# The dynamics of pragmatic enrichment during metaphor processing: activation vs. suppression.

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## Abstract

In this paper, we test between suppression and activation accounts of metaphor processing by means of a novel metaphor interference paradigm that makes use of mouse-tracking. The goal is to understand how context influences the activation of salient and non-salient features of a concept during the on-line processing of a metaphor. In two mouse-tracking experiments, we examine the activation and availability of conceptual features that were either irrelevant or relevant for understanding a metaphor across various contexts. Our findings support the conclusion that context works primarily by rapidly suppressing salient features of a concept that are not relevant for the particular metaphorical interpretation. What is more, it seems that even further contextual manipulation does not facilitate the activation of non-salient metaphor relevant features.

**Keywords:** Figurative language, lexical pragmatics, psycholinguistics, mouse-tracking.

## Introduction

Among the most intriguing aspects of language are the creative ways in which we can use it. We often use words and sentences in novel ways that create nonce interpretations of a stable linguistic repertoire for various social and pragmatic purposes. One particularly contentious debate surrounding creative language use is how we understand figurative language. While much research has sought to understand the various linguistic and conceptual mechanisms needed to understand figurative meaning (Glucksberg, 1998, Lakoff & Johnson, 1980), less attention has been paid to the pragmatic enrichment mechanisms needed to rapidly integrate contextual information into figurative interpretations (Gibbs, 2002).

In this paper, we address this question by using a novel mouse-tracking paradigm in an attempt to better understand how context affects the on-line processing of figurative language. Specifically, we examine metaphorical interpretations, which have received the greatest amount attention in the psycholinguistics literature, and report the results from two experiments designed to test between two contrasting views of how context can aid the comprehension of metaphors; either by suppressing information not relevant for the metaphorical interpretation or by increasing the accessibility of information needed to reach it..

## Metaphors and language processing

Many early experimental studies have demonstrated that metaphor processing is incompatible with the standard "literal-first" Gricean view of pragmatics (Gibbs, 2002). This is because figurative speech is understood just as quickly, and in some cases even more quickly, than literal speech (see Glucksberg, 2001 & Glucksberg, 2003 for extensive reviews). Processing delays reported in the literature are more likely to occur for unfamiliar metaphors, due to the relative difficulty needed to integrate contextual information into the novel interpretation at hand (Shinjo & Meyers, 1987), while reaction time differences might ultimately stem from speed-accuracy trade-off issues. McElree & Nordlie (1999), for example, observed that literal and figurative meanings might be derived equally fast, but the overall accuracy of figurative speech interpretation seems to be lower than that of literal speech at both early and late processing times. These findings suggest that strong contexts should not decrease the processing time for figurative language, but only increases the likelihood that the intended interpretation will be understood.

The finding that both literal and metaphorical speech is understood with the same speed and facility has been a central tenet of numerous theoretical accounts in psychology. One example is the class inclusion model (Hampton, 1988; Glucksberg & Keysar, 1990), according to which, understanding a metaphor such as "his job is a jail" amounts to updating the topic's category structure by integrating select features of the vehicle 'jail' (e.g. "confinement", "no exit", etc.) into it. Experimental work seems to suggest that this is done by first suppressing basic level meanings of a category (Gernsbacher, Keysar, Robertson, & Werner, 2001) and then creating ad hoc categories from the combination of topic and vehicle features (Barsalou, 1983).

Another prominent account that incorporates the lack of processing time difference between literal and metaphorical speech is that of Cognitive Linguistics (Lakoff & Johnson, 1983), which suggests that literal and metaphorical interpretation do not rely on different processing mechanisms. According to this approach, understanding

literal and metaphorical speech involves the recognition of patterns as opposed to complex mappings assumed in other theories; in the case of "my job is a jail", for example, both "job" and "jail" share the "container" relationship.

## Figurative language and lexical pragmatics

In linguistics, researchers have sought to integrate the findings mentioned above into both more formal and processing-oriented theories. For example, Relevance Theory currently offers an account of metaphor as a case of conceptual *broadening* and *narrowing* (Sperber & Wilson 2008). Relying on the aforementioned idea of ad-hoc categories (Barsalou 1983), relevance theorists also hold that nonce conceptual categories are constructed for each contextually specific metaphorical use. For example, in a metaphor such as "the goalie is a spider", the vehicle 'spider' is assumed to encompass encyclopaedic information ("insect", "has 6 legs", "fangs", "catches prey in web", etc.), which is selectively combined into a contextually relevant ad-hoc category SPIDER* (denoting something like "catches things near its web") after certain features of the lexically encoded concept SPIDER are suppressed.

Other accounts seem to rely more on processes of activation when it comes to explaining how context helps process figurative language on-line. The *direct access view*, for instance, holds that context primes the relevant features needed to interpret the figurative meaning to the extent that figurative meanings are interpreted in an almost identical manner to literal meanings (Gibbs, 2002). This account differs from the relevance-theoretic one in that it predicts that context affects the way in which conceptual/semantic information is accessed from the start rather than further processed once a lexical meaning is retrieved during some decoding process. This view is consistent with Recanati (1995)'s theory of truth-conditional pragmatics, which holds that when interpreting a sentence such as "my job is jail", a strong biasing context would make the properties of the concept JAIL that are needed for the figurative interpretation directly available (e.g. "confined space" as opposed to "punishment").

Prior work investigating suppression and activation in metaphor processing has relied on various priming and lexical decision paradigms (see Glucksberg, 2003 for a review). For example, Rubio-Fernandez (2007) tested the idea of active suppression in a cross modal priming paradigm and found that after reading metaphorical utterances, metaphor relevant properties remained active at longer intervals than metaphor inconsistent properties. This suggests that all properties of a given concept are activated and then properties not relevant for the metaphor are suppressed. One limitation of such studies, however, is that reaction time measurements might mask the continuous changes in the accessibility of properties. In other words, similar reaction times at a given interval might not necessarily reflect equal activation levels. In the present

study, we make use of a novel paradigm to further test how suppression and activation mechanisms are implemented during on-line metaphor comprehension. We use *mouse-tracking* because via motor movements it can provide a window into the way in which listeners' access conceptual information during processing, since it "breaks up" the button press (Freeman & Ambady, 2010). More specifically, we examine how both metaphor relevant and metaphor irrelevant features can interfere with mouse-trajectories toward metaphorical interpretation.

## Overview of Experiments

In the following two experiments, a metaphor interference paradigm (Glucksberg, Gildea, & Bookin, 1982; Wolff & Gentner, 2000) was combined with mouse-tracking. This paradigm offers a novel test of the on-line availability and competition of *salient* and *contextually relevant* features during the interpretation of a metaphor. Participants read metaphors such as "the goalie is a spider" along with filler items such as "the apple is red". They then clicked on either one of two pictures that best captured the overall meaning of the utterance. In the critical trials, one of these pictures, the correct target, depicted the topic in its metaphorical state (goalie making a save), while the other picture, a competitor image, was either an attribute from the vehicle available in the metaphorical state (spider web) or one only available in its non-figurative meaning (spider close-up). The interference of competitor target images on participants' mouse trajectories was compared across both literal and figurative utterances (Experiment 1) and then across strong and weak contexts (Experiment 2).

Prior to both of these experiments, participants completed a picture norming experiment to determine the relative salience of the various attributes for the metaphorical vehicle and become familiar with the pictures used in the main experiment. For this, they were shown the topic of the metaphor in isolation (SPIDER) and were asked to choose between the two competitor target pictures (web or close-up). This allowed for the experimental items (metaphorical utterances) to be separated into two groups:

1) *Salient (metaphor) relevant feature group* - the figurative attribute of the vehicle has more baseline salience than the literal attribute.
2) *Salient (metaphor) irrelevant feature group* - the literal attribute of the vehicle has more baseline salience than the figurative attribute.

## Experiment 1

28 participants at Cardiff University took part in both the picture-norming and main experiment in exchange for course credits. Participants completed both parts of the experiment within 30 minutes.

**Stimuli** Forty metaphorical sentences were adapted from Jones & Estes (2006), in which both the topics and vehicles of which had been already been normed for *aptness* and *conventionality*. In Jones & Estes (2006), aptness was

defined as the extent to which the vehicle's figurative meaning expresses an important feature of the topic. Conventionality was defined as the strength of the association between the metaphor vehicle and its figurative meaning. This allowed us to use a variety of metaphors that differed along these parameters.

Various pictures that depicted either *relevant* (spider web) or *irrelevant* (spider eyes/fangs) features of the metaphorical topic in this particular context were collected using Google Search. During the collection, multiple candidate pictures expressing the metaphorical meaning of the vehicle were collected (e.g. an outstretched goalie making a diving save, a tall goalie, a goalie stretching, etc.), and several research assistants independently decided which one best expressed the metaphorical meaning of the utterance at hand. The same pictures were used for both the norming and the main parts of experiment.

## Norming experiment

In order to establish the relative salience of the feature pictures prior to the main experiment, participants were presented with the metaphor topics (spider) and had to click on the feature picture that best represented the word. This allowed us to distinguish a relative baseline for which feature picture was more salient for the topic. For example, participants read the word VOLCANO (from "his anger is a volcano") and clicked on either a picture of an inactive volcano (metaphor irrelevant feature) or a picture of hot lava (metaphor relevant feature). In order for an item to be assigned to a group (salient metaphor relevant feature group or salient metaphor irrelevant feature group), the average ratings for a picture response for a given topic had to be above 66%. Two items that were towards chance, i.e. 50/50, were excluded from the analysis of the main experiment. 18 of the 40 metaphor vehicles were rated as having a salient (metaphor) relevant feature and 20 of the 40 metaphor vehicles were rated as having a salient (metaphor) irrelevant feature. This part of the experiment also served as a way of familiarizing participants with the pictures used in the main experiment.

## Main experiment

After completing the norming study, participants were instructed to read a sentence and choose the picture that best corresponds to its overall meaning. For metaphors, participants had to click on the correct target, e.g. a picture of the metaphor topic in its figurative state (goalie making a save). Different feature pictures (metaphor relevant or metaphor irrelevant) were used as competitors to test 1) the amount of interference with the correct target and 2) the stage in processing (early or late) during which the interference occurs. Early interference would suggest that a feature is available during lexical access, whereas later interference would suggest that this feature becomes available at a later stage, i.e. during pragmatic enrichment.

**Design and Procedure** In the main experiment, participants read metaphors such as "The goalie is a spider" as well as literal filler items such as "The apple is red". The filler items were included to make sure that participants listened until the end of the sentence. Without these sentences, listeners could have made their decisions just after hearing the metaphor topic. In the filler sentences participants would choose between two competing images, which were only distinguished by the final word in the utterance ("The apple is red" vs. "The apple is green"). For the 40 metaphor items, participants saw either one of three target-competitor picture versions for metaphorical items. In the relevant feature condition, participants chose between a picture of the metaphor relevant feature (spider web) and a picture of the topic in its metaphorical state (the outstretched goalie making a save). In the irrelevant feature condition, the same picture of the topic was used, but in conjunction with a metaphor irrelevant feature picture (frontal close up of a spider). In the control condition, the same topic picture was also used, but the competitor picture had no relationship to the topic or vehicle (e.g. an apple). Three lists were created so that each participant saw only one version of each item. To start a trial, the participant would click on the START button at the bottom center of the screen. Each item was presented word by word at an interval of 350ms per word. Participants were allowed to move the mouse towards a picture target, located at the top corners of the screen, only at the onset of the final word in the utterance. The trial ended once a target was clicked on.

**Predictions** If participants first access the salient meaning of the concept at hand, then salient picture features should interfere at an earlier point during the response. This should happen for both relevant and irrelevant features, however irrelevant features should not interfere later on in the response, as these features are not part of the figurative meaning, i.e. they become suppressed. Put differently, if a metaphor irrelevant feature is indeed the most salient, this should interfere with responses towards the correct target (picture of topic in metaphorical state) early on during the response because it would be "active" during lexical access. Similarly, if a metaphor relevant feature is not salient, later interference in responses should occur. When metaphor relevant features have higher salience than metaphor irrelevant features, both early and late interference should be noticed because this feature would be active both during lexical access as well as during the construction of the figurative meaning.

## Results and Discussion

Figures 1 and 2 show the mouse paths for correct responses for the relevant and irrelevant features groups, across salient and non-salient items respectively. Control groups were not included because mouse paths went directly to the target. To examine the relative interference of competitor pictures on participants' mouse paths to the correct targets, the average x-coordinates for mouse paths across the feature conditions

and saliency groups were compared. The time points for the x-coordinates from the normalized mouse paths (101 time stamps) were collapsed into 10 groups (or time bins) in order to better operationalize early vs. late processing. A mixed-model was used to analyze the x-coordinates of the mouse paths, which used time-bin, competitor (relevant vs. irrelevant), and feature salience as fixed effects. Subjects and items were used as random effects.

Interaction terms for feature competitors and feature salience were significant at time bins 30 to 40, $t = 2.83$, $p < .05$ and time bins 50 to 60, $t = 2.51$, $p < .05$. Figure 2 shows the mouse paths for the relevant and irrelevant feature competitors only for items for which the irrelevant feature was rated as more typical of the metaphor vehicle. A cross-over pattern for x-coordinate position is observed, in which metaphor irrelevant features interfere early on in the response (time bins 30-40), whereas the metaphor relevant feature interfere later on (time bins 50-60). This replicates several findings from different paradigms in that salient features seem to be more active, i.e. interfere more, during early processing and less salient features are accessed later, i.e. interfere later during the response. In the next experiment, we sought to replicate the cross-over pattern for feature interference and then investigate how priming versus neutral contexts mediate the availability of features when interpreting metaphors.
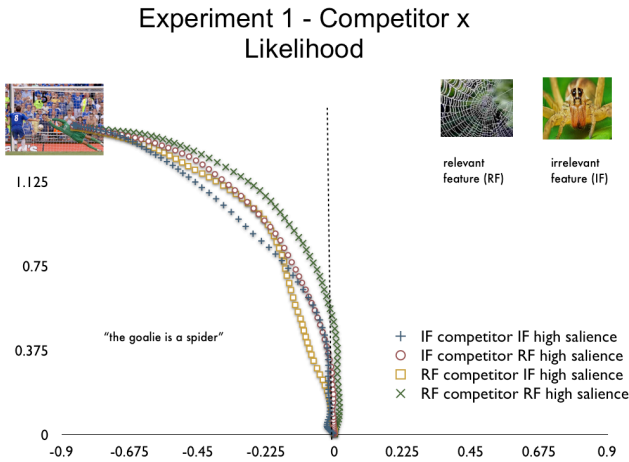
### Experiment 1 - Competitor x Likelihood



Figure 1. Time- normalized mouse paths for all conditions (competitor feature type vs. salience groups).

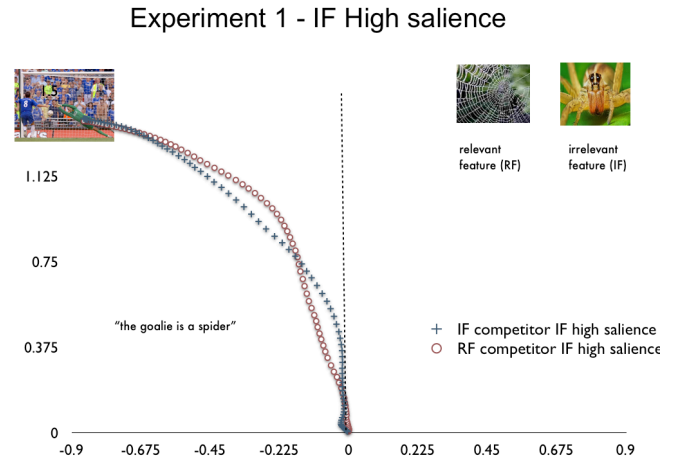### Experiment 1 - IF High salience



Figure 2. Time- normalized mouse paths for relevant vs. irrelevant features in the salient irrelevant feature group.

## Experiment 2

In this experiment, prior to each metaphor, participants read either a "strong" and "neutral" preceding context. This allowed us to test whether contextual information can rapidly adjust the relative salience of a feature of a concept, as activation accounts would predict. Specifically, "strong" contexts should explicitly promote the status/activation of metaphor relevant features, whereas "neutral", albeit felicitous ones should not. The direct access view would predict that the (late) interference effect found for non-salient metaphor relevant features should occur at an earlier time bin when preceded by strong contexts because of the increased activation of these features by the context. Suppression accounts, on the other hand, would predict that the early interference account for irrelevant features should be more diminished in strong when compared to weak contexts.

### Norming experiment

Prior to the main experiment, the same norming experiment as Experiment 1 was repeated. The two excluded items from Experiment 1 were rated as having high salience metaphor relevant features, however 1 of the remaining items was now excluded because it did not meet the 66% threshold. This resulted in 20 items in the high salience relevant feature group and 19 items in the high salience irrelevant feature group.

### Main experiment

The main experiment was identical to Experiment 1 except that items were preceded by either neutral or strong contexts. Details are discussed below.

**Stimuli** The stimuli were the same used in Experiment 1. The only difference was that items were preceded by a strong or weak context. For example, in our example item "the goalie is a spider", the strong context was: "We had many opportunities to score, but the ball was always

stopped" while the neutral one was: "We had many opportunities to score but couldn't convert our chances".

**Design and Procedure** The design and procedure were the same as in Experiment 1. The only difference was that contexts were presented prior to the onset of the metaphor or literal utterance. Participants were able to read each context at their own pace and press the enter key in order for the word-by-word presentation of the item to start.

## Results and Discussion

Figures 3 and 4 show mouse paths for the two conditions. Using the same time bins from Experiment 1, a mixed regression model was used to examine the interaction of context, feature competitor, and feature salience. When collapsed across contexts, the same interaction terms for feature competitor and feature salience were significant at time bins 30 to 40, $t = 1.89$, $p < .05$ and at time bins 50 to 60, $t = 3.07$, $p < .01$. When context was included in the interaction terms, they were not significant; time bins 30 to 40, $t = 95$, $p = .69$ and time bins 50 to 60, $t = .34$, $p = 71$. Context was, however, a significant predictor at time bins 30-40 for salient irrelevant features when the irrelevant features were the competitor, $t = 2.61$, $p < .03$, but not at time bins 50-60, $t = .75$, $p = 53$.

Experiment 2 replicated the findings from Experiment 1 in that early interference effects were observed for irrelevant features and late interference effects were observed for relevant features when the irrelevant feature was the most salient. Both neutral and strong contexts showed the cross-over interaction, however strong contexts only reduced the early interference effects of irrelevant features for items for which irrelevant features were the most salient. Taken together, these findings provide evidence for suppression accounts because relevant features still showed late interaction effects even with strong contexts. This is not predicted by the direct access view.

### Experiment 2 - Strong context



Figure 4. Time- normalized mouse paths for relevant vs. irrelevant features in the salient irrelevant feature groups in strong contexts.

### Exp 2 - IF competitor IF high salience



Figure 5. Time- normalized mouse paths for irrelevant features in the salient irrelevant feature groups across weak and strong contexts.

## Conclusion

In two mouse-tracking experiments, we tested the on-line availability of conceptual information when interpreting figurative language. Our main question was whether context acts primarily by suppressing context-independent features during lexical access for metaphorical interpretation or whether it increases the availability of non-salient features needed to understand the metaphor under question. Experiment 1 showed that salient metaphor irrelevant features of the vehicle provided early interference in participants' mouse paths towards correct targets. Non-salient features of the vehicle relevant to the interpretation interfered much later on in the participants' mouse paths towards the correct target. Experiment 2 tested whether the
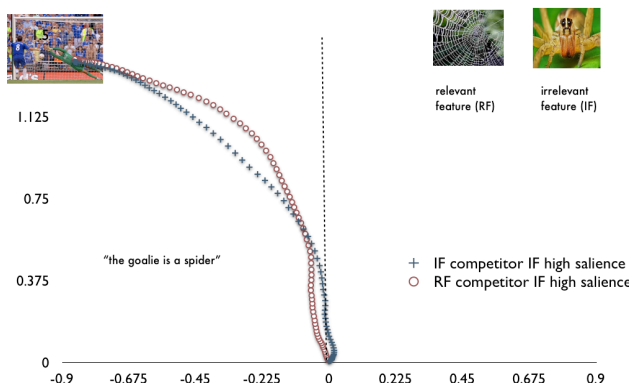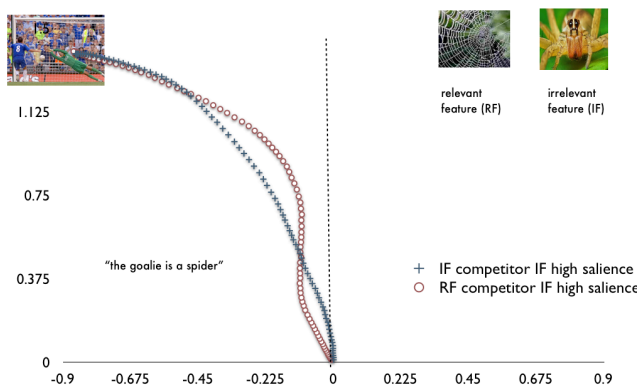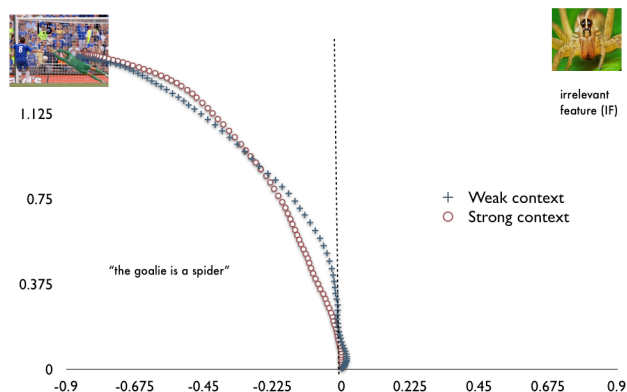
### Experiment 2 - Weak Context



Figure 3. Time- normalized mouse paths for relevant vs. irrelevant features in the salient irrelevant feature groups in weak (neutral) contexts.

presence of a biasing context primes the activation of the salient feature that is relevant to the metaphor earlier on in processing, but the same cross-over pattern found in Experiment 1 was replicated in both the neutral context and the strong context conditions. What context seemed to do was reduce the early interference effect for metaphor irrelevant features when these same features were salient features of the vehicle. Taken together, the findings from Experiment 2 provide support for suppression accounts.

While our paradigm did not find increased activation for non-salient metaphor relevant features in strong contexts, one possibility is that our strong contexts might not have been strong enough to adequately test direct access accounts. We used one sentence introductory context, when classical studies, such as Swinney's (1979) "bug" task, use an entire paragraph of context. In this vein, Noveck, Bianco, & Castry (2001) showed that longer contexts speed up metaphor processing in comparison to shorter ones. It may well be the case that the priming effects associated with activation accounts operate on a larger time scale than suppression mechanisms. We feel that this is a worthy topic for future research, for which our mouse-tracking paradigm is well suited to test.

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