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The Processing of German Verb-Object Metaphors

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Abstract

Competing accounts of metaphor processing make differentiating predictions regarding the role of a metaphor's elements: While some claim that the elements are role-neutral, others believe them to play different roles from the get-go. We tested these predictions with an investigation of German verb-object metaphors such as *Sebastian füttert eine Prinzessin ('Sebastian feeds a princess')*. Results are in line with accounts that posit different roles for a metaphor's elements. Additionally, we investigated the distinctive influence of context and a verb's selectional preferences when anticipating a post-verbal object. The findings show that participants anticipate an upcoming object less when these two factors clash (i.e., when context and a verb's selectional preferences point towards different objects), compared to when they are aligned (i.e. when they point towards anticipating the same object).

Keywords: metaphor processing; eye-tracking; visual world paradigm; experimental pragmatics; situated sentence comprehension

Introduction

When we hear the metaphor *Sebastian's cat is a princess* (meaning that Sebastian's cat is spoiled and very picky), how do we go beyond the encoded meaning of the word *princess* (member of a royal family) to grasp its figurative meaning? An important part of the answer to this question lies in understanding the relationship between a metaphor's topic (e.g., *Sebastian's cat*) and the metaphoric vehicle (*a princess*) during processing. Two leading theories of metaphor comprehension make different claims about this relationship (see Holyoak & Stamenković, 2018).

The first one, which we refer to as 'Implicit Comparison', claims that the metaphoric meaning of *princess* is understood through analogical reasoning. In this process, one must first fully retrieve the meaning of both topic and vehicle in order to understand their relational similarities. Relational similarities can be understood as coherences in the internal structure of the metaphoric elements (Gentner & Bowdle, 2008; Wolff & Gentner, 2011). After the relation between the structures has been understood, inferences are projected from vehicle to topic.

A second view, which we refer to as the 'Category Membership' approach, sees metaphor comprehension as a modulation of the encoded meaning of the metaphoric vehicle. Here, the vehicle represents a newly created, goal-oriented category (Glucksberg, 2001; McGlone & Manfredi, 2001; Sperber & Wilson, 2008), which involves adjusting the vehicle's meaning and understanding that it refers to a superordinate category of which the topic is a member. In this view, topic and vehicle play different roles throughout the entire process: While the encoded meaning of the vehicle is modulated, the topic provides a narrow set of dimensions necessary for this modulation to take place.

The question here is one of *symmetry*: Do the elements in a metaphor play the same initial role during comprehension or are their roles different throughout? One way in which this can be investigated is by varying the relative position of the elements in a metaphor during processing (Wolff & Gentner, 2011). However, addressing this question experimentally is difficult, considering that nominal metaphors (which are at the center of research on metaphor processing) cannot normally be reversed while keeping their meaning intact (*Sebastian's cat is a princess* is not equivalent to *The princess is Sebastian's cat*).

With the present work we address this issue by instead examining the time course of processing German verb-object metaphors, which do allow for the position of their elements to be naturally reversed without altering the meaning of the metaphor.

Competing Views on Metaphor Processing

The issue of whether or not the position of the elements of a metaphor matters during comprehension arises from the different underlying cognitive mechanisms assumed to be at play by the opposing views presented in the introduction. The Implicit Comparison view claims that a metaphor is understood in two stages: An initial stage of structural alignment and a secondary one of projection of inferences from vehicle to topic (Gentner & Bowdle, 2008). The initial stage is itself divided into three steps throughout which matches between identical properties of topic and vehicle are established and then grouped together into structurally consistent clusters known as 'kernels'. The kernels are then merged into a few structurally consistent interpretations. This entire first step is non-directional (Gentner et al., 2001): Both concepts must be equally scanned for similarities in their structure, regardless of position in the sentence. One way to understand this process is in terms of lexical retrieval: To create structurally consistent interpretations and determine

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structural similarities, both concepts must be entirely retrieved from memory, together with their associated features: It is not possible to know the ways in which the structures relate to one another if the structures for each term are not fully retrieved from memory.

The Category Membership view, by contrast, claims that metaphor understanding is essentially a local process of category construction and inclusion. This process has been described in terms of lexical modulation (Sperber & Wilson, 2008) or dual-reference (Glucksberg, 2003). A listener retrieves the encoded meaning of the heard word (*princess)* and subsequently understands that the word refers to a superordinate category, *princess** (meaning roughly something like 'things that are spoiled and need extra care') that includes both the literal princess and Sebastian's cat as its elements. The construction of this particular ad-hoc category is guided by the most prominent features of the metaphoric topic, also referred to as the topic's relevant dimensions (Glucksberg, 2001). Without these dimensions being activated before the vehicle, lexical modulation fails, and the metaphoric vehicle is understood literally (at least temporarily). But when these topic dimensions precede the vehicle, arguably very few features of the encoded meaning of the vehicle must be retrieved in order to create the *ad-hoc* category. Whether the topic comes before or after the vehicle is therefore crucial.

One study by Wolff and Gentner (2011) deals with the issue of symmetry by looking at comprehension times of metaphors compared to their reversed counterparts. They showed participants directional nominal metaphors (*a rumor is a virus*), their reversed equivalents (*a virus is a rumor*), literal category statements (*the apple is a fruit*) or scrambled statements (*the cat is a library*). Participants were asked to quickly give a comprehension judgement after the sentence had been presented for 1200 or 1800 ms (in experiment 1); 600 or 1200 ms (in experiment 2); and 500 or 1600 ms (experiment 3). The results showed that at the shortest presentation times (500 and 600 ms) participants gave comparable ratings to both metaphors and their reversed counterparts, while the literal category statements and scrambled statements remained at ceiling and basement level respectively. The authors argue that this is evidence in favor of an initial alignment stage in which both topic and vehicle are evaluated equally, regardless of their position. If during initial stages of processing the order of the metaphorical elements mattered, then we should have seen significantly lower comprehensibility ratings for the scrambled compared to the regular metaphors.

However, this evidence is based on the assumption that (i) the processing of metaphors is comparable to that of their reversed counterparts, and (ii), that speeded comprehensibility judgements reflect initial stages of processing.

Supporters of the Category Membership view would disagree with the conclusion of Wolff and Gentner (2011), given that they see the irreversibility of nominal metaphors itself as evidence for a role-specific distribution of labor (Glucksberg, 2008). It is thus necessary to test the claims with stimuli that permit reversing the elements of the metaphor without rendering the expression infelicitous.

Metaphors and Incremental Language Processing

A common characteristic of the psycholinguistic research on metaphor processing has been to examine the processing of metaphors once the entire metaphoric expression (i.e., topic and vehicle) has been presented and understood. However, research on situated incremental language processing has shown that understanding language involves an ongoing and simultaneous integration of different types of information (visual and linguistic) in order to update the mental representation of an event, as well as to generate expectations about upcoming (linguistic) input. Expectations about upcoming linguistic information can be guided (among other things) by possible referents that have been established in the previous linguistic context (Altmann, 1999), events in the visual context (Knoeferle et al., 2005) as well as semantic and world-knowledge constraints imposed by verbs (Altmann & Kamide, 1999). Thus, if we want to study the contribution of the individual elements of a metaphor to the overall interpretation during real-time processing, we would benefit immensely from anchoring our investigation in a situated, incremental language processing approach.

Verb-Object Metaphors

The current study contributes to the ongoing debate on the symmetry of metaphor comprehension by examining the activation patterns of literal vs. figurative meaning of metaphors during situated incremental language processing. Crucially, we are interested in metaphors that allow the order of presentation of their elements to be naturally reversed. Such constructions occur in German in cases in which the metaphoric vehicle appears as the accusative object of a sentence such as (a) and (b) in Table 1 below. An important feature of German syntax is that it alternates from a Subject-Verb-Object (SVO) to a Subject-Object-Verb (SOV) surface sentence structure in the presence of an auxiliary verb. This allows us to test the contribution of each element in a metaphor (the vehicle or the verbal topic) by changing sentence tense and observing whether there are differences in the way in which metaphoric meaning is constructed.

It is important to note that the metaphor in 1a) and 1b) does not share the canonical topic-vehicle structure of metaphors such as *my lawyer (TOPIC) is a shark (VEHICLE).* Instead, we have the verb *füttert* ('feeds'), which we describe as the "verbal topic", given that it is the element in the sentence pointing to the nominal topic (the cat). The word *füttert*, when embedded in an appropriate context (see Table 1) will most likely activate the metaphoric topic *Katze* ('cat'), given that the verb (together with context) provides enough semantic and contextual constraints for us to anticipate its most likely discourse referent.

Another important property of verb-object metaphors is that, as opposed to the topic in a nominal metaphor, the verbal

topic brings with it a set of thematic roles, i.e., a number of selectional preferences regarding the semantic properties of the verb's complements and arguments. Thematic roles have been shown to facilitate anticipation during incremental language processing (e.g. Altmann, 1999; McRae et al., 1997). The verb *füttern*, for example, requires one accusative object, and perhaps with the feature [+ animal].

Theories on metaphor processing have not previously looked at utterances such as 1a) and 1b) and have not made explicit predictions about how processing occurs. However, if a theory claims that a metaphor must necessarily be understood through a form of interaction between a topic and a vehicle (as Implicit Comparison and Category Membership views do), we must assume that the topic must be realized (even if indirectly) somewhere in the utterance, making the verb *füttert* the best candidate.

Context versus verb-based expectations

Furthermore, the claim that *füttert* will activate the metaphoric topic *Katze* is supported by past experimental evidence on the anticipation of post-verbal objects. Altmann and Kamide (1999) found that when participants hear sentences that include verbs with selectional restrictions (such as *eats* in the sentence *the boy eats cake*) participants' eye movements anticipated the direct object by moving towards the only depiction of an edible object in the given visual array upon verb onset presentation. In a follow-up study (Kamide et al., 2003), the authors reported that even when a verb does not on its own provide enough evidence for participants to anticipate a verbal object, the combination of a verb and a noun phrase can do just that: Upon hearing *the man will ride…* participants looked more at a visually represented motorbike than when they heard *the girl will ride…* These findings support a view of language processing according to which language comprehenders construct a mental representation of an event that is updated as soon as more information becomes available, and this information is in turn used to generate expectations about further input.

This line of research raises the question of whether anticipating an upcoming verbal object is driven by verb semantics alone or by the contextual plausibility granted by the previous linguistic context. Metusalem et al. (2012) asked a related question in an investigation of the role of event knowledge during incremental language processing. Their goal was to show that information about an event provided by a (linguistic) context could activate information that is compatible with the event at hand yet incompatible with the unfolding linguistic input. Words that are contextually incompatible can - if they belong to the domain of the event at hand ('semantically related') compared to contextually incompatible and semantically anomalous words - elicit a reduced mean amplitude N400 effect (a brain wave signature that via relative amplitude changes indexes lexical-semantic processes). Thus, regardless of grammatical and thematic fit, information relevant to the construction of a mental representation of an event can facilitate processing. But what if the information provided by the verb's selectional preferences is at odds with prior context information? We address this additional question in our experimental investigation.

The Experiment

We designed an eye-tracking experiment to address both the issue of metaphor symmetry in comprehension and the interaction between contextual cues and verb selectional preferences during the anticipation of post-verbal objects.

Participants

Thirty-two native speakers of German (aged 18 to 32) with normal or corrected-to-normal vision gave their informed consent and received 12 Euros each for their participation. The number of participants was determined via an a-priori power analysis through simulations using data from a pilot study (n=12) with the help of the R package 'SimR'(Green & MacLeod, 2016). The power analysis determined that with 32 participants power would be above 80% assuming a true effect size (for the difference between early-metaphoric and late-metaphoric in the vehicle region) with a Cohen's *d* value of 0.2.

Methods, Materials and Design

We created 36 verb-object metaphors which were paired with a literal and a metaphorical context (as seen in Table 1). Items were normed for metaphoric aptness and contexts were matched for length (±2 characters) as well as syntactic structure. The last sentence in each context was identical across conditions with the exception of the disambiguating word: In the literal conditions, participants heard the literal disambiguating word (*Adlige,* 'noble woman') and in the metaphoric contexts they heard the metaphoric disambiguating word (*Katze,* 'cat'*)*. This word was always the same word used in the written context to describe the given referent.

Additionally, we created 72 combinations of contexts + utterances as fillers: Metaphoric utterances, idiomatic, and literal sentences. For the filler trials, there was always one target image and three distractors, so that participants could easily and reliably establish the appropriate referent.

The experiment had a 2x2, repeated-measures design with the factors *Contextual Bias* (literal vs metaphoric) and *Verb Position* (early vs late, see Table 1 and Figure 1).

Figure 1: Example pictures for a critical item. Literal picture is bottom-left and metaphoric picture is top-right.

Table 1: Example of a critical item

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 Hunger hat. 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 Hunger hat. 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.')
1a) Early verb position: *Sebastian füttert*$_{\text{VERBAL TOPIC}}$ *eine Prinzessin*$_{\text{VEHICLE}}$*, und wird unablässig der Katze* (metaphoric disambiguating word in metaphoric conditions)*// der Adligen* (literal disambiguating word in literal conditions*) beistehen.* (**Literal English translation: '**Sebastian feeds a princess and will relentlessly the cat support')
1b) Late verb position: *Sebastian wird eine Prinzessin*$_{\text{VEHICLE}}$ *füttern*$_{\text{VERBAL TOPIC}}$*, und wird unablässig der Katze* (metaphoric disambiguating word in metaphoric conditions)*// der Adligen* (literal disambiguating word in literal conditions*) beistehen.* (**Literal English translation:** 'Sebastian will a princess feed and will relentlessly the cat support)

Predictions

If the Implicit Comparison view holds, we should find that when participants hear 'feeds' (topic), the relationship between looks to the princess (literal picture) and the cat (metaphoric picture) should be similar in the early verb and late verb constraint conditions. If, on the other hand, the Category Membership view holds, we should find differences in this relationship when participants listen to *füttert*, depending on its position (before or after *Prinzessin*). Specifically, we should find that when participants hear the topic prior to the vehicle, they will settle on a metaphoric interpretation of the vehicle (anticipate the cat) more easily than when they hear the vehicle prior to the topic.

Regarding the anticipation of a verb's likely upcoming object, there are three possible scenarios when the information given by the linguistic context clashes with a verb's selectional preferences: Participants could rely on (i) the verb or (ii) on the context to anticipate an upcoming object, or they could (iii) not anticipate the object whatsoever. Accordingly, in the literal-early condition (where context is compatible with princess as a likely object and the verb is more compatible with 'cat' as a likely object), we would either expect (i) a preference for looking at the cat (compared to the princess) or (ii) a preference for looking at the princess (compared to the cat), or (iii) no significant preference for either one.

Procedure

The experiment was a modified version of the classic eye-tracking Visual World Paradigm. Participants first read a 4-sentence text (see Table 1 for an example) and clicked anywhere on the screen when they were ready to continue. They then saw 4 pictures on the screen: One representing the literal (princess) and another the metaphoric (cat) meaning of the target sentence as well as two distractor images (see Figure 1 for an example). After two seconds, they heard the target utterance while the pictures remained on the screen (see Table 1 for an example of a critical item). Their task was to click on the image that they thought best fit both the written context and the spoken sentence. They could only move the mouse once the utterance had been played. On 1/3 of the trials (filler trials only), they answered multiple choice questions on the content of either the written text, the pictures, or the spoken utterance. Participants' eye movements were recorded using an EyeLink 1000+ eye-tracker from the company SR Research.

Analysis and Results

We quantified participants' viewing preference by measuring log-ratio (Arai et al., 2007) between looks to the metaphoric picture divided by looks to the literal picture when participants heard the topic (*füttert,* 'feeds') and the vehicle (*Prinzessin,* 'princess'). Log-ratio values are centered around 0, where positive values indicate a preference for the metaphoric picture and negative values a preference for the literal picture.

We fitted linear mixed-effects regression models to our data following the recommendations of Barr et al. (2013). All models included the factors *Contextual Bias*, *Verb Position* and their interaction as fixed effects as well as trial number as a control variable.

We fitted two models: One for *Prinzessin* (vehicle region) and one for *füttert* (verb region). Models were coded using a treatment contrast scheme, tailoring our contrasts to our hypotheses (Schad et al., 2019). When using treatment contrast, one condition is used as a baseline (the intercept of the model), with the coefficients of the predictor variables representing direct comparisons between a predictor and the baseline group while keeping all other predictors at a fixed level. This differs from the ANOVA-style, sum-contrast traditionally used, in which the intercept represents the overall mean of all conditions, and the coefficients of the predictor variables represent the effect of a specific factor compared to the overall mean.

Importantly, when using treatment contrast the coefficient of the intercept tests the null-hypothesis of whether the outcome value (i.e., log-ratio) is equal to zero. This means that the intercept term will tell us if there is a preference for either literal (negative log-ratio) or metaphoric (positive log-ratio) picture in the condition chosen as the baseline judging by whether or not the intercept is significantly different from

zero. The results for each region are summarized in Figures 2 and 3.

Summary of Results The results of the vehicle region suggest that the processing of verb-object metaphors differs depending on the position of topic and vehicle: In the metaphoric-early condition (topic has already been heard), participants showed a preference for the metaphoric picture (the cat) when hearing the vehicle (*Prinzessin)* as evidenced by a positive log-ratio. By contrast, in the metaphoric-late condition (topic has not been heard yet), they showed a preference for the literal picture (the princess) reflected in a negative log-ratio. These two conditions were also significantly different from one another, with the metaphoric-early (vs. metaphoric-late) condition displaying a more positive log-ratio. No such difference was found between the literal conditions.

The results of the verb region (topic) suggest that, in the metaphoric-early condition, participants were able to anticipate the cat (both contextually appropriate and in line with the verb's selectional preferences), as indicated by the positive log-ratio. However, when there was a clash between contextual bias and the verb's selectional preferences (as was the case in the literal-early condition, where the context points towards the picture of the princess as a likely referent while the verb points towards the cat) no evidence for anticipation was found as indicated by the literal-early condition's log-ratio hovering around zero. Below we specify the results of the tests performed in each region.

Vehicle Region (*Prinzessin*) The model for the vehicle region included random terms for context bias by subjects and context bias and verb constraint by items. This model was fitted three times: the first one coding the metaphoric-early condition as the intercept, the second one doing the same with the metaphoric-late condition and the third one with the literal-early condition. The first version of the model (metaphoric-early condition as intercept) showed a significant difference between early and late metaphoric conditions (*t=6.3, p<.001, Cohen's d=0.265*). Additionally, the intercept of the model was positive and significantly different from zero *(t=3.61, p<.001)*. This result suggests that there is a difference in viewing pattern when hearing the vehicle depending on whether the vehicle appeared after or before the verb. The second version of the model (metaphoric-late as intercept) showed a significant difference between metaphoric-late and literal-late (*t=3.9, p<.001, Cohen's d=0.3*). The intercept of this model was negative and significantly different from zero *(t=3.04, p<.01)*. This suggests that when they heard the vehicle prior to the verb, participants mostly considered the literal picture (the princess) as the likely referent, whereas they mostly considered the metaphoric picture when hearing the vehicle after the verb. The third model showed no significant difference between literal-early and literal-late conditions (t=0.21, p=0.83, Cohen's d=0.01). This finding suggests that the gaze preference differences found in this region were specific to the metaphoric conditions. Figure 2 below summarizes these findings.

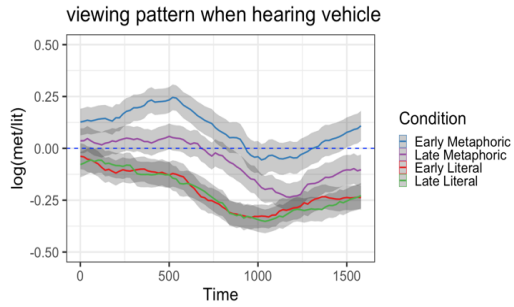

Figure 2 Results of vehicle (*Prinzessin)* region. Grey shaded areas represent 95% confidence intervals.

Verb Region (*füttert*) The model for the verb region included random intercepts and random slopes for both factors by items and random slopes for both factors by subjects. This model was fitted twice: One coding the metaphoric-early condition and the other the literal-early condition as the intercept. The first version of the model (metaphoric-early condition as intercept) showed a significant difference between metaphoric-early and literal-early *(t=2.959, p<.01, Cohen's d=0.237)* and a significant interaction between both factors *(t=26.723, p<.001, Cohen's d=0.37)*. The intercept of the model was positive and significantly different from zero *(t=2.456, p<.05)* signifying an overall preference for the metaphoric picture throughout the region. This suggests that when hearing the verb prior to the vehicle after having read a metaphorically biasing context, participants anticipated the object that was compatible with both context and the verb's selectional preferences (the cat).

The second version of the model (literal-early condition as intercept) showed a significant difference between early and late literal conditions (*t= 4.947, p<.001, Cohen's d=0.33*). The intercept of the model was not significantly different from zero (*t= 1.547, p=.123*), suggesting that participants did not reliably anticipate the object that was compatible with context (the princess) or the object compatible with the verb's selectional preferences (the cat) and only preferred to look at the princess when they heard the verb after the object (late-literal conditions) Figure 3 below summarizes these findings.

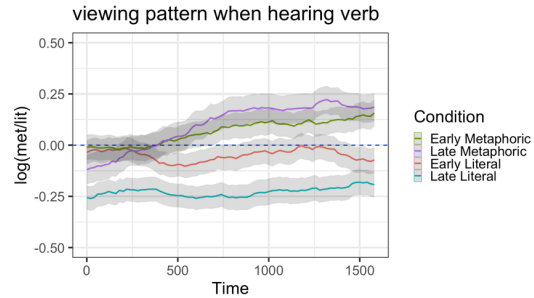

Figure 3 Results of verb *(füttern)* region. Grey shaded areas represent 95% confidence intervals.

Conclusion

Two theories on metaphor comprehension make different claims regarding whether or not the position of the elements of a metaphor matters when constructing metaphoric meaning. In the present work we addressed this issue by investigating the time course of comprehension of German verb-object metaphors such as *Sebastian füttert eine Prinzessin* ('Sebastian feeds a princess'). *Prinzessin* could either be interpreted as a noble woman, or as a spoiled cat. This type of metaphor allows for the position of its elements ('feeds': topic; 'princess': vehicle) to be reversed without altering meaning. Moving the verb to the end of the clause means that as people hear *Prinzessin* ('princess', vehicle), the topic (the verb) is not yet available. By contrast, for verb-second sentences, the topic verb has been encountered when participants process the vehicle ('princess'). A written discourse context preceding the target utterance established moreover a bias towards either a literal or a metaphoric interpretation of *Prinzessin*. In the target utterance, the verb established a bias towards the metaphoric interpretation. This design permitted us to also juxtapose discourse bias with verb selectional restriction (compatible vs. incompatible with the discourse context).

We tested the relationship of literal and metaphoric interpretation of the utterance by examining participants' viewing preferences to a literal and a metaphoric picture while they listened to literal or metaphoric target utterances.

With regard to the test of theories of metaphor processing, our results show differences in the gaze patterns as a function of the position of the metaphoric elements and as a function of the contextual bias. The vehicle 'princess' is processed differently depending on whether it follows or precedes the topic 'feeds'. We gather this from participants' viewing patterns when hearing the vehicle: They were less likely to look at the picture of the literal meaning of the vehicle (the princess) than at the picture of the metaphoric meaning (cat) when the vehicle followed the topic ('füttert') compared to when the vehicle preceded it.

This pattern is in line with the Category Membership view (Glucksberg, 2008; McGlone & Manfredi, 2001; Sperber & Wilson, 2008), which assigns different roles to each element in a metaphor and predicts that the position of the elements will affect processing. Specifically, this view predicts that hearing a topic before the vehicle can produce a more rapid construction of metaphoric meaning upon hearing the vehicle, given that the topic provides a necessary set of dimensions that allow for lexical modulation of the vehicle.

The results are harder to account for by the Implicit Comparison view (Gentner et al., 2001; Gentner & Bowdle, 2008), according to which processing a metaphor requires structural alignment of the metaphor's elements prior to a projection of inferences. This alignment process is role-neutral and the same amount of information should be retrieved from the encoded meaning of the vehicle whether it appears prior to or after the topic. To accommodate the present results, it should be possible for the processing of the vehicle's encoded meaning to vary as a function of the position of the topic.

With regard to assessing the influence of individual verbs that were compatible (versus incompatible) with a preceding discourse context, we examined the anticipation of post-verbal objects. Transitive verbs have been shown to generate expectation regarding their likely arguments (Altmann & Kamide, 1999) and these expectations can direct visual attention to appropriate objects. However, it has also been shown that information that is semantically compatible with context yet incompatible with the unfolding linguistic input is activated during processing (Metusalem et al., 2012). In our study, participants read a context that biased towards expecting a specific referent (a princess or a cat) and then heard a sentence in which a verb *(füttert*, 'feeds'*)* constrained the upcoming referent via its selectional preferences to only one of these referents (the cat).

We found that in the case in which context expectations matched a verb's selectional preferences (early-metaphoric condition, where both context and verb point towards the cat as likely referent), participants were able to anticipate a likely post-verbal referent when hearing the verb: They showed an overall viewing preference for the picture of the cat judging by the significantly positive log-ratio. When these sources of information were not aligned and participants heard the verb prior to the object (early-literal condition, where context points to the princess and the verb points to the cat as likely referent), we did not find evidence for anticipation, given that the log-ratio in this condition was not significantly different from zero. This pattern suggests that in this case participants deployed a *wait-and-see* comprehension strategy instead.

Overall, our study makes a strong case for the importance of extending the study of metaphors from nominal to other kinds in order to settle theoretical debates and refine existing accounts of (figurative) language comprehension. Future research on metaphor processing may want to continue to explore the way in which theoretical models can account for the processing of non-nominal metaphors.

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