Search efficiency scales with audiovisual semantic relatedness

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Does semantics guide audiovisual search?

Semantic information is crucial to understanding real world environments[1]

Sounds speed search for "perfect match" images (e.g., meow, cat)[2,3]

Is the audiovisual search benefit **specific** to perfect matches?

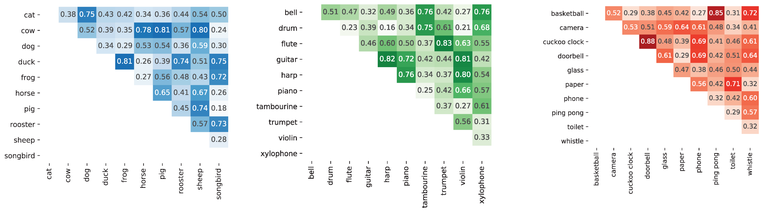
Is it **generalizable** to other semantic relationships?

Is it **task-dependent** or **automatic**?

Quantifying semantic relatedness

Sight-Sound Semantics Database[4]:
(Available on OSF!)

- Crossmodal
- Continuous
- Uses human judgements



Animals

Instruments

Household items

Measuring semantic influence on attention

Task dependent: Where is the image for the target word?

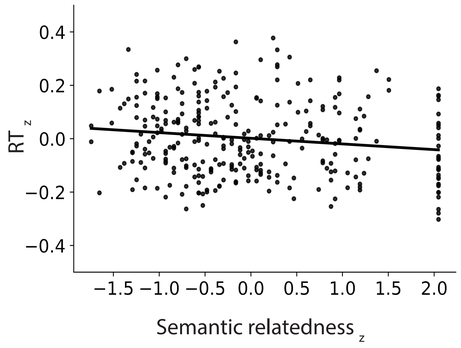
- 109 participants
- 90 sound/image pairs (all possible pairs from database)

Automatic: Where is the unique colored circle?

- 60 participants (preliminary data)
- 42 sound/image pairs (2 pairs per 3 categories per 7 relatedness bins)
- Circle location is randomized orthogonally to sound/image pairs

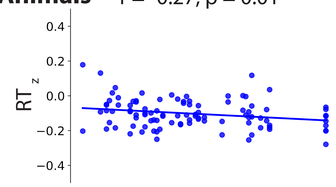
As semantic relatedness increases, search speeds decrease

All categories
r = -0.27, p = 0.009

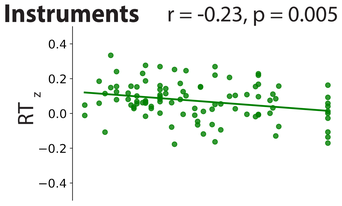


- Each point is a sound/image pair
- RT is z scored for each participant
- Relatedness is z scored across all categories

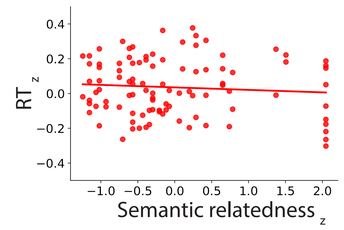
Animals r = -0.27, p = 0.01



Instruments r = -0.23, p = 0.005

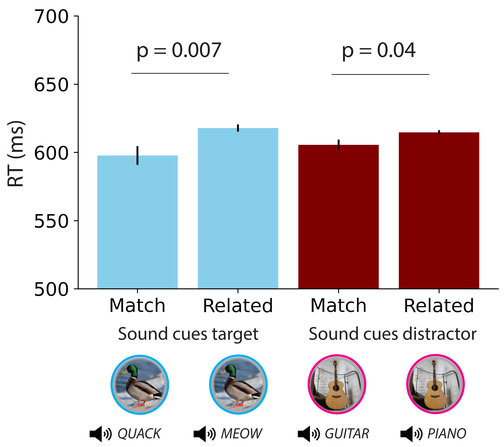


Household items r = -0.08, p = 0.4

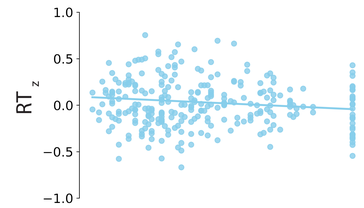


Semantic influence on audiovisual attention may be automatic

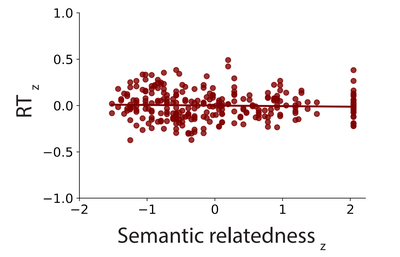
Perfect matches vs semantically related



Sound cues target r= -0.1; p= 0.06



Sound cues distractor r= -0.04; p= 0.5



- To ensure the circle location is entirely independent from the sounds and images, conditions have unequal numbers of trials

Conclusions

Search efficiency scales with audiovisual semantic relatedness.

The audiovisual semantic benefit is:

1. not specific to "perfect matches"
2. sensitive to category factors
3. potentially task independent & automatic

Leading to larger theoretical implications, such as:

1. More types of semantic relationships may influence attention than thought
2. Semantic infomration may influence attention more rapidly & automatically than previously thought

Future questions

What neural mechanisms underpin attentional prioritization for semantically related sounds & images?

Are attentional prioritization maps multisensory in nature?

Can visual information modulate attentional priority for auditory signals?

References (1) Malcolm, et al 2016 (2) Iordanescu, et al 2008 (3) Kvasova, et al 2019 (4) Wegner-Clemens, et al, 2022

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