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The Effect of Idiomatic Language on Event Processing

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Abstract

Mental representations of object states are necessary to keep track of changing objects in the world. When the object undergoes change and there are two representations, it creates competition between the object states. This is seen in sentences during which an object changes and is then subsequently referred to again (e.g. “The chef will chop the onion. And then, he will sniff the onion.”). When there is a larger degree of change between the states of the object, there is more competition, which is indicated by an increase in reading time when the object is referred to for the second time. The current study investigates how idioms can affect this process. It was hypothesized that, in cases in which an idiom can be interpreted literally but is then followed by a sentence that refers back to the object in a literal sense (e.g. “The man will break the ice. And then, he will transport the ice.”), the competition resolution would take longer than in a sentence with substantial literal changes. In addition it was hypothesized that sentences with objects that undergo substantial literal changes will have more competition than sentences with objects that undergo minimal literal changes. There was a significant difference in reading times at the critical point between the idiomatic condition and the substantial and minimal conditions, indicating that the longer reading time meant the reader took longer due to the reevaluation of the sentence’s literal meaning.
Introduction

When one goes through the world, objects are constantly changing, so one must constantly update one’s mental representations of the objects. Representations of an object in its different states must be maintained during sentence comprehension to be selected from later. When referring back to an object in its unchanged state after it has been changed, there is competition between the two representations of the changed and unchanged object (Hindy, Altmann, Kalenik, & Thompson-Schill, 2012). For example, in the sentences “The squirrel cracked the acorn. And then, the squirrel sniffed the acorn.” the cracked and uncracked representations of the acorn are kept simultaneously in one’s mind, which creates competition.

In a fMRI study, Thompson-Schill, D-Esposito, Aguirre, & Farah (1997) compared brain activation during a Stroop task with brain activation while reading these sentences. The Stroop task is known to cause conflict due to competing representations of a stimuli, in this case, text and text color (MacLeod, 1991). When reading sentences in which there were two competing representations of a stimuli, such as a cracked and uncracked acorn, Thompson-Schill et al. (1997) found that there was activation in the same area (the left posterior ventrolateral prefrontal cortex). In addition, this activation was related to the degree of change between the two representations; specifically, the greater the degree of change between the two representations, the greater the activation.

Kalenik (n.d.) sought to determine where in the sentence the competition arises. The study had substantial change and minimal change sentences. Participants read the sentences using a self-paced reading task, and the competition between the object states was measured by how much the reader slowed down their reading pace at the second mention of the object. Because both object state competition resolution (i.e., the increase in reading/response time) and
Stroop task performance should measure individuals’ ability to resolve conflict, individual Stroop task performance was correlated with reading times. There was a greater increase in reading times for the substantial change sentences than the minimal change sentences, indicating more competition. The competition was also determined to be at the end of the second sentence, where the object in its second state is referred to.

The current study will investigate how figurative language may affect object state competition. Idioms are a type of figurative language that can sometimes have literal interpretations, such as the phrase “spill the beans”. Idioms that can be interpreted literally which also contain an object that undergoes change could potentially be susceptible to the object state competition effect if it were followed by another sentence which refers back to the object. This may increase the competition between the object states already present because the first object was not interpreted literally, but rather part of an idiom and a greater meaning. For example in these sentences: “The man will break the ice. And then, he will transport the ice.” If the first sentence was interpreted literally, there would be competition between the object states of the ice. However, the phrase “break the ice” is an idiom that means “start a conversation to eliminate silence and awkwardness between strangers”. Therefore, the reader would likely have to reinterpret the sentence and change their mental representation of the event to an event including actual ice.

Literature about idiomatic processing has determined that when one reads a idiom, it is read as easily as a literal sentence (McElree & Nordlie, 1999). In addition, the idiomatic meaning for an idiom is processed when one reads it; a literal interpretation is not considered first, as was originally believed (Glucksberg, Gildea, & Bookin, 1982). This means that whether or not the ice in the “break the ice” scenario (or any other objects in idioms) is interpreted literally or not is not
a concern. The first sentence will be interpreted figuratively, so there is a possibility for a difference in competition effects.

Previous studies have investigated competition between figurative and literal meaning when one reads an idiom, and as mentioned, the figurative meaning is dominant. However, the current study will investigate how idioms can affect object state processing, specifically, whether it affects competition between object state representations. It was hypothesized that there would be a greater increase in reading time at the end of the second sentence in substantial change sentences than in minimal change sentences, as found in Kalenik’s study (n.d.). In addition, there would be an even greater increase in reading times at the second mention of the object in the idiomatic sentences.

Methods

Participants

Participants were college students (N = 76) ages 17 to 23 from the University of Connecticut who received extra credit in their introductory psychology class for their participation. The study relies on familiarity with English idioms, so subjects (N = 25) whose first language was not English, or who didn’t speak English at least 90% of the time (self-reported in language history questionnaire) were eliminated before data analysis.

Procedure

After participants completed a language history questionnaire, the experiment began with a self-paced reading task on e-Prime software. The participant was given a Cedrus RB-840 Response Pad and told to press the yellow button after they finished reading the segment of the sentence on the screen. First, the participant would see the first segment of the sentence on the left side of the screen (“The man”) with the rest of the sentence substituted with dashes. When
they pressed the button, the first segment disappeared and the middle of the screen showed the second segment (“will break”), with dashes substituting the first and last segments. This happens with the last segment of the sentence and the procedure repeats with the second sentence in the pair (Figure 1). This methodology collected reading times to the millisecond for how long the participant spent reading each segment. After each pair of sentences, the participant was asked if the second sentence were plausible given the first. They were told to press the green button if the sentences were plausible, and the red button if they were not. Participants were told that plausibility meant that the scenario was possible, not necessarily that it was likely. In the second part of the experiment, all of the sentences they had read previously were randomly presented, and for each one the participant was asked to provide a rating on a Likert scale of 0-7 in response to the question “How much change does the object in this sentence undergo?”. Participants then typed a number in using the number keys on a keyboard.

Materials

The e-Prime script was adapted from a study using the same two sentence format as the current study that also explored object state-change competition using a self-paced reading task (Kalenik, n.d.). The current study used the same measure of increased reading time as an indication of competition.

There were three conditions in the self-paced reading portion of the experiment. The idiomatic condition had a figurative sentence (containing the idiom) followed by a literal sentence. For an example, “The man will break the ice. And then, he will transport the ice.” The substantial condition had two literal sentences in which the object undergoes a large change. For an example, “The man will chop the ice. And then, he will transport the ice.” The minimal
condition also had two literal sentences, but the object underwent a small change. For an example, “The man will pick up the ice. And then he will transport the ice.”

Norming on Qualtrics from the same population of University of Connecticut undergraduates was done to collect change ratings for each condition to ensure that the substantial condition had a higher degree of change than the minimal condition (Table 1). All of the first sentences from all conditions were presented, balanced so that the one person would not be rating the matching sentences from the other two conditions. They were asked to rate how much the object changes on a scale from one to seven. In the idiomatic condition, they were asked both how much the object changes in the figurative and the literal interpretation.

The idiomatic stimuli were chosen from a bank of 171 normed idioms (Titone & Connine, 1994). The idioms have been normed and analyzed on the basis of four dimensions. One is familiarity, or how often one comes across the idiom in normal life. This data as is from 1994 and probably not accurate for the sample of participants tested, so norming was done for idiom understanding with University of Connecticut undergraduates on Qualtrics. Students were first asked to give an open-ended interpretation regarding how they interpret the sentence. They were then asked if they would interpret it idiomatically, and whether they understand the meaning of the idiom or not. If they answered yes, they had to provide a written response indicating what the meaning is, and if they answered no, they had to provide a guess for what the idiom means. Only idioms that were interpreted idiomatically a minimum 65% of the time were used.

Another dimension was compositionality, or the degree to which the literal meanings of the words that make up the idiom are related to the meaning of the idiom. The idioms “save your skin” or “cover your tracks” are highly decomposable because the parts “save” and “cover”
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relate to the idiomatic meaning of the idiom. Another is predictability, or the probability of completing an incomplete phrase with the idiom. For example, if given “break the _” would one fill it with “ice”? Compositionality and predictability dimensions were not considered for the purposes of the current study. Finally, there is literality, which is the idiom’s potential to be interpreted literally (Titone & Connine, 1994). “Kick the bucket” is an example of an idiom with high literality, because it can easily be taken literally with the meaning of a bucket being kicked. Idioms in this study have high literality since there must be a literal interpretation that will include an object that can literally undergo change (such as a bucket). An idiom like “crack a joke” will not be used because it has very low literality since you cannot actually crack a joke, because a joke is not an actual object.

In addition to the stimuli from the three conditions, there were filler sentences that served to keep the idiomatic interpretations of the idioms active despite multiple sentences where the idiom turns out to be literal. For example, “The woman will bring home the bacon. And then, she will pay the bills.” The sentence does not turn out to be about literal bacon as it does in the idiomatic condition.

Results

Reading times for the sentences were compared between the three conditions (Figure 2). Critically, reading times for the last segment of the second sentence (e.g., “the bucket”) were compared using t-tests between all three conditions (Figure 3). Comparisons between conditions were done by subjects and by items. Eliminating participants based on their accuracy on the plausibility questions had no effect. The data was skewed but log transformations did not have an effect on data analysis.

By Subjects Analysis
Paired t-test were performed to compare each condition. There was a significant difference between the reading times for the idiomatic and substantial condition ($M$ idiomatic = 1518 ms, $SD = 663$ ms; $M$ substantial = 1274 ms, $SD = 527$ ms; $t = -2.98$, $p = 0.000$). There was also a significant difference between the reading times for the idiomatic and minimal condition ($M$ minimal = 1202 ms, $SD = 459$ ms; $t = -4.11$, $p = 0.000$). There was no significant difference between the substantial and minimal conditions ($t = -1.21$, $p = 0.160$).

By Items Analysis

Paired t-tests were performed to compare each condition. The only significant difference here was between the idiomatic and substantial condition ($t = -3.00$, $p = 0.000$).

Degree of Change Ratings

Correlations between normed data for degree of change in the stimuli and reading times were performed to investigate the association of degree of change with the time it takes to resolve competition. There was no significant correlation between the degree of change and reading time for the idiomatic condition when the idiom was interpreted figuratively ($r = 0.17$, $p = 0.42$), the idiomatic condition when the idiom was interpreted literally ($r = 0.20$, $p = 0.17$), the substantial condition ($r = 0.05$, $p = 0.73$) or the minimal condition ($r = -0.09$, $p = 0.52$).

Discussion

There was a significant difference between the idiomatic condition reading time and the substantial and minimal condition reading times at the critical part of the sentence (the second referral to the object), but not between the substantial and minimal conditions. This means that there can be no inferences made about the object state competition because it is not clear that object state competition was resolved any faster for objects that change minimally than for objects that change substantially. This may be because subjects become accustomed to the
formula of the sentences. If the reader knows they do not have to think back to the original state of the object because the sentences always transition with “and then”, they may not be holding both representations of the changed and unchanged object states simultaneously. Kaleni (n.d.) included another sentence format, using “but first” in addition to “and then” for some sentences, but the only significant differences were in the “and then” conditions. The lack of variety in the current study may be the reason it did not replicate Kalenik’s findings of significant differences in reading time at the point of competition resolution.

The significant difference between the idiomatic condition and the substantial and minimal conditions is likely because it took longer for participants to finish reading the end of the sentences in the idiomatic condition because they had to reevaluate what the first sentence meant. Instead of interpreting it idiomatically, they have to change their original mental representation of the event to a literal representation of the words. This would increase reading times.

There were also several limitations to the study. One came from typographical errors in the stimuli of the experiment. Another limitation was the methodology used. The self-paced reading task relied on an unnatural method of reading sentences (button-pressing) which may not have been a completely accurate way of measuring time spent reading each segment. An eye-tracking study could record more accurate measurements for how long participants spend reading the sentences.

In addition, the critical segment of the sentence was at the very end of the second sentence, and research has shown that people slow down when reading the ends of a sentence or group of sentences (Rayner, Kambe, & Duffy, 2000). This is known as a wrap-up effect. Although the sentences were consistent in the placement of the critical point at the end of the
pair of sentences, this may have further confused the response times at the end of the sentences.

Further studies could add another sentence after the sentence pairs to eliminate this confound.
References


Figures and Tables

Table 1.  

*Stimuli Change Ratings*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Idiomatic (Figurative interpretation)</td>
<td>3.35</td>
<td>0.68</td>
</tr>
<tr>
<td>Idiomatic (Literal interpretation)</td>
<td>2.96</td>
<td>1.15</td>
</tr>
<tr>
<td>Substantial</td>
<td>4.33</td>
<td>0.89</td>
</tr>
<tr>
<td>Minimal</td>
<td>1.88</td>
<td>0.91</td>
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</table>
The man will break the ice. And then, he will transport the ice.

Figure 1. Self-paced reading task stimuli presentation.
Figure 2. Comparisons of reading times by the segment of the sentence.
Figure 3. Reading times at the second mention of the object in the second sentence. (e.g. “The man will break/chop/pick up the ice. And then, he will transport the ice.”)