



Tracking metaphor through eye movements

From words to meanings

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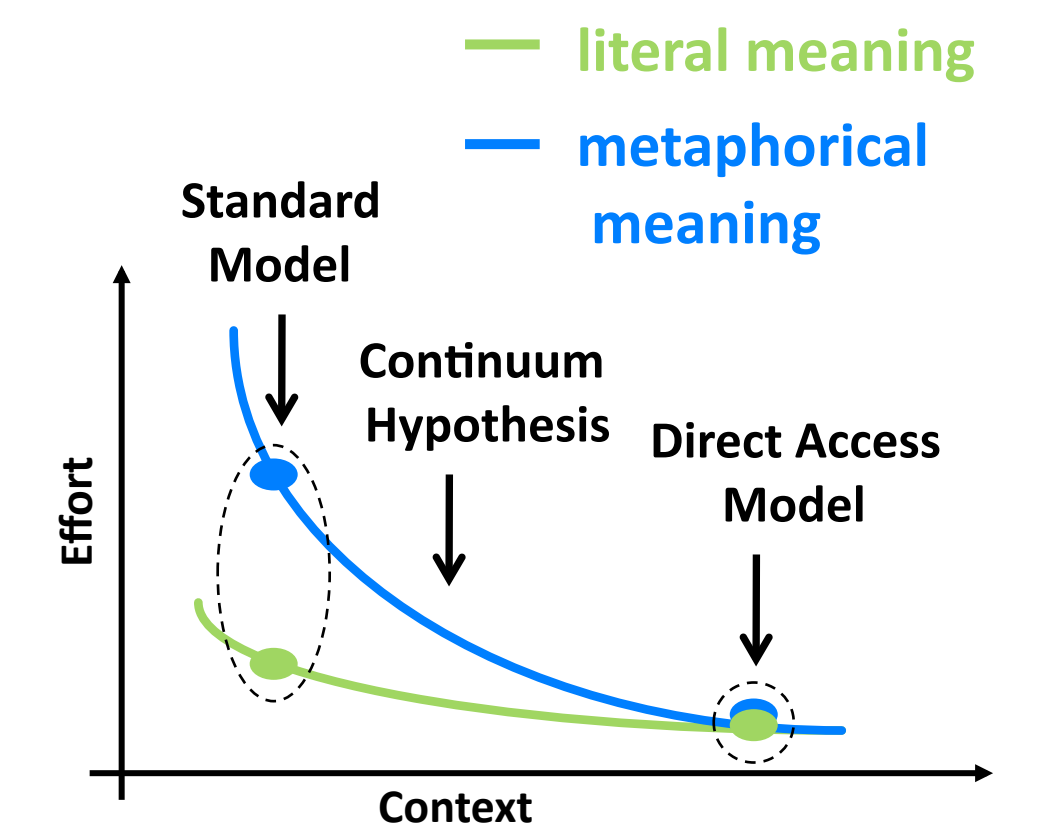
Research questions

- When we hear that a lawyer is a shark, do we stumble into the literal meaning of the utterance or do we directly reach the speaker's meaning?
- To what extent can context delete the differences between a metaphor and a literal expression?

Using eye-tracking data recorded during the reading of no-contextualized and micro-contextualized passages containing literal and metaphorical uses of the same words, we explored how costly is for the parser to build pragmatic meanings.

Background and hypothesis

- According to the **Standard Pragmatic Model**, figurative meaning is reached only after the rejection of literal meaning → different cognitive costs
- According to the **Direct Access Model**, provided with the appropriate context, figurative meaning is reached as rapidly as literal meaning → equal cognitive costs
- We hypothesize that metaphor and literal expressions are not different in nature but the processing time and costs are strongly modulated by the amount of contextual information, among other factors, along a continuum (**Continuum Hypothesis**).



Stimulus and task

no-context condition

20 passage pairs + 20 fillers

Sai che cos'è quel pesce? **Uno squalo**, **come tutti sanno**.
Sai che cos'è quell'avvocato? **Uno squalo**, **come tutti sanno**.

target region spill-over region

micro-context condition

20 passage pairs + 20 fillers; micro-context was obtained by making the ground (the term linking the topic and the vehicle of the metaphor) explicit

Quel pesce **è molto aggressivo**. **È uno squalo**, **come tutti sanno**.
Quell'avvocato **è molto aggressivo**. **È uno squalo**, **come tutti sanno**.

ground region target region spill-over region

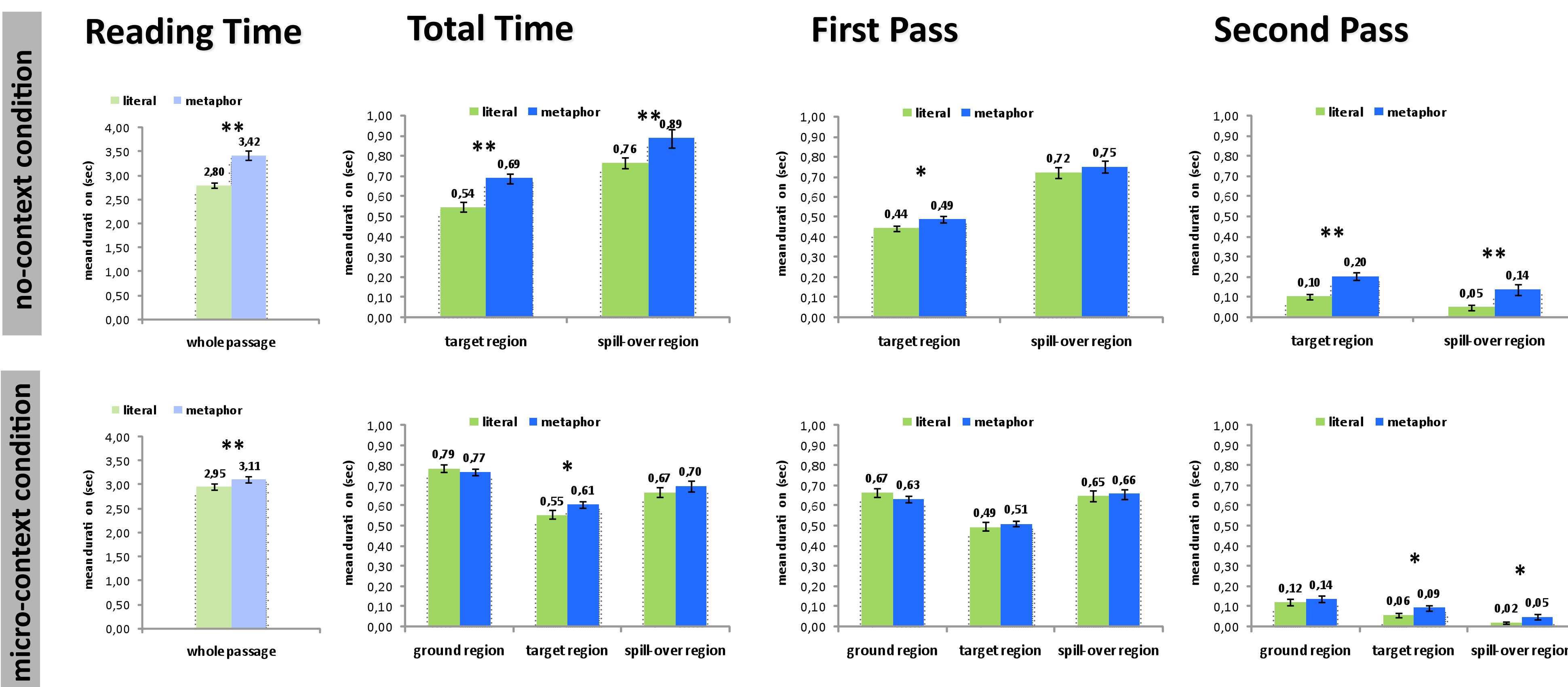
Metaphor comprehension was given as an implicit task to avoid confounding effect: subjects were required to perform an adjective-association task



Methods

- 18 subjects participated (7F/7M, mean age 24 ± 1 years; right-handed; normal vision; 16 years of schooling on average)
- Eye movements were monitored with ALS 501 tracked at 240 Hz
- 11% of trials rejected due to major track loss
- Statistical procedure: paired sample t-test
- In addition to reading times, we investigated three candidate measures of processing costs: Total Time, First Pass, and Second Pass.
- The analysis focused on two regions of interest: the target and the spill-over regions. For the micro-context condition, a third region was included, i.e., the ground region.

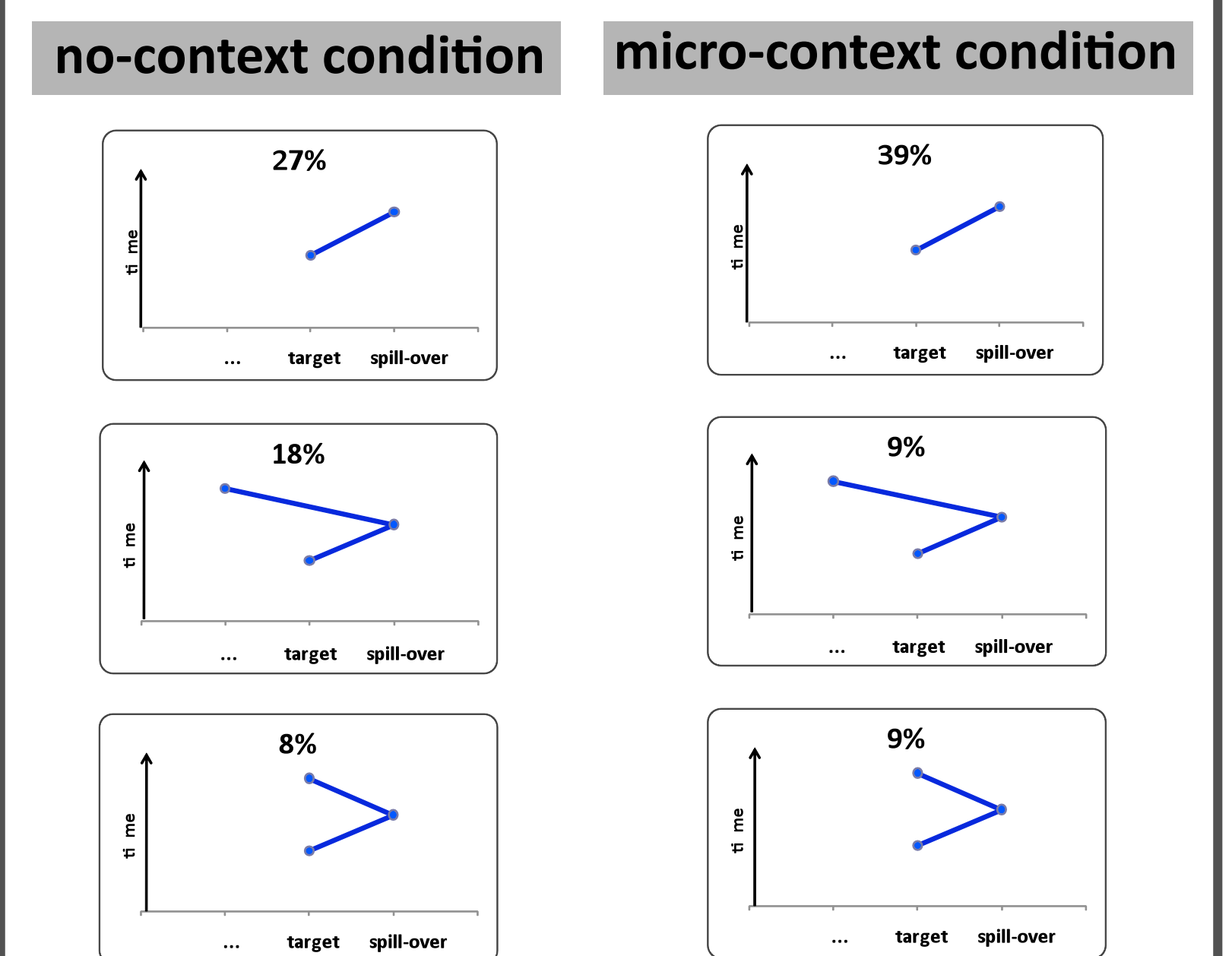
Results



- In both conditions, reading times significantly vary between literal and metaphorical stimuli ($p < 0,01$). However, eye-movement measures show different reading-patterns across the two conditions.
- In the absence of context, significant effects were obtained for Total Time measure on both the target and the spill-over regions for the literal vs metaphor contrast ($p < 0,01$). More specifically, early effects were observed on the target region, and strong late effects occurred on both target and spill-over.
- Provided with a supportive context, Total Time measure becomes significant only on the target region for the literal vs metaphor contrast ($p < 0,05$). No early effects were registered, while late effects remained on both target and spill-over regions.

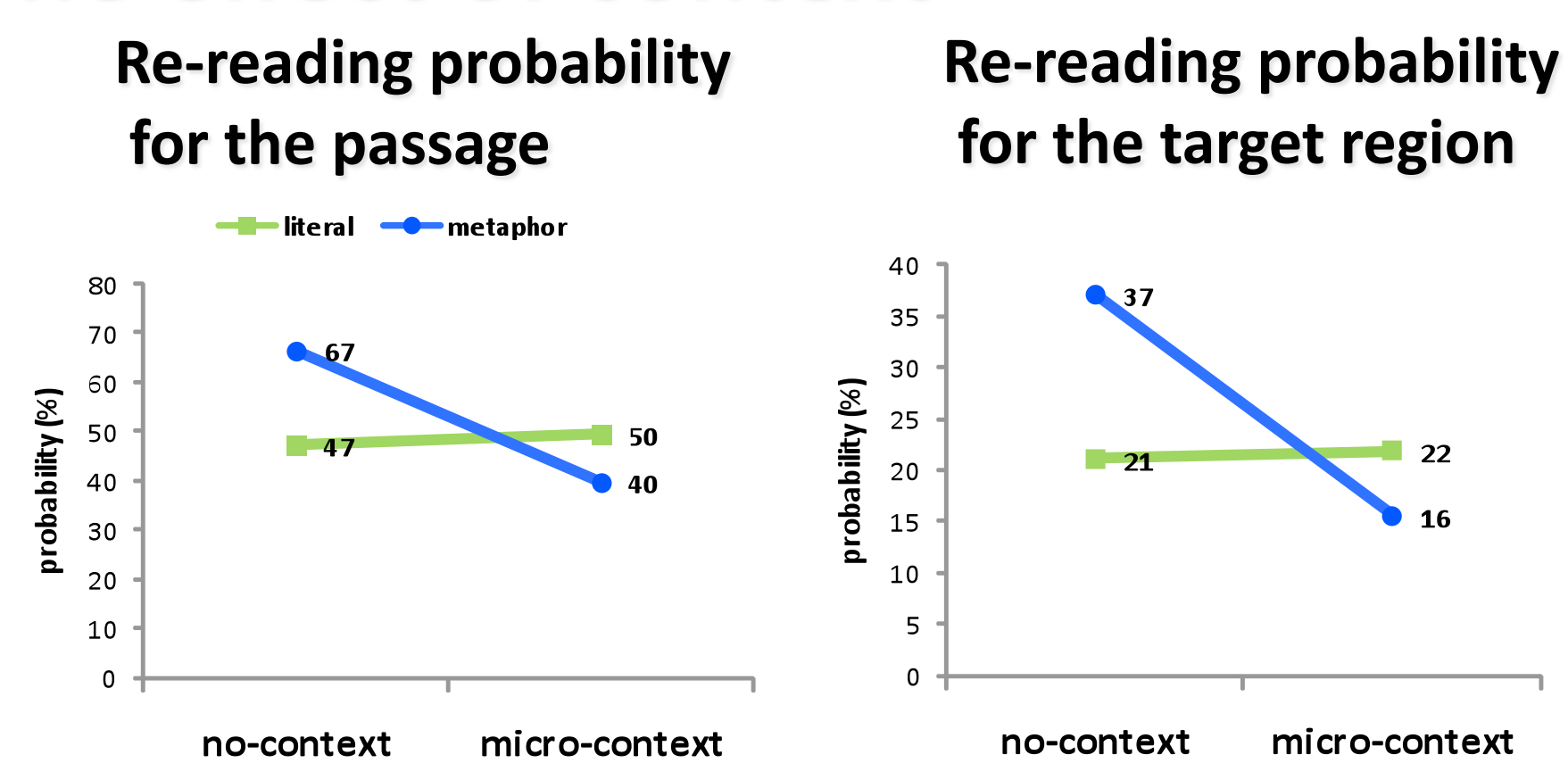
Paths for metaphor reading

For metaphorical stimuli in both conditions, we selected the most frequent regression patterns



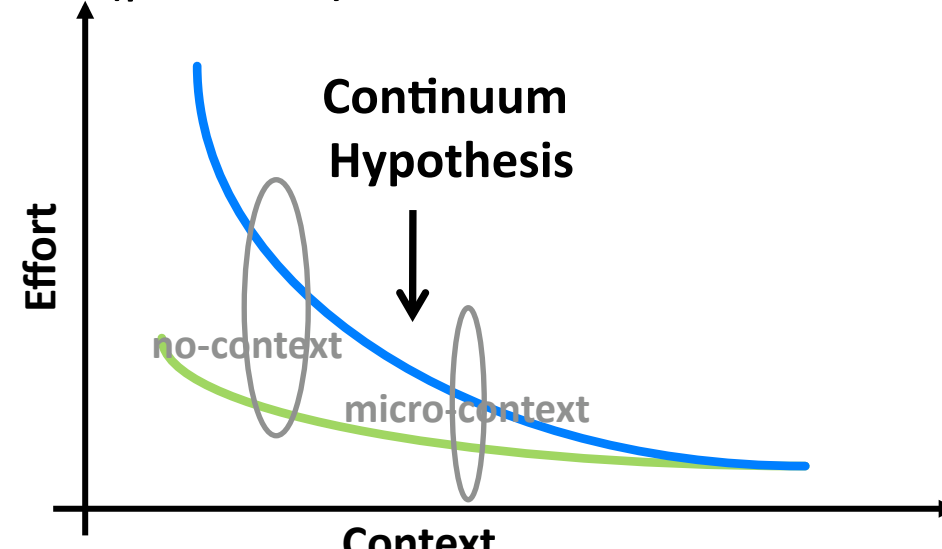
- In both conditions, after having read the target region, most of the participants terminate on the spill-over region.
- In the absence of context, some participants check back to the beginning of the sentence, and a few reread the target word.
- When context becomes richer, the proportion of rereading patterns decreases.

The effect of context



We performed a logistic regression on Re-reading probability on the whole passage and on the target region with Metaphoricity as predictor variable, which revealed reliable independent effect ($p < 0,05$)

Context modulates re-reading probability of metaphors, while unaffected literal expressions. Cf. the Continuum Hypothesis →



Conclusion

- Our data suggest that metaphor is more effortful for the parser than literal expression.
- However, we observed a strong effect of context, which, when becomes richer, facilitates interpretative efforts, suppressing early effects (First Pass), and reducing the crucial territory (no effects on spill-over region).
- The richer the context, the less effortful the metaphor is for the parser, in a continuum fashion.**
- This hypothesis is consistent with recent models of pragmatic processing (Relevance Theory).**
- Yet context does not eliminate late effect, which spreads from the target word to adjacent lexical material, suggesting that metaphor remains special and metaphor resolution occurs late....

Next step

(Spotorno, Bambini, Bertini, in prep.)

... Can context eliminate any difference in processing costs between literal and metaphorical expression?

narrative context condition

Literal passage

Ieri ho visitato un grande acquario. Ospita animali marini di ogni dimensione. Ho visto che i pesci più grandi vengono collocati in vasche spaziose e soprattutto molto profonde. **Certi pesci sono squali** e ritengo che serva molto spazio per riprodurre il loro ambiente naturale.

Metaphorical passage

Ieri ho parlato con un magistrato. È impegnato in un processo molto difficile. Ho visto che gli avvocati più scaltri basano le strategie difensive sull'utilizzazione degli avversari. **Certi avvocati sono squali** e ritengo che questa tattica non faccia onore alla loro professione.

Pilot data on 6 subjects show no significant effects between literal and metaphorical expressions in narrative context condition ($p > 0,05$)

