

The costs and benefits of different metaphoric structures: evidence from pupillometry

Camilo R. Ronderos^{1,2}, Ernesto Guerra³, Pia Knoeferle^{1,4,5}

¹Humboldt-Universität zu Berlin, ²University of Oslo, ³Universidad de Chile, ⁴Berlin School of Mind and Brain,

⁵Einstein Center for Neurosciences Berlin

c.r.ronderos@ifikk.uio.no

The difference between understanding metaphoric and literal expressions has long been at the center of metaphor research. Noveck et al. (2001), for example, argued that understanding a metaphor carries additional costs and benefits (quantified as longer reading times and higher comprehension accuracy, respectively) than a literal equivalent, resulting in greater processing load. However, it has not been investigated whether a metaphor's processing load is stable or whether it varies as a function of the sequence of its elements.

This question is critical for theory development. Some accounts, for example, posit that metaphors are processed asymmetrically (e.g., Chiappe et al., 2003; Glucksberg, 2001; Wilson & Sperber, 2008): In a nominal metaphor (e.g., 'my cat is a princess'), the topic ('my cat') must appear prior to the vehicle ('a princess'), and the order may not be reversed. However, German verb-object metaphors (see 1a and 1b), can reverse the topic-vehicle sequence and still be felicitous. Does this mean that verb-object metaphors are not asymmetrically processed? One possibility is that topic-vehicle metaphors are understood better than vehicle-topic metaphors, resulting in an increased cost-benefit balance (following Noveck et al. 2001) which should translate to a greater processing load for topic-vehicle compared to vehicle-topic metaphors.

The present work thus investigates the impact of the sequence of the elements on a metaphor's processing load via pupil dilation. This has been associated with increased processing load of linguistic stimuli (e.g., Engelhardt et al. 2010; Just & Carpenter, 1993), but has not been previously used to study figurative language comprehension.

We re-analyzed the data of a previous study on the processing of German verb-object metaphors such as (1). 32 participants read 4 sentences that either biased towards a literal or a metaphoric interpretation of the target utterance (literal and metaphoric conditions, see 1). They then heard the utterance (1a or b) while looking at four pictures, two of which represented the literal and the metaphoric interpretation of the sentence (a princess and a cat). We reasoned that if metaphors carry more processing load compared to literals regardless of element sequence, both utterances (1a&b) should cause more pupil dilation in the metaphoric compared to the literal condition. If, however, topic-vehicle metaphors (1a) are understood better than vehicle-topic metaphors (1b), there might a lesser processing load for (1b) relative to literal controls.

We computed pupil dilation using the R package PupilPre (Kyröläinen et al., 2019) for preprocessing the data, time-locked to the onset of the main verb ('füttert', Figure 1) and the onset of the direct object ('Prinzessin', Figure 2) (i.e. the regions where the metaphor is understood in the metaphoric-late condition and the metaphoric-early condition, respectively). We followed Engelhardt et al. (2010) for data pre-processing. We fitted mixed-effects linear models (with treatment contrast coding) to the verb and vehicle regions, with verb position (early vs. late), context (literal vs. metaphoric) and their interaction as fixed effects and pupil dilation (measured in abstract units) as dependent measure.

In the early verb metaphoric condition (i.e., topic-vehicle order), participants showed more pupil dilation when hearing the vehicle compared to the early-verb literal condition ($t=2.7$, $p<0.05$). A significant interaction was also found ($t=14.3$, $p<0.001$), suggesting that this difference was unique to the metaphoric conditions. No significant differences were found in the verb region. We interpret this as suggesting that topic-vehicle metaphors are associated with a higher processing load compared to literals, but this does not hold for vehicle-topic metaphors. To confirm these preliminary findings, a follow-up replication experiment is underway. Overall, we see this finding as complementing Noveck et al. (2001) and as being in line with asymmetric accounts of metaphor comprehension.

(1) Example of critical item. The verb is considered the topic since it is the only element that refers to the nominal topic ('the cat'). In German, the verb 'füttern' (feed) has a strong selectional preference for taking an animal as its accusative object. All items had verbs with strong selectional preferences biasing towards the nominal topic of the metaphor.

(1a, early-verb conditions) Sebastian **füttert** VERBAL TOPIC eine **Prinzessin** VEHICLE und wird unablässig der Adligen/der Katze beistehen.

(1b, late-verb conditions) Sebastian wird eine **Prinzessin** VEHICLE **füttern** VERBAL TOPIC und wird unablässig der Adligen/der Katze beistehen.

'Sebastian feeds/will feed a princess and will continuously support the noble woman/the cat.'

Example of linguistic context

(Literal context) Sebastian liebt eine berühmte Adlige. Er hat sie in einem Schloss kennengelernt und seitdem sind sie unzertrennlich. Die Adlige ist schwach und abhängig, und kann sehr hilfsbedürftig sein. Deswegen tut Sebastian alles für sie, wenn sie etwas braucht. Er wird sich immer um sie kümmern wollen.

(English translation: 'Sebastian loves a famous noble woman. He met her in a castle and they have been inseparable since. The noble woman is weak and dependent and can be very needy. That's why Sebastian would do anything for her when she's hungry. He will always want to take care of her.')

(Metaphoric context) Sebastian liebt eine wunderschöne Katze. Er hat sie in einem Tierheim adoptiert und seitdem sind sie unzertrennlich. Die Katze ist verwöhnt und launisch, und kann sehr wählerisch sein. Deswegen würde Sebastian alles für sie tun, wenn sie etwas braucht. Er wird sich immer um sie kümmern wollen.

(English translation: 'Sebastian loves a beautiful cat. He adopted her in a shelter and they have since been inseparable. The cat is spoiled and moody and can be very fussy. That's why Sebastian would do anything for her when she's hungry. He will always want to take care of her.')

Figure 1

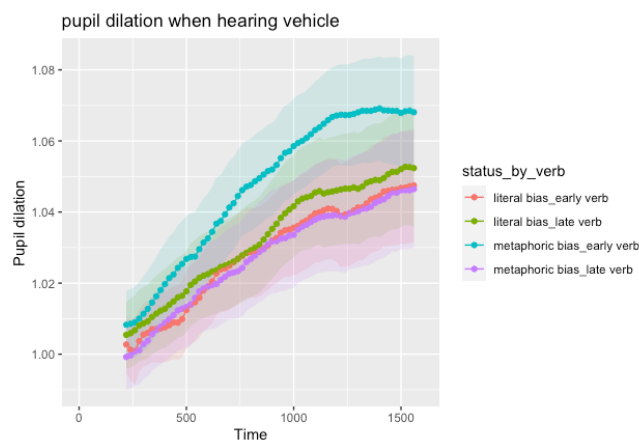
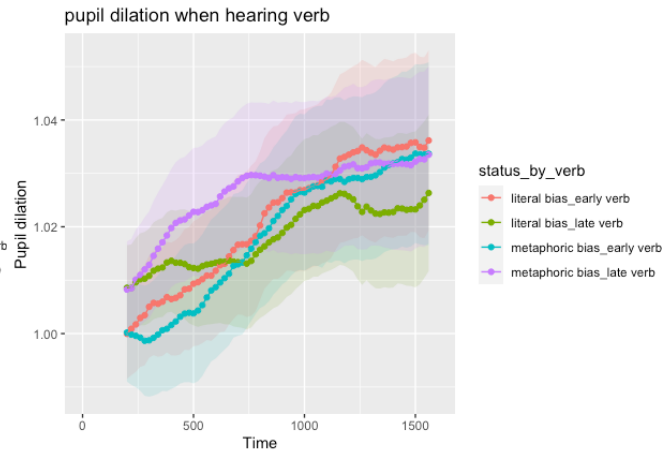


Figure 2



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