The Influence of Explicit Markers on Slow Cortical Potentials During Figurative Language Processing

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Abstract

Recent event related brain potential (ERP) results show that figurative interpretations of proverbial phrases (e.g., *lightning never strikes the same place twice*) elicit sustained slow cortical potentials that are more negative over the front of the head than for literal interpretations of the same phrases (Ferretti, Schwint, & Katz, under review). We extend this research by examining the influence of explicit markers placed before the proverbs, such as *literally speaking* and *figuratively speaking*, and by contrasting two literal conditions in which there either is overlap or no overlap between content words in the proverbs and the preceding contexts. The results show that slow cortical potentials were most negative for proverbs interpreted in figurative contexts, and most positive for literal contexts that contained overlapping words. Moreover, markers directed readers toward the contextually appropriate interpretation of the proverbs earlier than found in previous research. These findings have direct relevance for theoretical explanations of figurative language processing.

Introduction

In recent years, researchers have begun to examine how people comprehend figurative statements when they are placed in contexts that are consistent with either their figurative or literal meanings. Different models of figurative language processing make distinct predictions about how and when figurative interpretations of text are constructed. Some posit that figurative statements are constructed only after an initial literal interpretation is determined to be inconsistent with the preceding context (Grice 1975). Alternatively, other approaches focus on different variables that may increase or decrease the activation of figurative meanings relative to literal meanings during language processing, such as arguing that one is obligated to process salient meaning regardless of literalness (Giora, 2003), or positing that the figurative meaning of a phrase is accessed directly if the preceding context is sufficiently constraining (Gibbs, 1994). The constraint-based model holds that the literal and figurative meanings of sentences compete for activation and the most activated meaning is determined by the relative strength of different sources of information for those competing meanings (Katz & Ferretti, 2001).

A growing body of research has provided evidence that it cannot be the case that people always construct a literal interpretation before considering possible figurative interpretations (e.g., Gibbs, Bogdanovich, Sykes, & Barr, 1997; Katz & Ferretti, 2001). Nonetheless, recent research using event-related brain potential methodology (ERP) has shown that people have more difficulty integrating words into contexts when they are to be interpreted figuratively rather than literally (Coulson & Van Petten, 2002; Katz, Blasko, & Kazmerski, 2004), even when no differences are found in self-paced reading times involving the same materials (Ferretti, Schwint, & Katz, under review).

Slow-cortical potentials and figurative language processing

Previous research using ERP methodology to examine figurative language processing has primarily focused on single word indices of text integration difficulty, such as the N400 and Late Positivity. The N400 is the most widely used ERP measure for investigating the semantic integration of words in text (more difficult words produce larger N400s, Kutas & Hillyard, 1980), and are often followed by a brain potential that is more positive for words that are more difficult to integrate (Coulson & Van Petten, 2002). These measures have been useful for investigating manipulations involving the final word of statements that are to be taken literally or figuratively (Coulson & Van Petten, 2002; Katz et al., 2004). However, using single word ERP indices to investigate text integration difficulty for statements can be problematic when discourse contexts have an influence that begins early and is maintained across the figurative statements. One can still use these indices to investigate differences between conditions on the word in which the differences between conditions first appear, but the

interpretation of differences on subsequent words in statements becomes difficult because the ERP potentials to these words are going to be influenced by earlier differences between contextual conditions. We suggest that this issue is important to consider in studies of figurative language processing that involve investigations of how people integrate entire figurative sentences, such as familiar proverbs, into discourse contexts.

One way to deal with the problem of early context effects discussed above is to conduct longer averages that begin at the first word of a figurative statement and extend over the entire statement. There are at least two advantages of employing longer averages under such circumstances. First, because the averages are time-locked to the first word of the crucial statement they cannot be "contaminated" by effects that occur earlier in the statement. Second, there is a growing body of evidence in the sentence processing literature that show longer averages capture slow potentials that develop over sentences and, importantly, that these potentials are sensitive to the ease in which sentences and clauses are integrated into mental representations of the text and, thus, have been taken as an index of working memory constraints (e.g., King & Kutas, 1995; Münte, Schiltz, & Kutas, 1998).

To our knowledge, only a recent study by Ferretti et al. (under review) has investigated slow cortical potentials while people interpret familiar figurative statements (i.e., proverbs such as *lightning never strikes the same place twice*) placed in contexts biased toward either a literal or figurative interpretation. The results from this study are clear; at the third word of the proverbs, slow cortical potentials at the front of the head were more negative for proverbs preceded by figurative biasing contexts in comparison to literal biasing contexts, and this difference was sustained over the remaining words in the proverbs. Interestingly, they found, as did Katz and Ferretti (2001) with a different item set, no differences between the two contextual conditions in a self-paced reading time study employing the same items. The authors conclude that these results demonstrate that people have more difficulty integrating the proverbs in figurative than literal contexts, and that self-paced reading may not always be sensitive to processing differences between contextual conditions when people read familiar figurative statements.

Explicit markers and proverb comprehension

In the present study, we investigate how explicit markers, such as *literally speaking* and *figuratively speaking*, influence how people interpret proverbial statements. Explicit markers are brief statements presented immediately prior to figurative language that invites the reader as to the usage of the upcoming statement, in our case proverbs (Honeck, 1997). Proverbs are often preceded by explicit markers because their interpretation can be plausible in either a figurative or literal sense. Thus, the markers help disambiguate the intended meaning of the proverbial phrases.

To our knowledge there is only one study that has investigated the role that markers play in the interpretation of proverbs during online discourse comprehension. In this research, Katz and Ferretti (2003) examined the effect of *Literally speaking*, *In a manner of speaking*, and *Proverbially speaking* on self-paced reading times for familiar and unfamiliar proverbs placed in figurative or literal biasing contexts. Although the markers helped disambiguate the meaning of unfamiliar proverbs, and thus decrease reading times, the influence of these markers on familiar proverbs was small. With familiar proverbs, the marker *literally speaking* had no influence on reading times for the literal contextual condition, whereas the markers *proverbially speaking* and *in a manner of speaking* increased reading times up to the second last word of the proverb. From the second-last word of proverb through to the beginning of the subsequent sentence people read the proverbs at a similar rate regardless of the contextual bias, and regardless of type of marker employed.

In the research reported here, we extend the results of Katz and Ferretti (2003) and Ferretti et al. (under review) in a number of specific ways. First, we re-visit how people interpret familiar proverbs preceded by explicit markers using a larger item set that controls for problems with our earlier item set. In particular, we use a larger set of familiar proverbs (42 versus 12) that were all 7 words long (our previous items varied in length). Second, we contrast a literal context that ends with the marker *literally speaking* with a figurative context that ends with the marker *figuratively speaking*. The contrast between these two markers is more direct between the meaning of *literally* and *figuratively*. Furthermore, it enables us to extend our investigation to another commonly used explicit marker. Third, we use ERP methodology rather than self-paced reading because recent research by Ferretti et al. (under review) has cast some doubt on the sensitivity of self-paced reading measures (at least as indexed by moving window methodology) to differences between contextual constraints on the ease of reading familiar proverbs. Finally, we contrast two different literal contextual conditions in addition to a figurative contextual condition. Specifically, one literal condition has contexts that do not have any content words that overlap with the proverbial statements, whereas the second literal condition was identical with the exception that it contained content words that overlap with the proverbial statements. There are a couple of reasons for contrasting these two literal conditions. One is that it enables us to investigate how the overlapping content words may lead to specific expectations for the upcoming figurative statements. If this is true, then we may find differences between the two literal conditions that occur on the markers, before the proverbial statements are encountered. Finally, adding the overlapping condition provides a third level of possible integration difficulty due to the amount of abstraction that must occur for people to conceptually integrate the proverbial statements. Based on previous findings by Ferretti et al. (under review) and

Coulson and Van Petten (2002), we expect to find a gradient in how difficult it is to integrate the same statements into the developing discourse – least for the literal contexts with overlapping content words, and most for the figuratively biasing contexts. These differences in integration difficulty should be evident in the slow cortical potentials over the front of the head.

Method

Participants

Thirty participants participated in the ERP experiment and 57 participants participated in the norming studies reported below (27 for familiarity ratings, 30 for the remaining norms). All participants were native English speaking undergraduate students from Wilfrid Laurier University who received course credit or financial compensation for their participation.

Materials

Forty-two familiar proverbs were paired with either a figurative context, a literal context without content words that overlapped with the proverbs, or a literal context that had content words that overlapped with the contexts (see examples 1a and 1b). Each proverb was always preceded by 4 sentences that described conversations between people, and the sentence preceding each passage was always identical across the three experimental conditions. The proverbial statements were preceded by the marker *literally speaking* for the two literal conditions, whereas the marker *figuratively speaking* always preceded the statements in the figurative condition. In order to construct the literal condition that did not contain overlapping content words between the contexts and proverbs, we replaced the content words with a synonym. On average, there were 2.5 content words that overlapped with proverbial statements in this literal condition.

We conducted 4 separate norming studies in order to insure that our items 1) were familiar (1 = not at all familiar, 7 = very familiar), 2) were equal in how comprehensible they were in the literal and figurative contexts (1 = not at all easy to comprehend, 7 = very easy to comprehend), 3) were equal in how appropriate the proverbial statements were for the literal and figurative contextual conditions (1 = not at all appropriate, 7 = very appropriate), and 4) differed in how figuratively or literally biasing the contexts were (1 = very literal, 7 = very figurative). The results of these norming studies are presented in Table 1. The only statistical difference between the 3 conditions was for how figuratively or literally biasing the contexts were (figurative versus literal contexts with overlapping contexts, $t(41) = 19.67$, $p < .001$; figurative versus literal contexts without overlapping contexts, $t(41) = 19.13$, $p < .001$).

(1a) Figurative context
"Why won't you tell me what you're making for my birthday?" said Joseph as he peered into the kitchen. "It's a surprise and you'll find out soon enough," said Katherine as she directed him away. As Katherine was pushing him from the kitchen entrance, a recipe for Beef Wellington, Joseph's favorite food, dropped from the counter and he picked it up. "I guess I'll find out sooner than you thought," said Joseph. Katherine stated "figuratively speaking, the cat is out of the bag."

(1b) Literal Contexts (overlapping words in brackets)
"What could that possibly be?" wondered Joseph as he gazed at a strange looking sack **(bag)** under the Christmas tree that appeared to be moving. "You'll find out tomorrow," said Katherine, as she moved to block his view of the sack **(bag)**. Suddenly, an animal **(cat)** scratched a large tear through a small air hole and climbed away **(out)**. "I guess I'll find out sooner than you thought," said Joseph. Katherine stated "literally speaking, the cat is out of the bag."

The 42 proverbs and their corresponding passages were placed across 3 experimental lists. Each list contained all proverbs with 14 of the items from each of the three experimental conditions. No participant saw any proverb or context more than once, and across the 3 lists each proverb was paired with each of the three experimental conditions. Ninety-six filler trials that were similar in narrative form and length were also included as part of each list and none of these items contained figurative statements.

Table 1: Mean Ratings for the passages embedded in each of the 3 contextual conditions.

Dimension	Figurative Rating	Literal-Synonym Rating	Literal-Overlap Rating
Familiarity	5.0	5.0	5.0
Comprehension	6.1	6.2	6.2
Appropriateness	5.5	5.6	5.4
Context Figurativeness	6.0	2.1	2.0

Procedure

Participants sat in a chair in front of a computer monitor located in a electrically shielded room. They read each paragraph one word at a time and answered a periodic "yes" or "no" comprehension question about the content of the passages. All words were presented for a duration of 300 ms with an SOA of 500 ms in the center of the computer screen.

EEG Recording and Analysis

The electroencephalogram (EEG) was recorded from 64 electrodes distributed evenly over the scalp. Eye movements and blinks were monitored via additional electrodes placed on the outer canthus and infraorbital ridge of each eye.

Electrode impedances were kept below 5KΩ. EEG was processed through a Neuroscan Synamps2 amplifier set at a bandpass of 0.05 – 100 Hz, and digitized at 250 Hz.

Results

Data was re-referenced off-line to the average of the left and right mastoids. High frequency noise was removed by applying a low-pass filter set at 30 Hz. ERPs were then computed in epochs that extended 200 ms before the first word of the markers to 500 ms after the onset of the last word of the proverbs (i.e., -200 to 4500 ms). Trials contaminated by blinks, eye-movements and/or excessive muscle activity were rejected off-line before averaging; a total of 22% of trials were lost due to such artifacts.

Three-way ANOVAs were conducted on the mean amplitudes at 9 separate regions of interest: one for each 500 ms word region in the proverbs, and one for each of the words comprising the markers. The primary factors of interest were context (figurative vs. literal-synonym vs. literal-overlap) and electrode site, both of which were within-participants variables. List was used as a between participant factor to stabilize variance caused by rotating participants across different lists. All p-values are reported after epsilon correction (Huynh-Felt) for repeated measures with greater than one degree of freedom. Table 2 displays the main effect of context and the context by electrode interaction for each region of interest. Table 3 shows the results of the simple main effects for context at these regions. Figure 1 shows the topographical distribution for mean amplitudes at all electrode sites, and Figure 2 shows the mean amplitudes at two sites located on the midline of the head.

Table 2: The main effect of context and context by electrode interaction at each region of interest.

Word Region	Context	Electrode X Context
1st Marker	F(2,54)=3.77*	F(122,3294)=2.10*
2nd Marker	F(2,54)=2.82#	F(122,3294)=1.79*
1st Proverb	F(2,54)=4.03*	F(122,3294)=2.01*
2nd Proverb	F(2,54)=6.61*	F(122,3294)=1.21
3rd Proverb	F(2,54)=3.68*	F(122,3294)=1.38
4th Proverb	F(2,54)=3.64*	F(122,3294)=1.62
5th Proverb	F(2,54)=3.05#	F(122,3294)=2.07#
6th Proverb	F(2,54)=3.66*	F(122,3294)=1.91
7th Proverb	F(2,54)=3.24*	F(122,3294)=1.93#

*$p < .05$, # = $.10 > p > .05$

Analysis for Markers

The analysis for the first word of the marker (i.e., literally, figuratively) demonstrated that the mean amplitudes for the literal condition with overlapping words was more positive than the other two conditions, which did not differ from one another. There was a significant context by electrode interaction. We investigated this interaction by conducting a 5-way ANOVA that again included context and list, but also included hemisphere (left vs right), laterality (lateral vs medial), and anteriority (prefrontal vs frontal vs parietal vs occipital). In this analysis, context interacted with anteriority, $F(6,162) = 3.55$, $p < .05$, and this interaction was modulated by a three-way interaction with hemisphere, $F(6,162) = 4.25$, $p < .01$. In these interactions, the literal condition with overlap was more positive than the other two conditions at anterior than posterior locations, and the three-way interaction demonstrated that these differences were larger over the right than left hemispheres.

Table 3: Simple main effects for context at each region of interest.

Region	Figurative vs. Lit-overlap	Figurative vs. Lit-synonym	Lit-overlap vs. Lit-synonym
1st Mark	F(1,54)=6.43*	F < 1	F(1,54)=4.76*
2ndMark	F < 1	F(1,27)=3.99#	F(1,54)=4.46*
1st Prov	F(1,54)=7.74*	F < 1	F(1,54)=3.52*
2ndProv	F(1,54)=11.83*	F(1,27)=7.50*	F < 1
3rd Prov	F(1,54) = 6.55*	F(1,27)=4.22*	F < 1
4th Prov	F(1,54)=50.33*	F < 1.85	F <1.85
5th Prov	F(1,54)=6.02*	F < 1	F < 2.2
6th Prov	F(1,54)=7.31*	F < 2	F < 1.7
7th Prov	F(1,54) = 6.47*	F < 1.5	F < 1.8

At the second word of the markers there was a two-way interaction between context and electrode site. The distribution ANOVA at this region revealed a three-way interaction between context, anteriority, and hemisphere, $F(6,162) = 3.20$, $p < .05$. This interaction occurred because the literal condition without overlapping content words was more negative than the other conditions at anterior locations, but was similar at posterior locations and, further, this difference was largest over the left than right hemispheres.

Analysis for words in the proverbs. Visual inspection of Figures 1 and 2 show a gradient in how negative the slow potentials were across the seven words of the proverbs, especially at anterior locations. Specifically, the amplitudes for the figurative condition were the most negative, followed by the literal condition without overlapping contents words, and the literal condition with overlapping words was the most positive. The main effect of context was either significant or marginally significant for all words in the proverbs. At every word location, the literal condition with overlapping content words was significantly more positive than the figurative condition, and also was significantly more positive than the other literal condition at the first word. The literal context without overlapping words was significantly more positive than the figurative condition

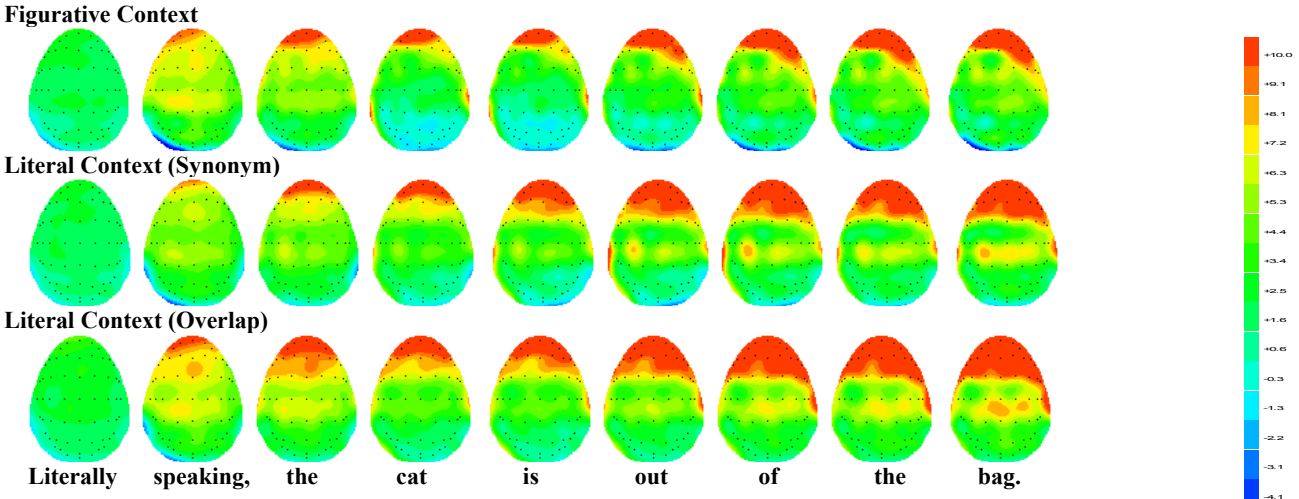

Figure 1: Topographical distribution of mean slow potential amplitudes in micro-volts at all electrode sites for each 500 ms word region starting at the first word of the markers through the last word of the proverbs for the three contextual conditions.

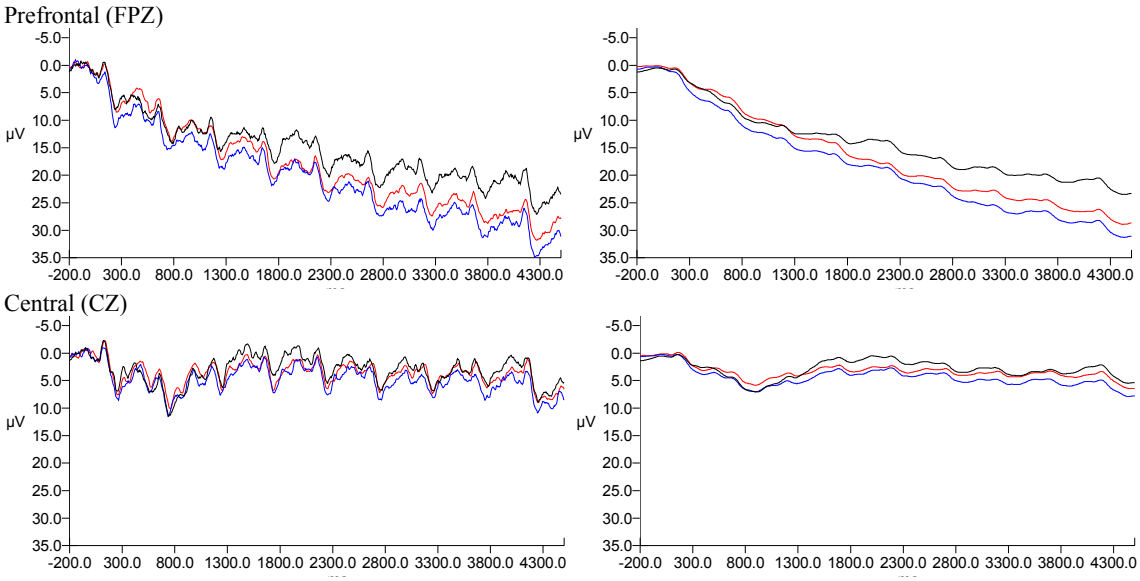

Figure 2: Mean amplitudes over the midline at one prefrontal (FPZ) and central (CZ) location filtered with a low pass filter set at 30 Hz (left columns) and at .7 Hz (right columns) to reveal the development of slow cortical potentials over the proverbs. The figurative condition is shown in black, the literal condition without overlap in content words in red, and the literal condition with overlap in content words is blue.

at the second and third word of the proverbs. The only significant interaction between context and electrode site occurred at the first word of the proverbs. The distribution ANOVA revealed a context by laterality interaction at the first word, $F(2,54) = 3.44$, $p < .05$. This interaction occurred because at lateral sites, the literal condition without overlapping words did not differ from the figurative condition, but at medial sites it was more positive. This two-way interaction was modulated by a three-way interaction with hemisphere, $F(2,54) = 3.66$, $p < .05$, which occurred because the increase in positivity at medial versus lateral sites for the literal condition without overlapping content words was larger over the right than left hemisphere.

Discussion

The results show that slow cortical potentials for proverbial statements at the front of the head were most negative for the figurative condition, followed by the literal condition without overlapping words, and were most positive for the literal condition with overlapping words. These results are consistent with recent ERP results that show that people have more difficulty integrating the figurative than literal

meanings of words into contexts (e.g., Coulson & Van Petten, 2002; Ferretti et al., under review). The present results also show that the markers, in combination with the literally and figuratively biasing contexts, influenced the processing of the familiar proverbs earlier than found in Ferretti et al. (under review). In that research, significant differences in slow potentials for figurative and literal conditions were not found until the third word of the proverbs, whereas in the present research, the same two contextual conditions (figurative and literal without overlapping content words) differed at the second word.

The addition of the literal condition with overlapping words show that people used these few words to quickly generate expectancies for the proverbs. First, the slow potentials for these markers was significantly different on the first word of the markers (i.e., literally) relative to the two other conditions. This finding is striking when one considers that across the 3 contexts, the sentence preceding the markers was identical, and that the other literal condition only varied on average by 2.5 content words. Further, the advantage of this condition over the other two conditions was found at the first word of the proverb, and in comparison to the figurative condition, remained throughout the proverbs.

The marker *literally speaking* clearly had a different influence on the literal condition without overlapping content words; people had the most difficulty integrating the markers by the second word of the marker (speaking) and the first word of the proverb. One possible reason for this effect is that readers were attempting to integrate the information from the marker with the preceding contexts prior to the proverbs, but because the content words did not overlap directly it lead to integration difficulty. Alternatively, it appears that for the figurative condition people cannot easily generate a figurative interpretation based on the markers until they receive the first few words the familiar proverbs. We admit that this explanation for the markers is speculative and that further research is needed to clarify these differences. We are currently conducting research that should clarify the nature of these early differences. In this research, we are directly comparing when the markers are present versus when they are absent.

Implications for Models of Figurative Language Processing

Our results are most consistent with models that assume we actively construct interpretations during discourse processing, rather than retrieve entrenched meanings from semantic memory (e.g., Coulson & Van Petten, 2002; Katz & Ferretti, 2001). The fact that we find differences in slow potentials on the markers and for the first few words of the proverb cannot be accounted for by models of figurative language processing which posit that the literal meaning of a statement must be processed prior to constructing a figurative meaning (e.g., Grice, 1975). The findings are also problematic for the graded salience hypothesis (Giora, 2003) that assumes obligatory access of salient meaning. This model would need to explain why the familiar (and hence salient) proverbs were not as easy, and maybe even easier, to integrate into the figurative context than into the literal contexts (especially when there were no overlapping content words).

In conclusion, our results indicate the utility of investigating slow-wave cortical potentials for the online investigation of figurative language processing and for investigating discourse processing in general. Furthermore, they show that explicit markers can have an immediate impact on how easily it is to integrate familiar proverbial statements into a developing discourse representation.

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