Conceptual relations compete during auditory and visual compound word recognition

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Relational interpretations

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- Conceptual relations link the compound's constituents
- **Such paraphrases act as an interpretive gist**

snowball

ball **made of** snow

sweatband

band **for** sweat

honeybee

bee **makes** honey

Levi's 16 relations

Levi (1978)

Conceptual relation	Compound	Conceptual relation	Compound
H ABOUT M	*newsflash*	M HAS H	*doorframe*
H BY M	*handclap*	H LOCATION IS M	*farmyard*
H CAUSES M	*joyride*	M LOCATION IS H	*neckline*
H CAUSED BY M	*sunbeam*	H MADE OF M	*snowman*
H DERIVED FROM M	*seafood*	H MAKES M	*flourmill*
H DURING M	*nightlife*	H IS M	*girlfriend*
H FOR M	*mealtime*	H USES M	*steamboat*
H HAS M	*bookshop*	H USED BY M	*witchcraft*

How is this unseen information processed?

Competition between relations (Spalding et al., 2010)

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- Ambiguity:
  "Alaskan beetle can release a deadly bug spray" - spray PRODUCED BY bugs
  "She wore plenty of bug spray" - spray FOR bugs
- Flexibility of modifier relation:
  plastic - MADE OF
  eye - eye HAS strain, shot FROM eye, bath FOR eye

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- **Multiple relational interpretations are proposed and evaluated**

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Competition between relations (Spalding et al., 2010)

- Multiple relational interpretations are proposed and evaluated
- This process is *competitive*
- **Greater competition between interpretations makes processing difficult**

Evidence from Schmidtke et al., 2016

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- **Two visual lexical decision datasets including small set of compound words**

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- **Hetergeonous set of relations for compound = slow processing**

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- **A strong dominant relational meaning = fast processing**

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- **Competition quantified: Entropy of conceptual relations**

The current study

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- **What about auditory compound word processing?**

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- What about auditory compound word processing?
- Prediction: same competition effect in auditory and visual lexical processing
- Conceptual relations are bridging structures not specified in surface form
- Conceptual combination is a mental operation of concepts
- **Therefore, the linguistic modality of expressed entity should not matter**

The current study

1. **Possible relations task; data used to quantify competition**

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2. **4 lexical decision datasets (2 visual; 2 auditory)**

The current study

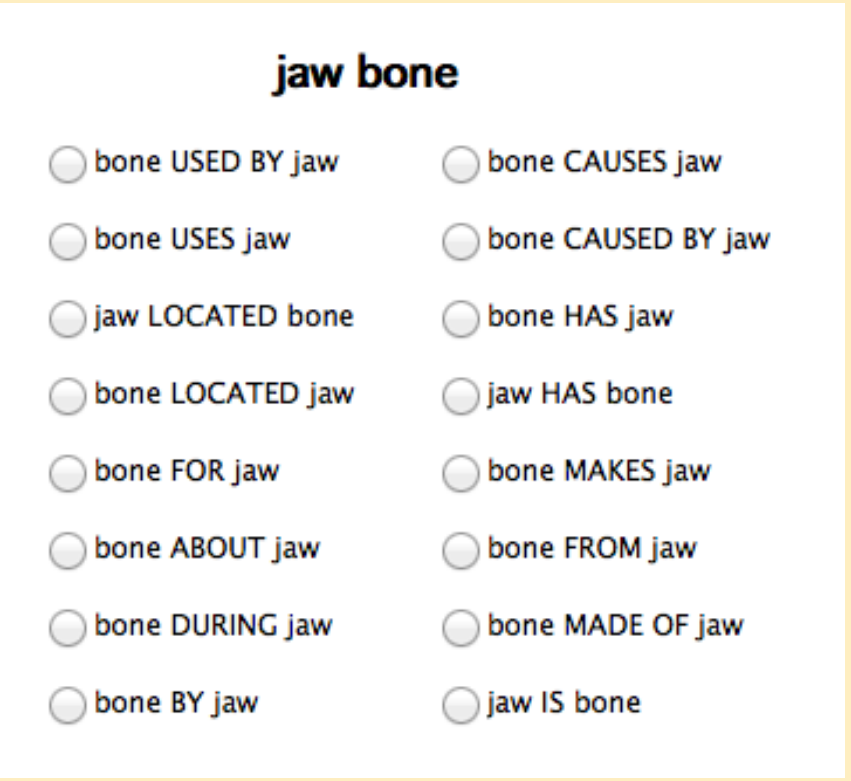
1. Possible relations task; data used to quantify competition
2. 4 lexical decision datasets (2 visual; 2 auditory)
3. **Attempt to predict lexical decision latencies from possible relations data**

Possible relations task

Instructions

- "Pretend that you are learning English and know the meaning of the individual words, but have not yet seen the words together."
- "What is the most likely meaning of this phrase?"

Example trial



Stimuli, participants and platform

- **Possible relations task administered on Amazon Mechanical Turk**

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- **600 existing unspaced English compounds**

Stimuli, participants and platform

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- **47-48 participant ratings per compound**

Stimuli, participants and platform

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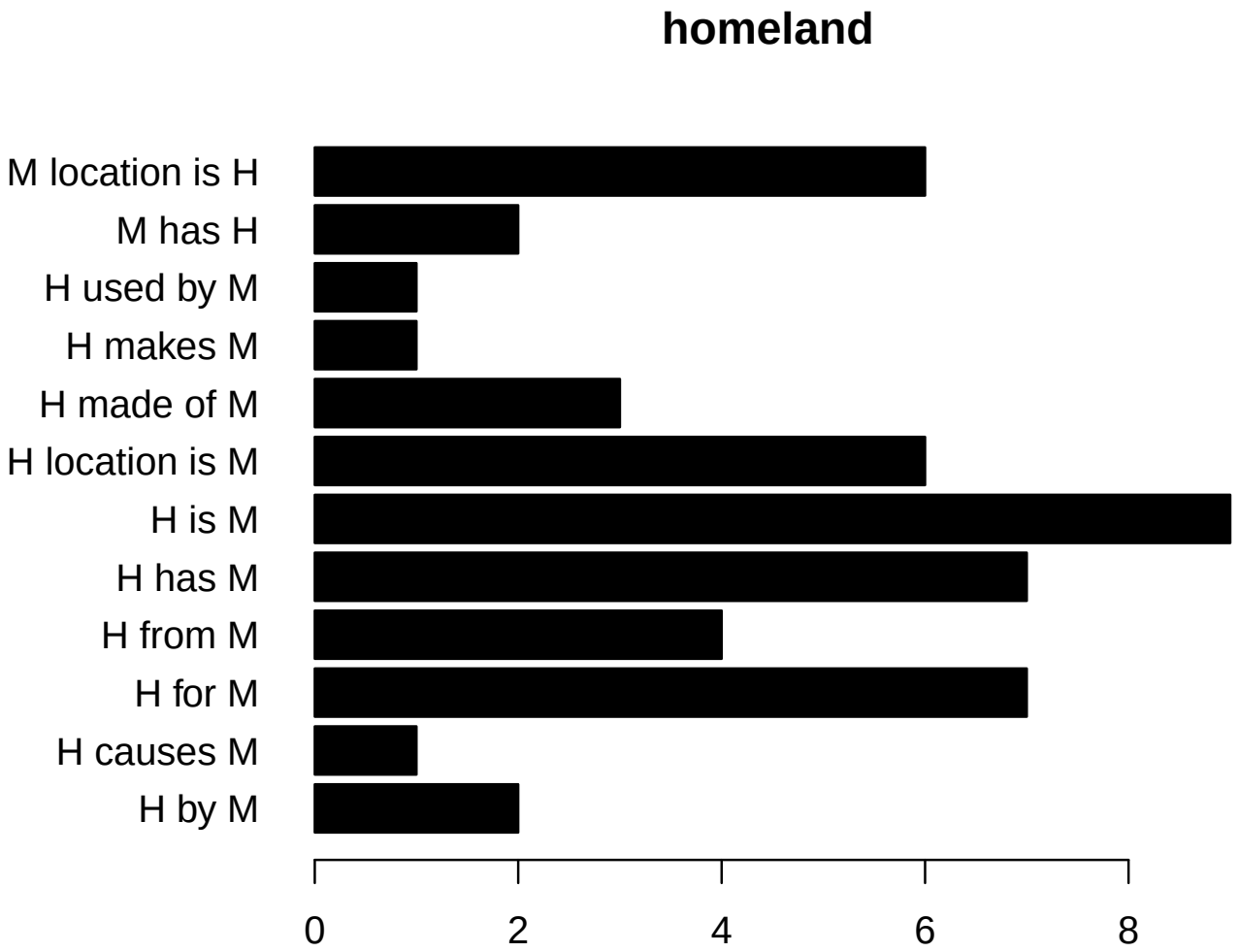
- **all participants US English monolingual speakers**

Raw results: distribution of possible relations



Entropy of conceptual relations

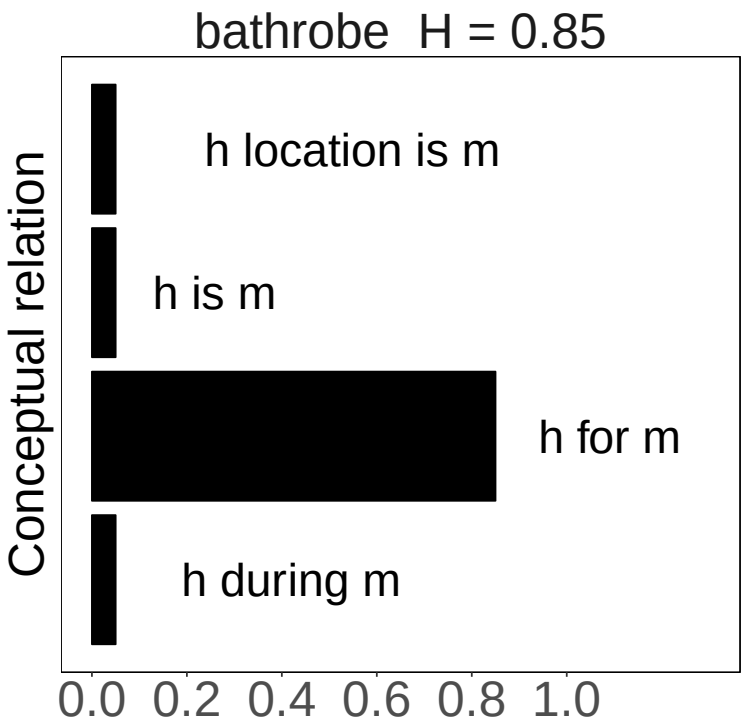
- **High Entropy indicates greater uncertainty and high competition**

Entropy of conceptual relations

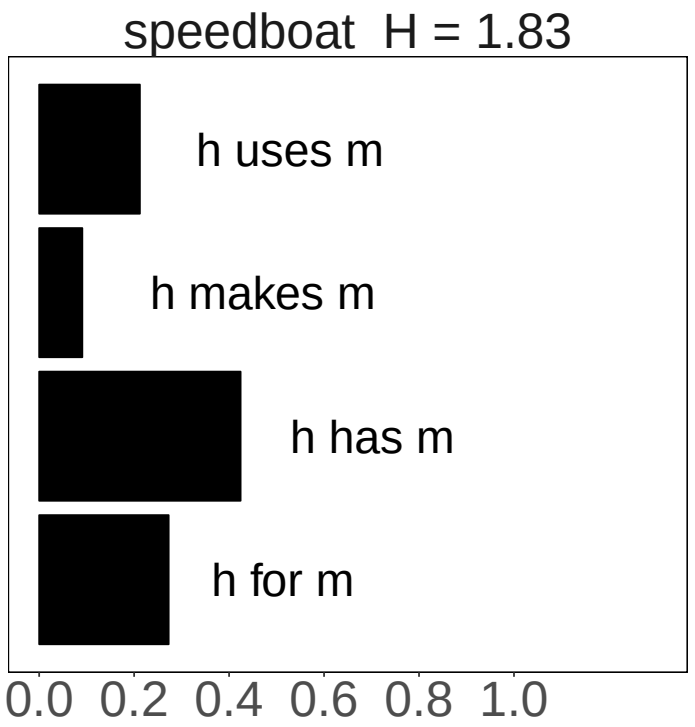
- High Entropy indicates greater uncertainty and high competition
- **Low Entropy indicates more structuredness and low competition**

Examples

Processing benefit



Processing cost



Probability of selection

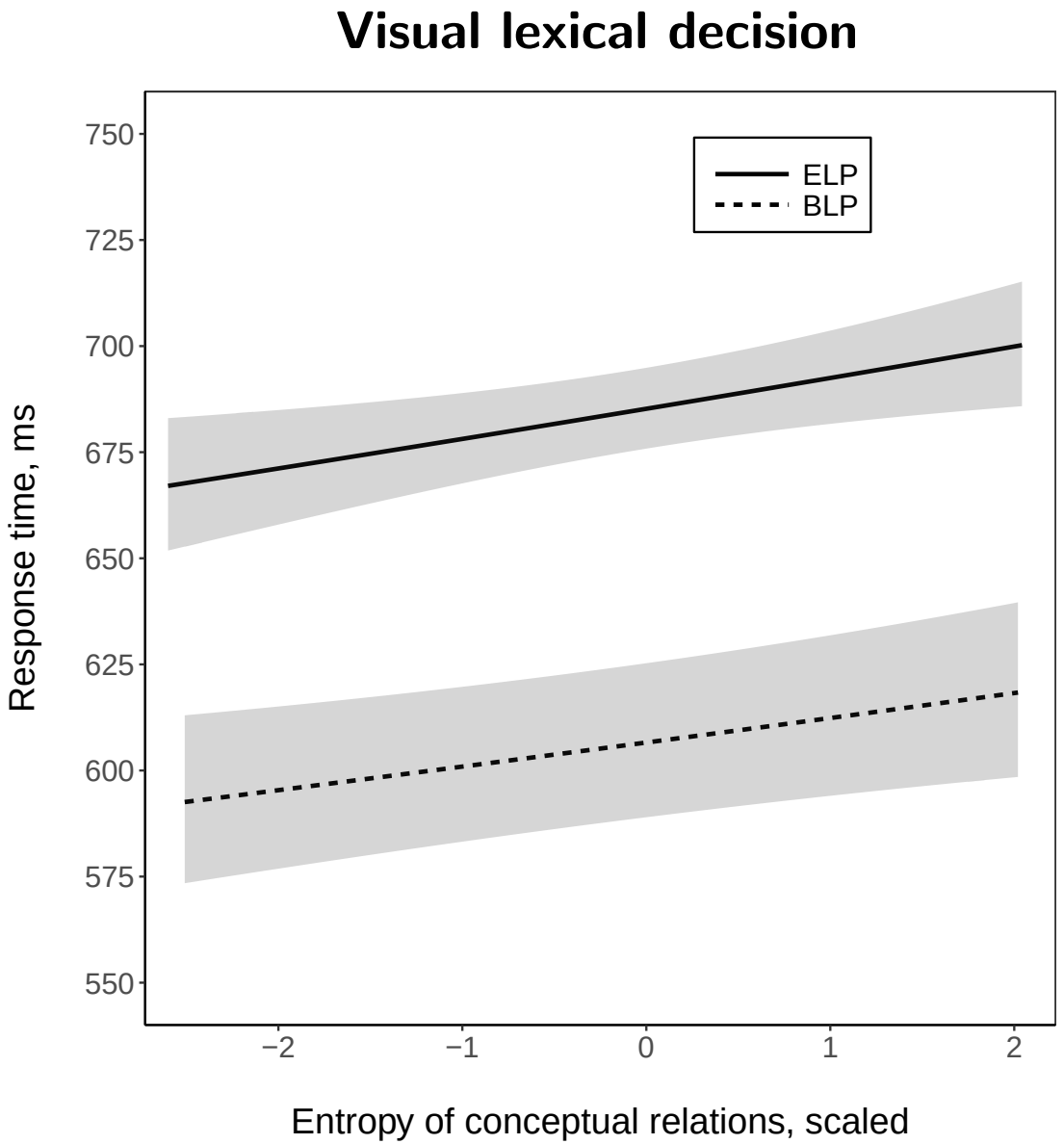
Lexical decision datasets: visual

- English Lexicon Project (ELP; Balota et al., 2007)
  - 497 compounds
  - 816 US participants
  - 15,145 trials
- British Lexicon Project (BLP; Keuleers et al., 2012)
  - 417 compounds
  - 78 UK participants
  - 13,354 trials

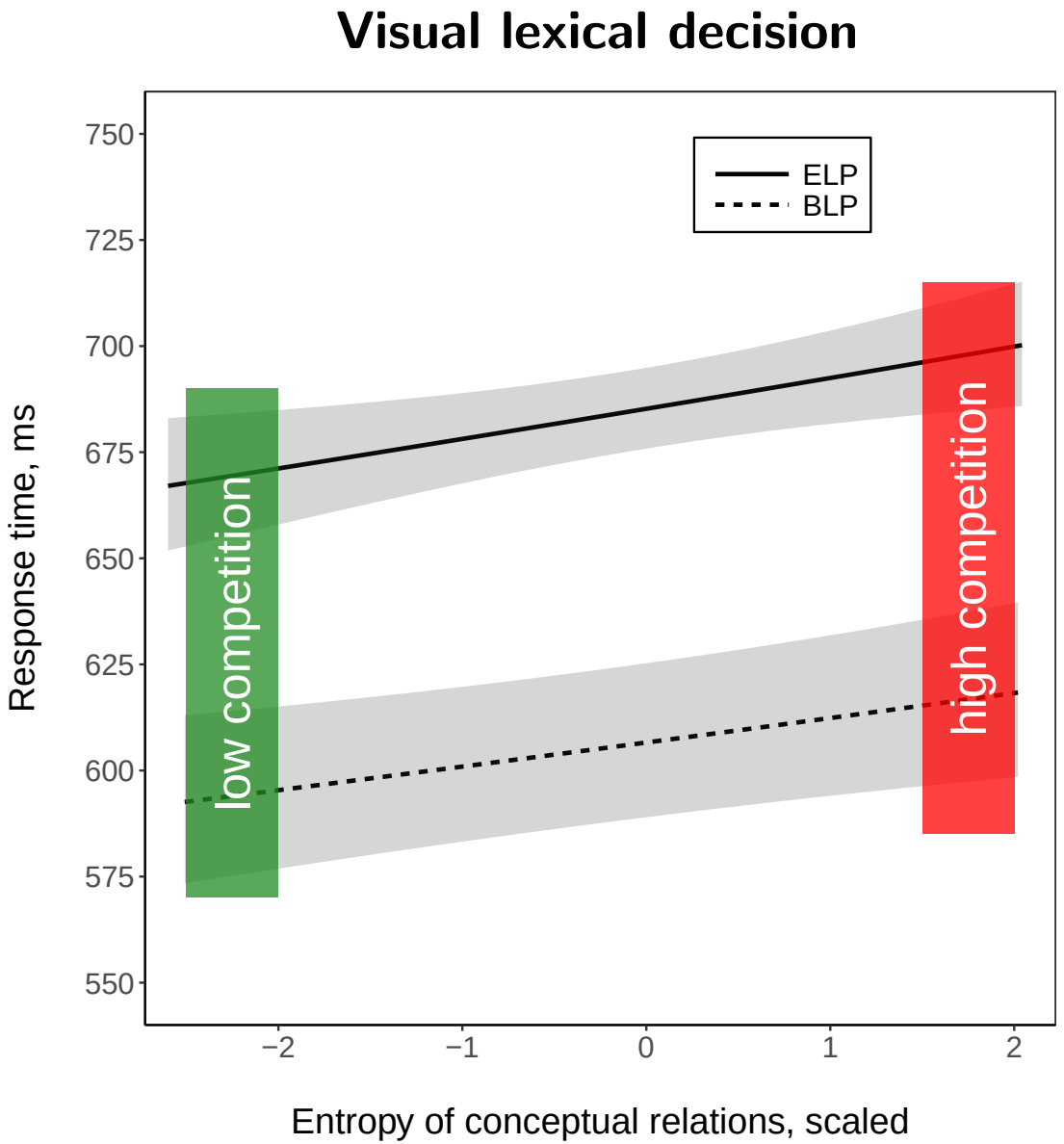
Analysis

- Linear mixed effects models
- Predicting response time latencies
- Lexical predictors
  - **Entropy of conceptual relations**
  - **Semantic similarity**
    - Left-whole: *car-carwash*
    - Right-whole: *wash-carwash*
  - Compound frequency
  - Left and right constituent frequencies
  - Left and right family sizes
  - Compound length
  - Duration (auditory)
  - Uniqueness point and complex uniqueness point (auditory)
- Other controls
  - Trial number
  - Random effects for participant and item

Results


Visual lexical decision
Response time, ms
750
725
700
675
650
625
600
575
550
ELP
BLP
−2
−1
0
1
2
Entropy of conceptual relations, scaled

Results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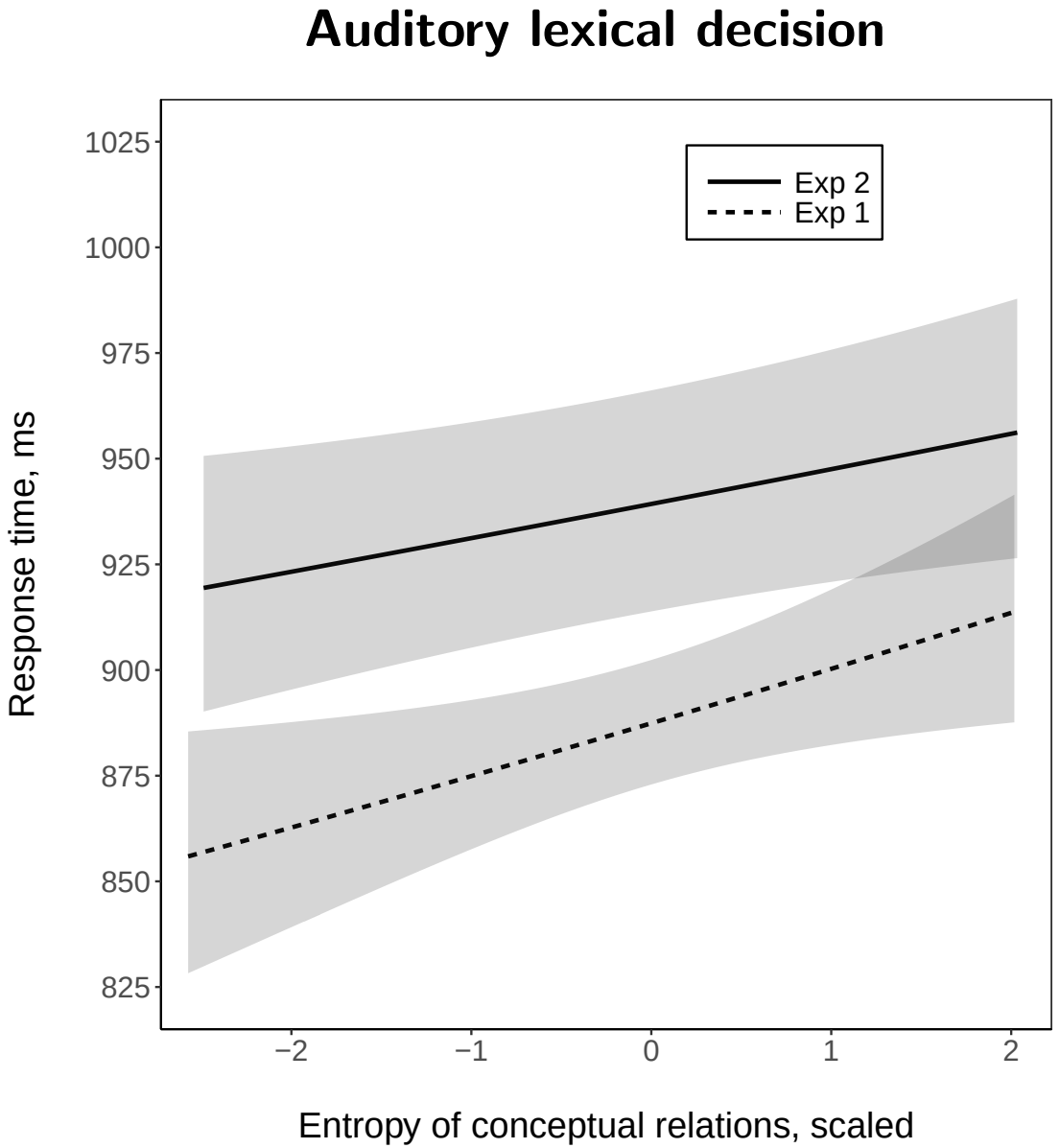
Lexical decision datasets: auditory

- Auditory exp 1
  - Massive Auditory Lexical Decision (MALD; Tucker & Brenner, submitted)
  - 416 compounds
  - 230 Canadian monolingual participants
  - 1,693 trials
- Auditory exp 2
  - 426 compounds
  - 55 Canadian monolingual participants
  - 21,236 trials

Results


Auditory lexical decision
Exp 2
Exp 1
Response time, ms
1025
1000
975
950
925
900
875
850
825
−2
−1
0
1
2
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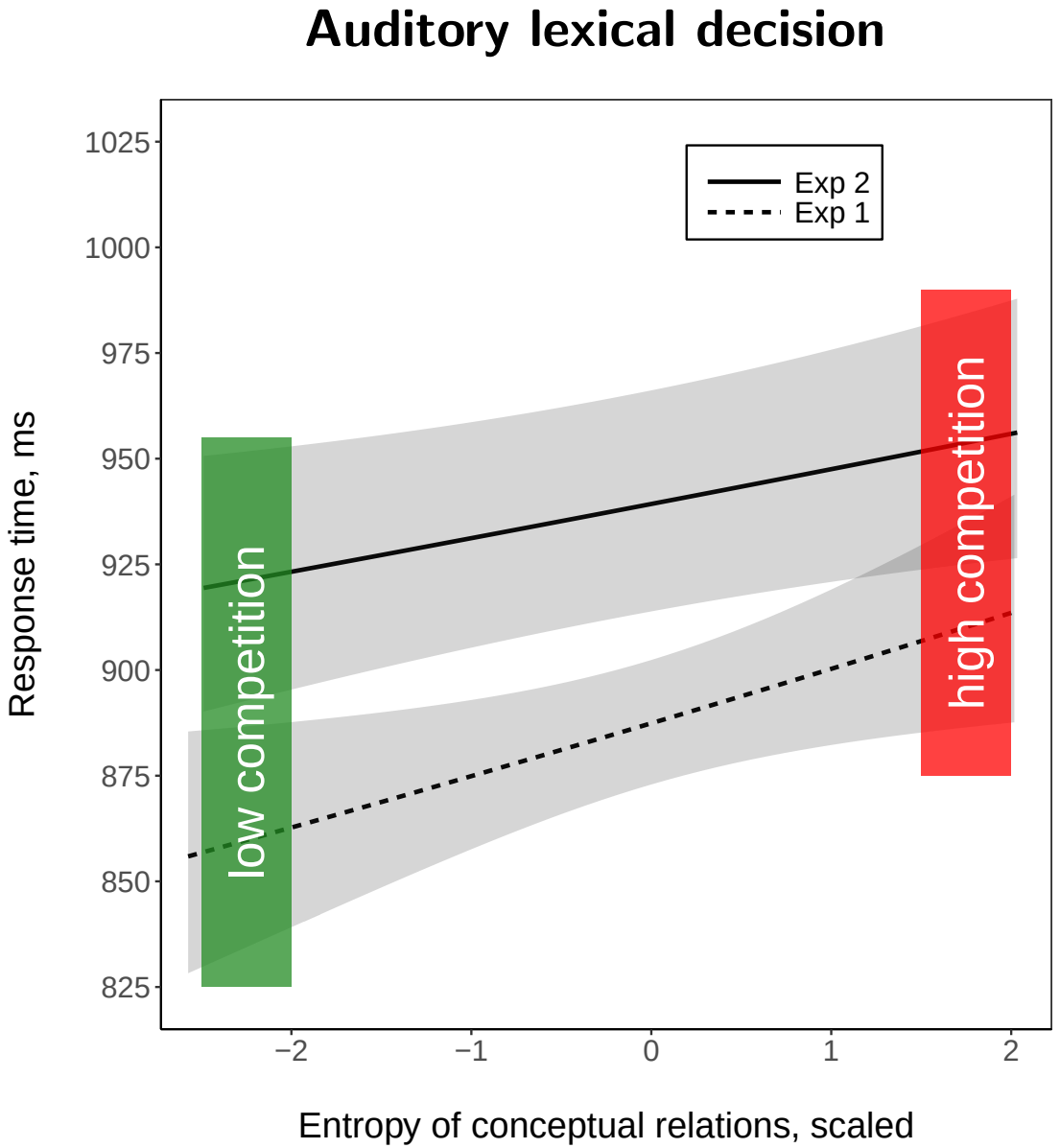
Results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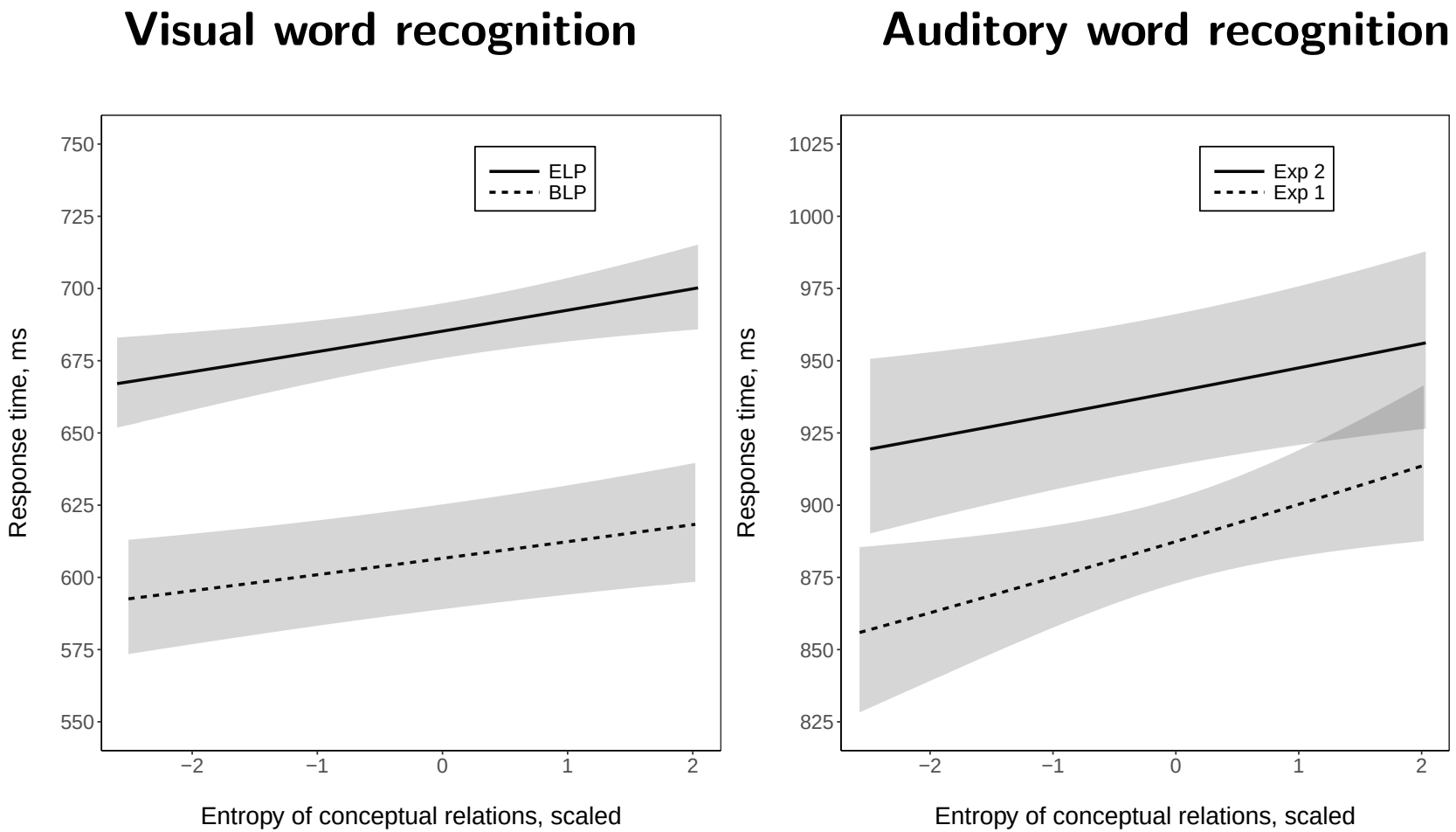
Other effects in auditory lexical decision

- Auditory exp 1
  - Effect of right-whole semantic similarity
    - Boost for greater similarity: *wash-carwash*
  - No constituent frequency effects (consistent with prior studies)
  - No family size effects
- Auditory exp 2
  - Effect of left-whole semantic similarity
    - Boost for greater similarity: *car-carwash*
  - No constituent frequency effects
  - No family size effects

Results: summary of competition effects



Results summarized

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  - **Conceptual combination operates over conceptual structure**

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  1. **present without role of constituent frequency**

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  2. **complementary to semantic transparency effects**

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  - **Future work:**

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  - Future work:
    - What about novel compounds?
    - When does this high-level information come into play?
    - **Reading in context. A role of individual differences?**

Thanks!

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