

Animacy Effects in Production and Comprehension of English Object Relative Clauses

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20 LSA
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NEW ORLEANS MARRIOTT

JANUARY 8-11

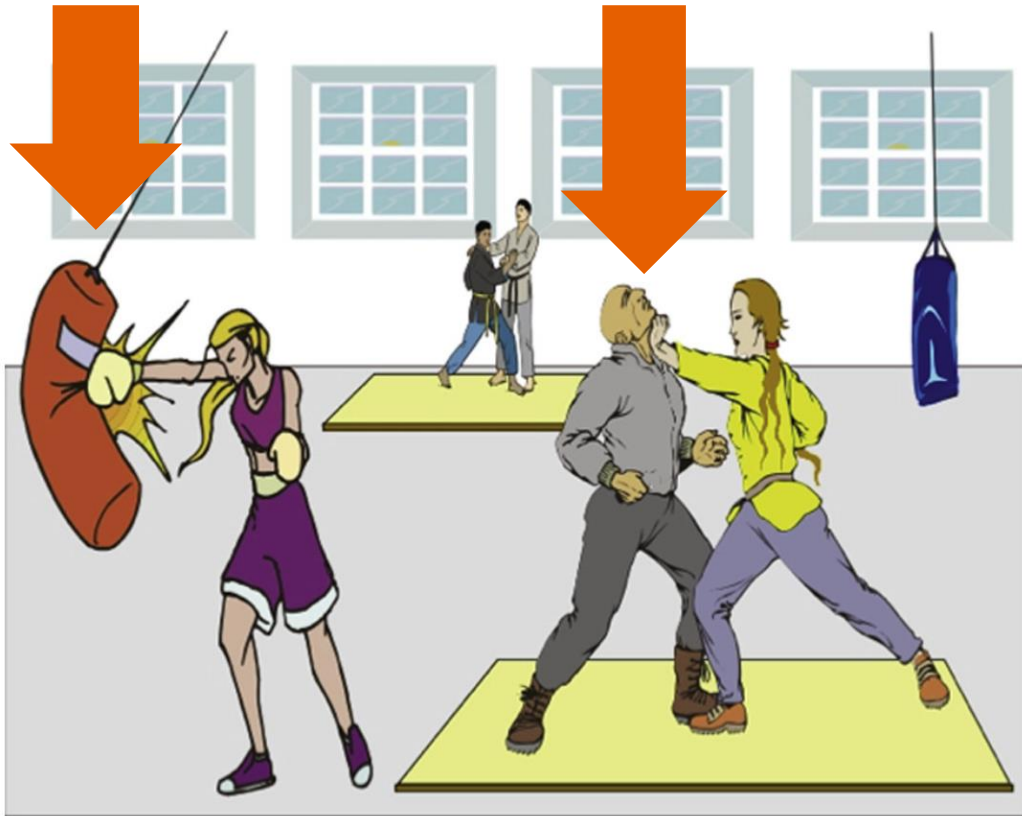
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Introduction



ANIMACY IN OBJECT RELATIVE CLAUSE PRODUCTION

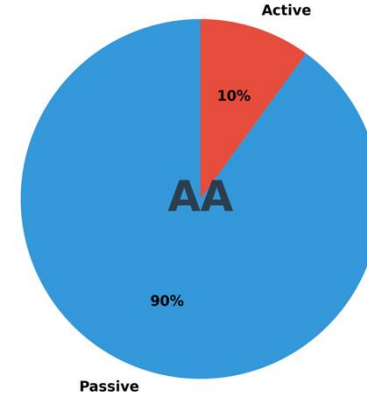


Gennari et al. (2012)

animate

the man that's punched by the woman

the man that the woman punches

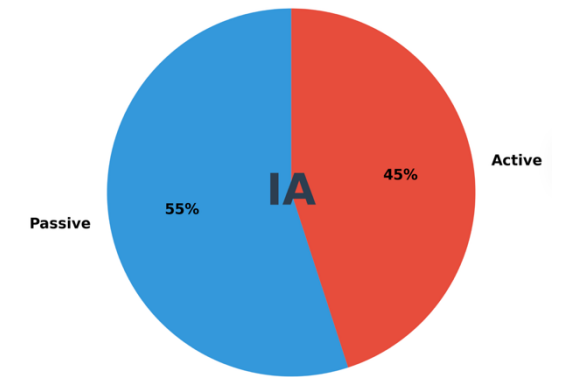


inanimate

the sandbag that's punched by the woman

the sandbag that the woman punches

animate



animate



ANIMACY IN OBJECT RELATIVE CLAUSE PRODUCTION

The animacy status of nouns affects the order in which they are retrieved from memory during sentence construction (Bock et al., 1992).

Animate Head Nouns:

- more conceptually salient;
 - more likely to possess the subject position;
- (Bock et al., 1992; Bock & Warren, 1985; Perera & Srivastava, 2016)

In the context of ORCs:

- **Condition AA:** stronger preference for **passive** structures as they **allow subject position** for animate nouns.

(Perera & Srivastava, 2016)

Animacy-Based Accessibility Mechanism

active

the baby that the woman carries

object

passive

the baby that's carried by the woman



subject



ANIMACY IN OBJECT RELATIVE CLAUSE PRODUCTION

The simultaneous retrieval of two conceptually **similar** nouns leads to **competition** between them.

(Gordon et al., 2001; Smith & Wheeldon, 2004)

In the context of ORCs:

- when two nouns share the same animacy feature (e.g., **Condition AA**), they tend to trigger competition in production planning, resulting in a strong preference for a **structure that can reduce this competition**;

→ which is usually **passive** in many languages;

(Gennari et al., 2012; Montag et al., 2017)

Similarity-Based Competition Mechanism

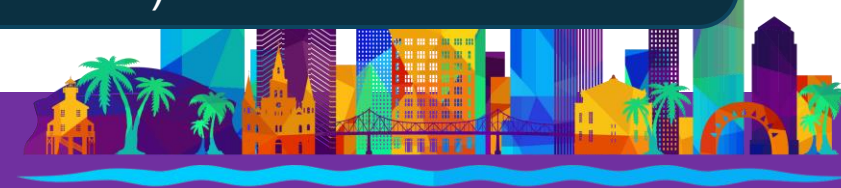
active *the baby* that *the woman* carries
Head Noun ↔ Agent

passive *the baby* that's carried by *the woman*
Head Noun ↔ Agent



Congruent Animacy

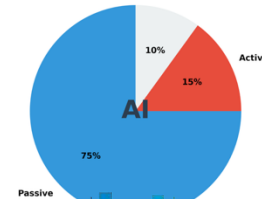
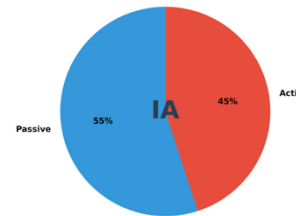
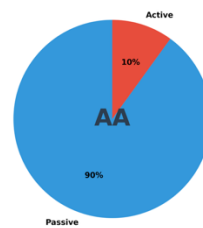
Two nouns in the ORC share the same animacy status (e.g., Condition AA)



ANIMACY IN ORC | WHAT WE DON'T KNOW YET

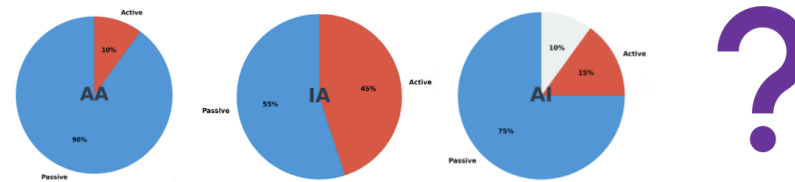
- Condition AA (e.g., Gennari et al., 2012 on English, Serbian and Spanish; Hsiao & MacDonald, 2016 on Mandarin Chinese)
- Condition IA (e.g., Gennari et al., 2012 on English, Serbian and Spanish; Hsiao & MacDonald, 2016 on Mandarin Chinese)
- Condition AI (e.g., Rodrigo, et al., 2018 on Spanish and Japanese)
- ? **Condition II** (Ianimate head noun + Ianimate agent)

	AA	IA	AI	II
<i>Animacy-Based Accessibility Mechanism</i>	✓	✗	✓	✗
<i>Similarity-Based Competition Mechanism</i>	✓	✗	✗	✓



ANIMACY IN ORC PRODUCTION | GAP

	AA	IA	AI	II
<i>Animacy-Based Accessibility Mechanism</i>	✓	✗	✓	✗
<i>Similarity-Based Competition Mechanism</i>	✓	✗	✗	✓



Research Question

RQ 1: How does animacy influence the structure choice of English ORC production by native speakers?

Hypothesis: (1) Following previous studies and our preliminary result, we predict a stronger passive preference in conditions **AA, AI, and II** among native speakers, driven by a combination of *animacy-based accessibility* and *similarity-based competition mechanisms*.



ANOTHER KEY FACTOR | WORKING MEMORY

Similarity-based competition is fundamentally a **memory-based** phenomenon.

- When two similar nouns must be retrieved or maintained, they compete in working memory (Gordon et al., 2001, 2006)

Cue-based retrieval model (Lewis, Vasishth, & Van Dyke, 2006):

- Sentence processing relies on retrieving items from memory using cues
- When cues partially match multiple items (e.g., two animate nouns), **interference** occurs
- Managing this interference requires cognitive resources

Our prediction:

Individuals with higher WM capacity should better **tolerate** similarity-based interference

→ Greater **structural flexibility** in production (i.e., more active ORCs even in high-interference conditions)



ANOTHER KEY FACTOR | WORKING MEMORY

Study	Key Finding
Traxler (2007)	Higher WM → better syntactic ambiguity resolution
Andrews et al. (2006)	WM capacity predicts ORC comprehension accuracy
Wu et al. (2022)	Higher WM → more active ORCs in AA condition (children & adolescents)
Wells et al. (2009)	Statistical learning & experience may matter more than WM

Gap:

- WM's role in **animacy-driven** structure choice remains underexplored
- No study has examined WM across **all four animacy configurations**



ANOTHER KEY FACTOR | WORKING MEMORY

RQ 2: How might individual differences, such as **working memory**, interact with animacy features to influence ORC **production**?

Hypotheses:

- (1) We predict **higher working memory** capacity to correlate with **higher accuracy rate** and **increased use of active structures**, especially in animacy conditions where active ORCs are less expected (such as AA, AI, and II).
- (2) We predict that participants with **higher working memory** capacity will likely to produce **more active** ORCs in conditions that place greater demands on cognitive resources.



ANIMACY IN ORC **COMPREHENSION** | **MIXED FINDINGS**

	Language tested	Participant's L1	Comprehension method	Metrics	Findings
Hsiao & MacDonald (2016)	Mandarin Chinese	Mandarin Chinese	Self-paced reading (word-by-word)	<ul style="list-style-type: none"> Comprehension question accuracy Comprehension question response time reading time 	<ul style="list-style-type: none"> ✗ No animacy or structure effect in accuracy ✗ No animacy or structure effect in response time Animacy effect was found at “bei”: shorter reading time for “bei” in animate-head noun condition
Humphrey et al. (2016)	English	English	Decision task (whether picture and audio matches)	<ul style="list-style-type: none"> Comprehension accuracy Comprehension reaction time (RT) 	<ul style="list-style-type: none"> ✓ Animacy effect in accuracy: less accurate for active animate-animate ORCs Significant animacy effect, structure effect and interaction: AA active ORCs took longer RT than IA active ORCs, but no difference in passives.
Wu, Henderson, & Gennari (2022)	English (active ORCs only)	English	Decision task	<ul style="list-style-type: none"> Comprehension accuracy Comprehension RT 	<ul style="list-style-type: none"> ✗ No animacy effect in accuracy ✓ Animacy effect in RT: longer RT in animate-head active ORCs than inanimate-head active ORCs



ANIMACY IN ORC COMPREHENSION | RQ

RQ 3: How does **animacy** influence **comprehension accuracy** for English ORCs among native speakers?

Hypothesis:

(1) minor **animacy** effect on native speakers' comprehension accuracy: lower accuracy in active ORCs under animacy conditions that are less commonly expressed in active form (such as AA, AI, and II), as these conditions may have greater cognitive demands on our comprehenders.

RQ 4: How does **animacy** affect **reaction times** in comprehending English ORCs among native speakers?

Hypothesis:

- (1) **structure** effect on RT: RT (active) > RT (passive)
- (2) **animacy * structure** on RT: **longer RT** for **active ORCs** in the AA condition (e.g., “the man that the girl is pushing”) compared to the IA condition (e.g., “the car that the girl is pushing”); the shortest RT for active ORCs in the IA condition.



ANIMACY IN ORC COMPREHENSION | WORKING MEMORY

RQ 5: How do individual differences, such as **working memory**, interact with animacy to affect ORC **comprehension accuracy** and **reaction time**?

Hypothesis:

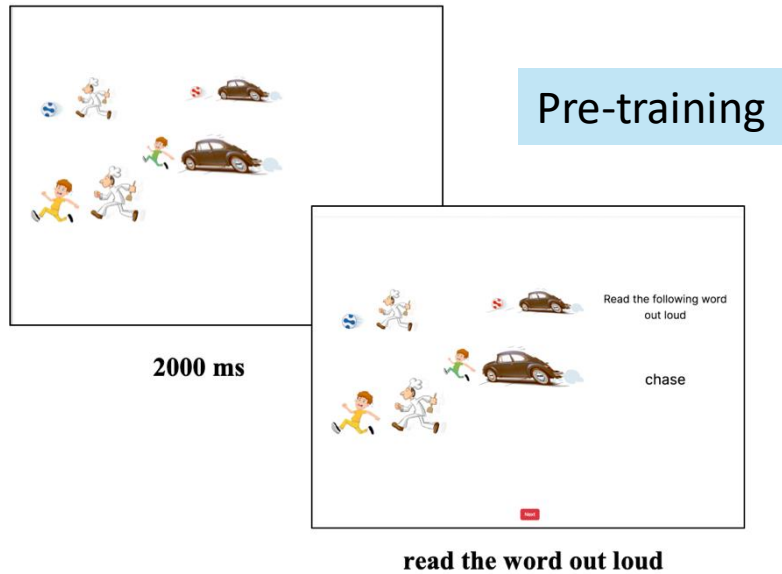
- (1) **WM advantage overall**: higher working memory capacity → greater comprehension accuracy and reduced RT across all animacy conditions
- (2) **Animacy*WM interaction**: this advantage to be especially **pronounced** in conditions with higher processing demands, such as **active ORCs in the AA, AI, and II conditions**, where individuals with higher working memory capacity may be better equipped to manage the cognitive load, leading to higher accuracy and shorter reaction times.



Method



TASK 1: ELICITED PRODUCTION



Pre-training

2000 ms

Read the following word out loud

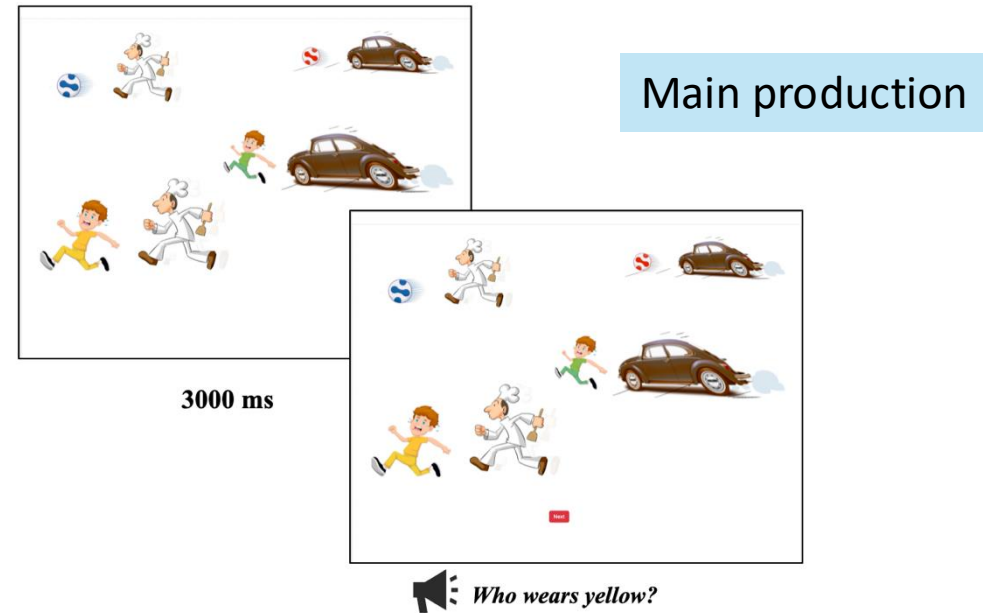
chase

read the word out loud

The diagram shows a sequence of two boxes. The top box contains four illustrations: a soccer ball, a chef, a boy, and a car. The bottom box contains the same four illustrations and the text 'Read the following word out loud' and 'chase'. Below the bottom box is the instruction 'read the word out loud'.

Items:

- 4 practice items
- 20 experimental items
- 50 fillers



Main production

3000 ms

Who wears yellow?

The diagram shows a sequence of two boxes. The top box contains four illustrations: a soccer ball, a chef, a boy, and a car. The bottom box contains the same four illustrations and the text 'Who wears yellow?'. Below the bottom box is a speaker icon.

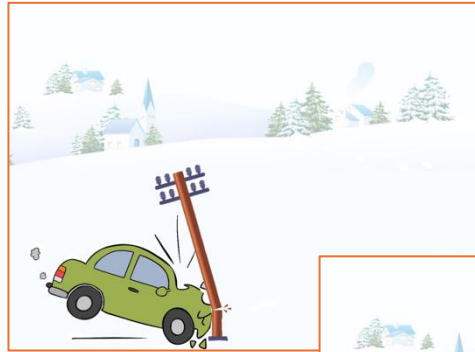


“the boy (that) the chef is chasing”

“the boy (that/who is) chased by the chef”



TASK 1: ELICITED PRODUCTION

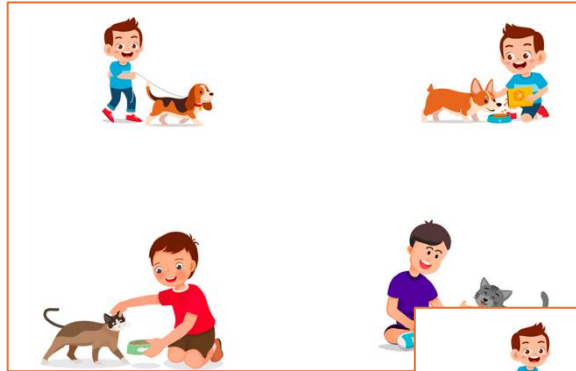


3000ms

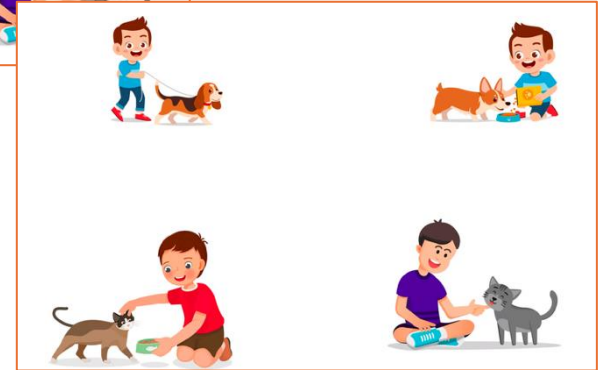


“Briefly describe what’s in the picture.”

Fillers



3000ms



“Who wears red?”

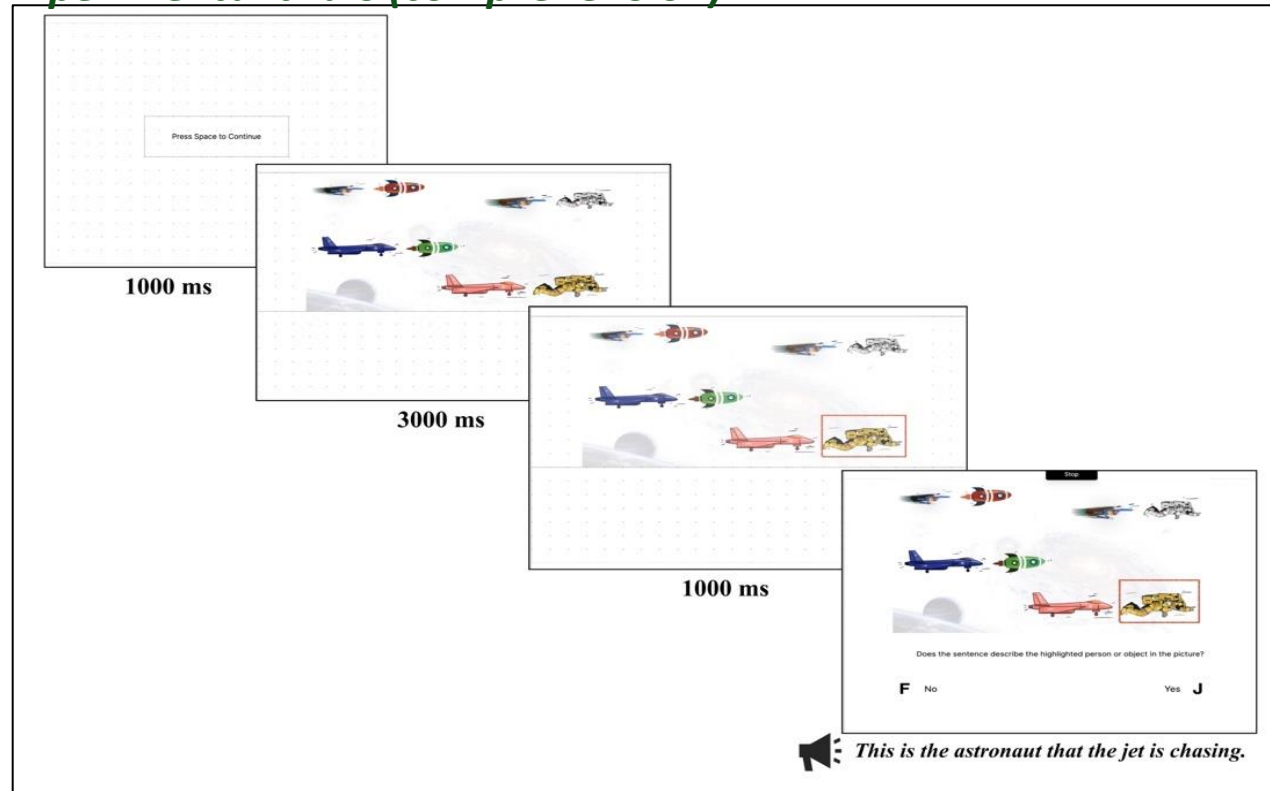


“the boy (who/that is) feeding the cat”



TASK 2: OFFLINE DECISION TASK

Experimental trials (comprehension)



- 24 experimental items (4 animacy * 2 structure * 3 item): **YES**
- 36 fillers: **30 NO + 6 YES**

We measure:

- Comprehension accuracy
- Response time



TASK 3: BACKWARD DIGIT SPAN

Task 3

In this task, you will see a sequence of numbers.
Using the number pad on the right, you should repeat
the digits in the REVERSED order
Click the `[start]` button below to start practicing!



Start

2



1



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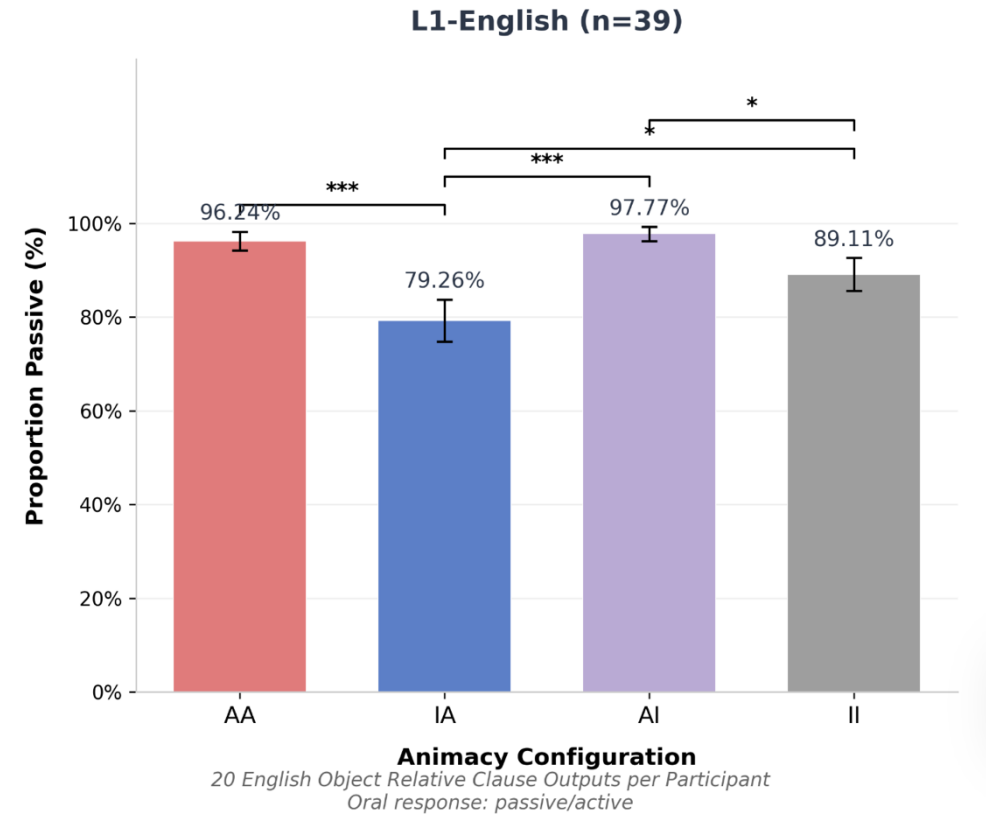
Results



Results | Production

Observations:

- Native English speakers showed **animacy-driven variation**
- Significant animacy effect was found ($p < .001$)
- **Least passive use** in IA condition



Results | Production

- **headnoun (***)**: inanimate head noun → less passive use (more active use)
- **Agentnoun (n.s.)**
- **Headnoun * agentnoun interaction (n.s.)**

- **Congruency (*)**: incongruent animacy → less passive use (i.e., more active rate)

	Estimate (β)	SE	z	p
Headnoun (inanimate) animacy	-2.50	0.54	-4.63	< .001 ***
Agentnoun (inanimate) animacy	0.61	0.71	0.86	.392
Headnoun × Agentnoun interaction	0.53	0.82	0.65	.518
Congruency (incongruent)	-2.52	1.00	-2.51	.012 *



Results | Comprehension

Condition	Active Acc. (%)	Passive Acc. (%)
AA	99.2	98.3
IA	95.7	✓ 100.0
AI	95.7	✓ 100.0
II	97.4	✓ 100.0

- ✓ near ceiling (94–100%) accuracy across conditions and structures.
- ✓ Comprehension success was uniformly high

RT:

Animacy and structure (active vs. passive) had NO significant main effects on RT.

→ comprehension was equally easy across conditions.



Results | Working Memory

We now know that animacy significantly affected ORC structure choice.

- Next we ask: *Does working memory modulate the strength of the animacy effect in structural choice?*

Did adding WM interaction with Condition improve the model?

WM Variable	χ^2	Df	p	Improvement
bds_score	3.95	3	.267	X No
bds_span	2.97	3	.397	X No

- Working memory (BDS score or span) **did NOT explain additional variance** in animacy-driven structure choice.
- This seems to suggest that **animacy sensitivity** is not contingent on domain-general memory resources.



Results | Working Memory

- *Although WM did not interact with ANIMACY, did WM show an effect on structure choice?*

Fixed effect of WM (z-scored) on passive use
(L1-English, main effects model)

WM Variable	Estimate	Std. Error	z	p
bds_score	-0.611	0.295	-2.074	.038 *
bds_span	-0.460	0.303	-1.515	.130

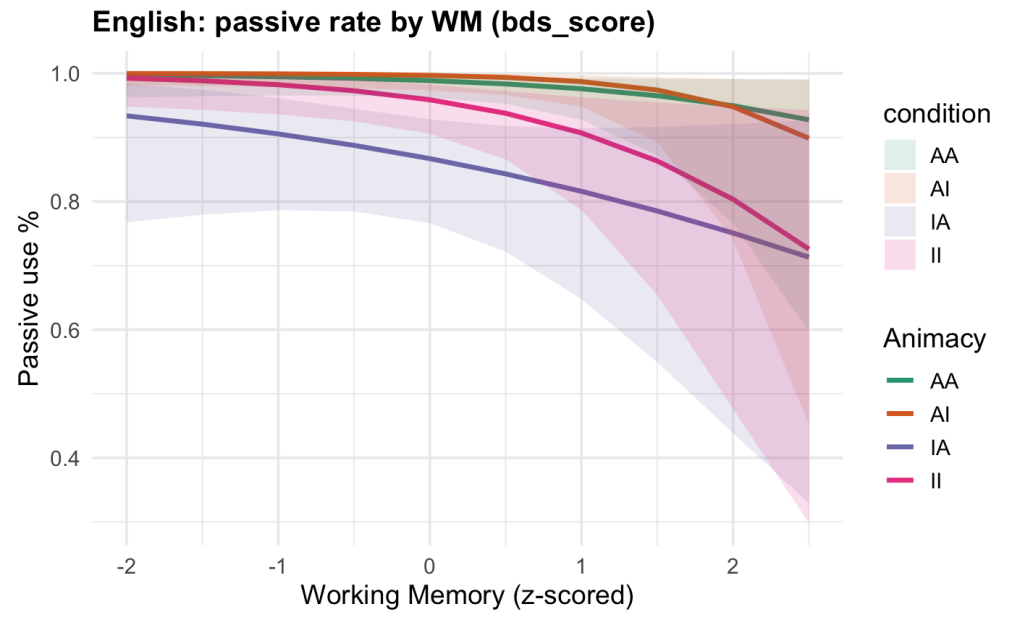
Yes, WM on structure choice was found:

- Participants with **higher WM** produce **fewer passives** (so used active structures more when they could)



Results | Working Memory

- *Although WM did not interact with ANIMACY, did WM show an effect on structure choice?*



Main observation:

- Main effect of **working memory (measured by bds_score)** was found on structure choice: higher bds_score, less likely to use passive, **regardless of animacy**



Results | Working Memory

So what does this tell us?

Finding 1: WM did NOT interact with animacy

- Animacy sensitivity is consistent across WM levels
- → Animacy-driven structure choice appears to be a **robust, automatic** process
- Not contingent on domain-general memory resources

Finding 2: WM DID affect overall structure choice

- Higher WM → fewer passives (more actives) **across all conditions**
- → WM affects **structural flexibility**, not animacy sensitivity

Interpretation (PDC framework, MacDonald, 2013):

- Lower WM → default to structures that reduce planning load (passives)
- Higher WM → can tolerate planning demands of active ORCs
- WM expands the speaker's **structural repertoire**



Conclusion

Production: Both mechanisms at play

- **Animacy-based accessibility:** Strong **headnoun** animacy effect: animate head nouns (AA, AI) → more passives
 - **Similarity-based competition:** **Congruency** effect: congruent animacy (AA, II) → more passives
 - **IA condition:** lowest passive rate: neither mechanism favors passive
- English ORC production is jointly shaped by *accessibility* and *competition*

Comprehension: Structure over animacy

- Near-ceiling accuracy; no animacy effect on accuracy or RT
- Listeners may NOT rely on fine-grained animacy cues
- Potential task effect (our offline decision task might not be robust enough to capture it)

Working Memory: Flexibility, not sensitivity

- No WM × Animacy interaction → animacy sensitivity is robust across WM levels
 - Main effect of WM → higher WM, more active use across all animacy condition
- WM expands **structural flexibility**, not animacy sensitivity



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Theoretical Framework

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Thank you
Comments or questions?

