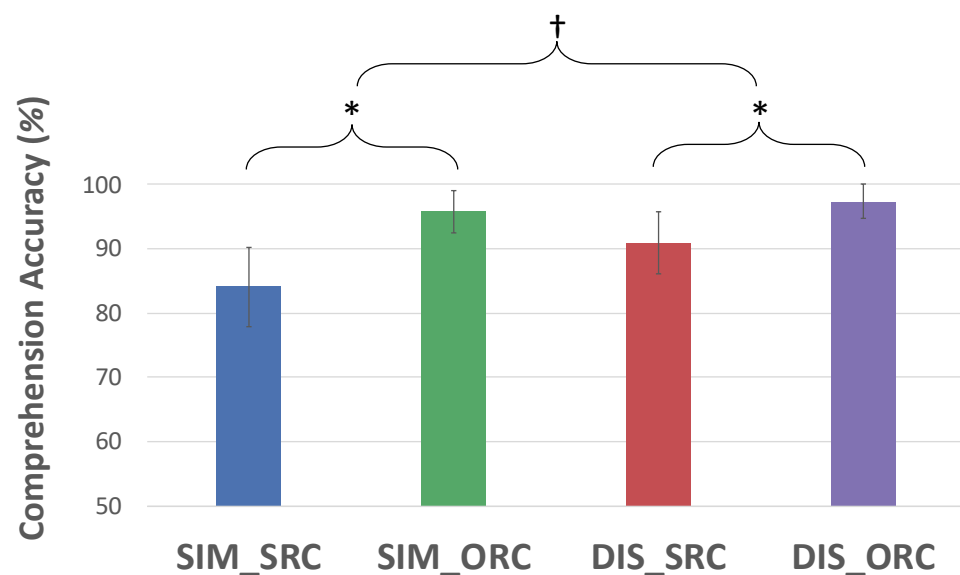
interest area

spill over effect

wrap up effect

Procedure

Participants read sentences in a self-paced moving window fashion and answered a comprehension question immediately after reading each sentence.



good enough effect

- offline comprehension showed the predicted pattern that similarity impaired reading comprehension
- No expected effect was found in online processing. The reaction time was shortest in the hardest condition. Thus we supposed participants gave up their reading comprehension due to the overwhelming difficulty.