Comprehension of non-conventional indirect requests: An event-related brain potential study

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Event-related brain potentials (ERPs) were used to examine the real-time processing of non-conventional indirect requests and literal statement control stimuli in 20 healthy adults. Participants read short story scenarios ending in a 7-word target utterance that could be interpreted either literally, as a statement, or non-literally, as an indirect request, depending on the prior discourse contexts. For example, in a story about a couple in a restaurant, *My soup is too cold to eat* serves a literal statement about the temperature of the soup when said by a woman to her husband, but serves as an indirect request when the woman makes the same statement to her waiter. Differences in ERPs to literal statements and indirect requests emerged at the second and third words of target sentences, suggesting memory retrieval demands were greater for indirect requests. ERPs to the fifth word of target sentences also differed, as this was the point at which the exact nature of the request was evident to readers. Over-sentence ERPs revealed a low frequency positivity that was larger for indirect requests, suggesting that the construction of the situation model was easier for requests than for literal statements. Results support the claim that pragmatic cues have an early influence on sentence processing, and that prior models of figurative language processing, such as those derived from the Standard Pragmatic Model, are insufficient to describe indirect request processing. The data of the current study support a model in which the literal meaning of an utterance is understood in both conditions, but that when the utterance is meant as an indirect request, transient processing costs occur as language users exploit pragmatic cues such as discourse context, world-knowledge of social conventions, and speaker status.

Keywords: ERP, experimental pragmatics, indirect requests, neurolinguistics, neuropragmatics

1. Introduction

An indirect request is a common form of non-literal communication in which an interrogative regarding an addressee's ability, or an indicative utterance about the state of the world, is interpreted as a request that the addressee perform an action. Searle (1975), for example, points out that the locutionary force of *Can you pass the salt?* con-

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cerns the addressee's ability to pass the salt, while its illocutionary force is a request for the addressee to pass the salt to the speaker. Known as a *conventional indirect request*, this highly entrenched form may be motivated by considerations of politeness, allowing the addressee to opt out of the request by replying to the literal content of the question (e.g., *No, my arm is broken* or *No, it's out of my reach*) (Brown & Levinson 1987).

Non-conventional indirect requests involve statements whose illocutionary force derives not from their form, but rather from the relationship between the speaker, the statement, and the context of utterance. For example, imagine that a woman and her husband are having dinner in a nice restaurant. A waiter comes to their table, the couple orders, and eventually the waiter returns with a bowl of soup for the woman and a salad for the man. The woman then tastes her soup, looks up at the waiter with a somewhat disappointed countenance, and says *My soup is too cold to eat.* Such negative state remarks are commonly interpreted as requests when the speaker is of higher social status (e.g., customer vs. waiter) and the interaction occurs in a particular cultural setting (e.g., a restaurant) (Holtgraves 1994).

Neuropragmatics research on this topic has focused almost exclusively on the import of an intact right versus left cerebral hemisphere for the comprehension and production of conventional indirect requests. This literature suggests while the processing of indirect requests is compromised by damage to either side of the brain, an intact right hemisphere is particularly important for deriving the contextually appropriate meaning of an indirect request (Hirst et al. 1984; Weylman et al. 1989). Although early research on this topic has been criticized for its failure to formally characterize the criteria for identifying requests (see e.g., Joanette et al. 1990; Stemmer 1994 for a critique), more rigorous studies have shown that patients with damage to the right hemisphere show an over-reliance on conventional indirect request forms in their production, and have difficulty in the comprehension of non-conventional requests, especially when interpretation relied heavily on contextual information involving conversational principles and social norms (Brownell & Stringfellow 1999; Stemmer et al. 1994).

Past research on the neural substrate of indirect request processing thus indicates the importance of the right hemisphere for the utilization of contextual information in the construction of the situation model. However, it does little to discriminate between several relevant models of the processing of non-literal language – models whose differences lie in predictions regarding the relative time course of the construction of literal relative to non-literal meanings. For example, the most prominent model of indirect request processing is the two-stage, or Standard Pragmatic Model derived from work in pragmatics by Grice (1975) and Searle (1975). According to this model, language users first compute the literal meaning of an utterance to determine its contextual appropriateness; if inappropriate, the language user uses the cooperative principle to infer the speaker's communicative intention (Clark 1979; Clark & Lucy 1975). A variant of the standard model, the Graded Salience Hypothesis, argues that the initial reading need not be the literal one, but rather the salient one, where salience is a function of frequency and recency (Giora 2003). As conventional indirect requests are highly frequent, the most salient reading of e.g., *Can you pass the salt?* is in fact its request meaning. Consequently, the Graded Salience Hypothesis predicts that the initial reading of this utterance is as a request; its interpretation as a question about the speaker's salt-passing ability will, by contrast, arise only if prompted by contextual demands.

Other models of indirect request interpretation argue against this two-step approach, and stress the import of context in the development of an on-going interpretation. The Direct Access Model, for example, suggests that in appropriately constraining contexts, it is possible to entirely by-pass the literal meaning, constructing only the request reading (Gibbs 1994). The Constraint-based Model suggests that multiple sources of information (including lexical factors such as word frequency as well as higher level contextual considerations) are concurrently applied as literal and figurative meanings compete in parallel for activation (Katz & Ferretti 2001).

2. The present study

Given the importance of issues regarding the time course of meaning construction for processing models of indirect requests, the present study utilized event-related brain potentials (ERPs) to provide a real-time measure of brain activity temporally correlated with the comprehension of statements interpreted either literally, or as indirect requests. The ERP is a non-invasive measure of electrical brain activity that has proven to be a useful tool for studying cognitive and language processes. It provides a link to the neurobiology of behavior, it has a high temporal resolution, and it often allows the investigator to draw inferences about the cognitive nature of observed processing differences.

The present study was designed to record ERPs from healthy participants during the comprehension of non-conventional indirect requests in strongly supportive story contexts. Materials were adapted from a behavioral study of reading time comprehension reported by Holtgraves (1994). As such, the target sentences were negative state remarks, statements such as *My soup is too cold to eat* or *It's getting kind of dark in here* that either indicate a problem as perceived by the speaker, or identify one of the speaker's desires. Target utterances were preceded by one of two very similar scenarios that differed only in pragmatic cues that served to render the utterance an indirect request (e.g., for a new bowl of soup, or for someone to turn on a light), or a literal statement (e.g., about the temperature of the soup, or the lighting conditions). These pragmatic cues included the status of the interlocutor (e.g., fellow customer vs. waiter), the locations of interlocutors (e.g., close to as opposed to far away from a light switch), and frame or schema (e.g., workplace, restaurant, etc.).

Recording ERPs as healthy adults read target utterances in these different kinds of contexts thus allowed us to compare brain activity to the same sentences used either literally or as indirect requests. Whereas many ERP language researchers compare ERPs to one or two critical words in a sentence, in the present study we compared ERPs to each word in our 7-word target utterances to identify the point in a sentence when processing diverged for literal statements and indirect requests. The direct access view predicts processing differences from the very beginning of the target utterance; the standard model predicts processing differences would be confined to the sentence-final words.

We also hoped to illuminate the cognitive nature of any observed processing differences between literal and non-literal language by examining which known language ERP components were modulated. For example, the N400, a negative-going centro-parietal waveform observed between 300 and 500 ms after word onset, is typically interpreted as indexing the difficulty of semantic integration; the left anterior negativity (**LAN**), also observed 300-500 ms post-onset, is typically interpreted as indexing the degree to which working memory is taxed (for reviews, see Coulson 2004; Coulson 2007). Modulations of the N400 or the LAN would thus signal that understanding requests makes demands on semantic integration and working memory processes, respectively. Also of interest, is a late positivity that follows the N400 component, possibly indexing non-literal language processing that requires the retrieval of additional semantic information from long-term memory (Coulson & Van Petten 2002).

Besides phasic ERPs to individual words in a sentence, temporally extended tasks such as reading or speech comprehension also elicit electrical changes with a slower time course, and may index neural activity related to the construction of the situation model (Kutas & King 1996). In order to examine these slow cortical potentials, it is necessary to average several seconds worth of data (viz. average EEG that begins at the onset of a particular class of language stimuli and ends several seconds later), and apply a low-pass filter to the ERP data. Slow cortical potentials have been shown to be sensitive to the demands of sentence processing in subject- versus object-relative clauses (King & Kutas 1995; Mueller et al. 1997), and in sentences such as *After she climbed the ladder, she fixed the roof* whose form iconically corresponds to the order of the events it describes, versus sentences of the form 'Before X, Y' that present two events in a different order from that in which they occurred (Münte et al. 1998). Moreover, Ferretti et al. (2007) observed differences in the amplitude of a frontally focused slow cortical potential elicited by proverbs in contexts where they applied literally versus figuratively.

In the present study, we time locked ERPs to the first word of target utterances to examine differences in slow cortical potentials elicited by literal statements and indirect requests. Given that the interpretation of non-literal meanings is assumed to be more taxing than literal ones, we might expect indirect requests to elicit less positive slow potentials than literal statements. Moreover, the direct access view predicts these differences will emerge at the beginning of the utterance, whereas the standard model suggests such differences would only be evident at the end of the sentence.

3. Experiment

3.1. Method

Participants. Twenty right-handed, monolingual, native English speaking UCSD undergraduate volunteers (10 women, 18 to 29 years of age, mean age 21.2, s.d. = 2.94, s.e. = 0.80), with normal or corrected to normal vision and no history of reading difficulties or neurological disorders, participated in this experiment in partial fulfillment of a course requirement.

Materials. The stimuli consisted of 60 pairs of short (3-4 sentence) scenarios, each followed by a target utterance and a comprehension probe. One scenario of each pair biased the final target utterance to be interpreted as an indirect request, and the other, slightly different scenario, biased a purely literal interpretation of the exact same target utterance. The target utterance was followed by a comprehension probe that participants were asked to judge for its plausibility as a continuation of the vignette they had just read (see Tab. 1 for a sample stimulus pair and Tab. 2 for examples of target utterances). Four lists were constructed such that any given participant saw each of the 60 target utterances only once, 30 preceded by the indirect request context, and 30 preceded by the literal context. In each list, approximately half of the targets in each condition were followed by an expected probe and half by an unexpected one.

Table 1. Sample stimulus pair.

Indirect Request context
Scenario: *Diane and her husband Bill were celebrating their wedding anniversary and started the evening off with dinner at a restaurant. After they had ordered, the waiter soon brought out a bowl of soup for Diane and a salad for Bill. After tasting her soup, Diane said to the waiter,* Target: *My soup is too cold to eat.* Comprehension probe (expected): *The waiter soon came back out with a new bowl of hot soup to replace Diane's cold soup.* Comprehension probe (unexpected): *The waiter rolled his eyes and muttered something about the bourgeoisie.*
Literal context
Scenario: *Diane and her husband Bill were celebrating their wedding anniversary and started the evening off with dinner at a restaurant. After they had ordered, the waiter soon brought out a bowl of soup for Diane and a salad for Bill, and then returned to the kitchen. After tasting her soup, Diane said to her husband,* Target: *My soup is too cold to eat.* Comprehension probe (expected): *Bill frowned and said she should send it back.* Comprehension probe (unexpected): *The waiter soon came back out with a new bowl of hot soup to replace Diane's cold soup.*

Table 2. Examples of target utterances.

It's getting kind of dark in here.
I'm having a double shot of whiskey.
It's really kind of cold in here.
We could use some water in here.
This shirt is too big for me.
I can't reach that box up there.
Actually, it will look better over there.
I'd like my hair short on top.
The café is closing for the night.
The backyard fence needs to be painted.

All materials were tested in a normative study conducted prior to the ERP experimental phase, using different participants drawn from the same population. Participants in the norming study read each scenario on the questionnaire and were asked to decide whether the final statement (i.e., the target), contained in quotation marks, was meant as a literal statement of fact, or as a request for the hearer to do something. On a scale from 1 (obviously a request) to 5 (purely a literal statement), the average rating for the indirect request scenarios was 1.9 (s.d. = 0.4) versus 4.1 (s.d. = 0.5) for the literal context scenarios.

Procedure. Participants sat in an electrically shielded, sound-attenuated chamber and read stimuli on a computer monitor while their EEG and EOG data was recorded. Each scenario was presented on a single screen, and participants were instructed to move their eyes freely while reading them. Each scenario was presented for a variable period of time calculated as a direct function of the scenario length (270 ms/word). Following each scenario, the target utterance was preceded by a fixation cross, presented for 1000 ms, to orient the participant to the center of the screen. Each word of the target utterance was then presented in the center of the screen for 200 ms and followed by 300 ms of blank screen. The final word of the target was followed by a blank screen for 2300 ms before the presentation of the probe sentence. The probe sentence was presented for 6 s, and then followed by a blank screen for 2 s until the next trial began.

Participants' task was to carefully read each scenario, and to minimize blinking during the presentation of the target utterances. Upon presentation of the probe sentence, participants were asked to press one button if it served as an expected, and another to indicate the probe was an unexpected, continuation of the story they had just read (see Tab. 1 for both expected and unexpected probe sentences). Response hand was counterbalanced across participants. This probe task ensured that participants did indeed understand the utterance as either a literal statement or a request in the given context, and encouraged them to focus on the materials.

EEG Recording. Electroencephalogram (EEG) was recorded from twenty-nine tin electrodes mounted in an Electro-Cap, referenced online to the left mastoid, and later re-referenced to the average of the right and left mastoids. Horizontal eye-movements were monitored via electrodes place at the outer canthus of each eye and referenced to each other. Blinks were monitored via an electrode placed below the right eye. The recorded EEG was processed through SA Instrumentation Co. amplifiers set at a band pass of 0.01-40 Hz as it was continuously digitized at a sampling rate of 250 Hz and stored on a local hard disk.

Data Analysis. Grand average ERPs time-locked to the beginning of each word in the target utterance were computed for recording epochs extending from a 100 ms pre-stimulus onset baseline to 920 ms post-stimulus onset. The average artifact rejection rate for words in the request condition was 19% (s.d. = 4.2), and was 23% (s.d. = 6.1) for words in the literal condition. Due to the relatively small number of stimuli in each condition (30), all artifact-free trials were included in the averages, irrespective of whether the participant correctly answered the subsequent comprehension probe. Averages of artifact-free ERP trials were calculated for each of the seven words in the target utterance in both conditions after subtraction of the 100 ms pre-stimulus baseline. Long-epoch (4-second) grand average ERPs were also computed over the time-window extending 3680 ms post stimulus-onset, after subtraction of the 400 ms pre-stimulus baseline in order to look at any effects developing and extending over the seven words of each target utterance. For the purposes of statistical analysis, the ERPs were quantified by employing software that measures the mean amplitude of the waveforms in microvolts during the time-epochs specific to this experiment. These measurements were subjected to repeated measures ANOVA. All p-values were corrected using the Huynh-Feldt correction when sphericity assumptions were violated (Huynh & Feldt 1976). However, for clarity original degrees of freedom are reported.

4. Results

4.1. Comprehension probe accuracy

Performance on the comprehension probes was relatively high. Out of 60 possible correct responses, scores ranged from 46 (76.7%) to 59 (98.3%) correct (mean = 51.7 (86.2%); s.d. = 5.67, s.e. = 0.86). These results indicate that participants were able to focus on the materials, and to comprehend the scenarios and target sentences in the manner intended.

4.2. Slow cortical potentials

As in Ferretti et al. (2007), slow cortical potentials were quantified by measuring the mean amplitude of waveforms measured 0-500 ms (word 1), 500-1000 ms (word 2), 1000-1500 ms (word 3), 1500-2000 ms (word 4), 2000-2500 ms (word 5), 2500-3000 ms (word 6), and 3000-3500 ms (word 7). Indirect requests elicited more positive waveforms than did literal statements (see Fig. 1).

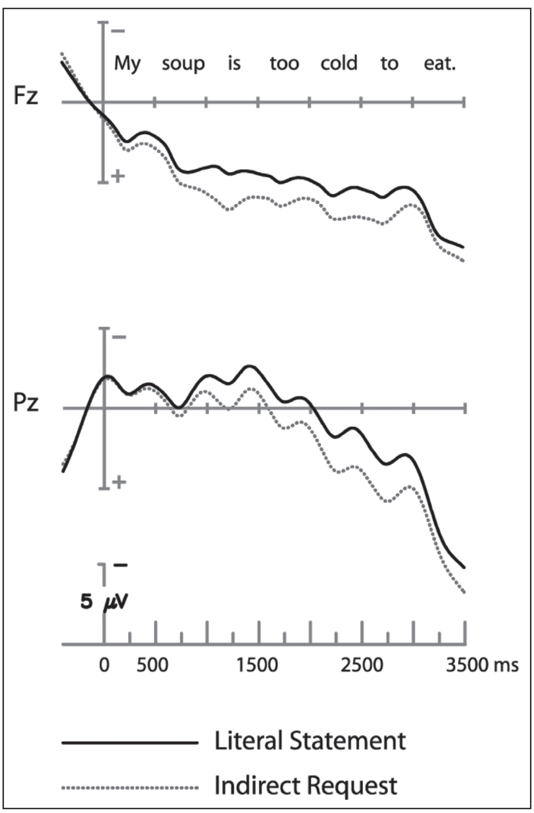

Figure 1. Slow cortical potentials time-locked to the first word of target utterances, with event-related potentials (ERPs) to literal statements plotted in solid, and indirect requests in the dotted line. Each graph shows voltage (on the y-axis) as a function of time (on the x-axis). By convention negative voltage is plotted upwards. The upper graph shows brain activity recorded from electrode Fz, a midline electrode over frontal cortex; the lower graph was recorded from electrode Pz, a midline electrode over parietal cortex. ERPs to indirect requests were more positive than literal statements between the second and the sixth word of 7-word target utterances.

The amplitude of this positivity differed reliably as a function of discourse context 500-1000 ms (word 2) [Sent. Type $F(1,19) = 5.12$, $p < 0.05$], 1000-1500 ms (word 3) [Sent. Type $F(1,19) = 7.85$, $p < 0.05$], 1500-2000 ms (word 4) [Sent. Type $F(1,19) = 4.78$, $p < 0.05$], 2000-2500 ms (word 5) [Sent. Type $F(1,19) = 6.90$, $p < 0.05$] and 2500-3000 ms (word 6) [Sent. Type $F(1,19) = 4.89$, $p < 0.05$] after sentence onset. This effect was broadly distributed over the scalp and slightly larger toward the front of the head. There were no significant effects either in the 0-500 ms interval (word 1), or 3000-3500 ms (word 7). Slow cortical potentials thus began to diverge at the second word of the sentence, but had converged again by the sentence-final word.

4.3. Event-Related Potentials to words in target utterances

While there were no significant effects found at word 1, there was a significant interaction of sentence type with electrode site at word 2 in the 700-900 ms time-region [Sent. Type x Electrode Site $F(28,532)= 2.52$, $pHF < 0.05$, $e = 0.1901$], as well as a significant effect of sentence type at word 3 in the 700-900 ms time-region [Sent. Type $F(1,19) = 4.68$, $p < 0.05$]. These late positive component (**LPC**) effects were due to the ERPs to requests being more positive than to literal statements late in the epoch (Fig. 2). This effect at word 2 was largest over the right hemisphere at centro-parietal sites, while at word 3 it had a bilateral centro-parietal distribution.

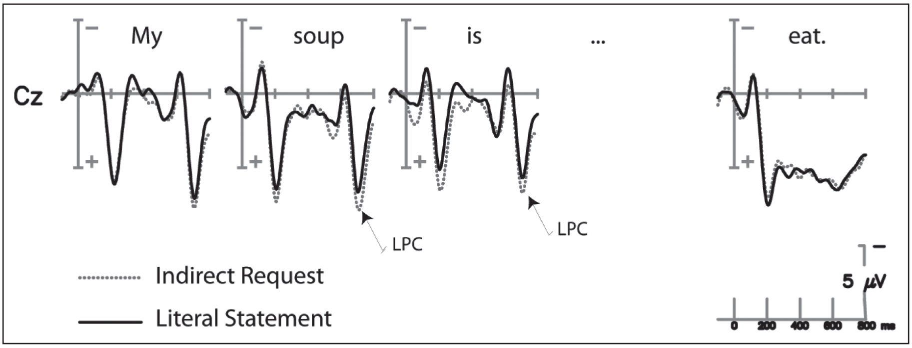

Figure 2. Phasic ERPs time-locked to the onset of the first, second, third, and final word of target utterances. Data was recorded from Cz at the vertex of the scalp, an electrode where the late positive component (LPC) is prominent. Indirect requests (dotted line) elicited larger LPC than literal statements (solid line) in the second and third word of target utterances. Note that by convention, negative voltage is plotted upwards.

The data also revealed a marginal effect of sentence type at word 3 in the 400-700 ms time region [Sent. Type $F(1,19) = 3.40$, $p = 0.08$]. There seem to be some baseline issues however, in that the ERPs in each condition begin to diverge at word-onset at some sites, possibly due to a carryover from the late positivity elicited by word 2. These findings are congruent with the over-sentence ERP findings in which there was a significant effect of sentence type at words 2 and 3, but not word 1.

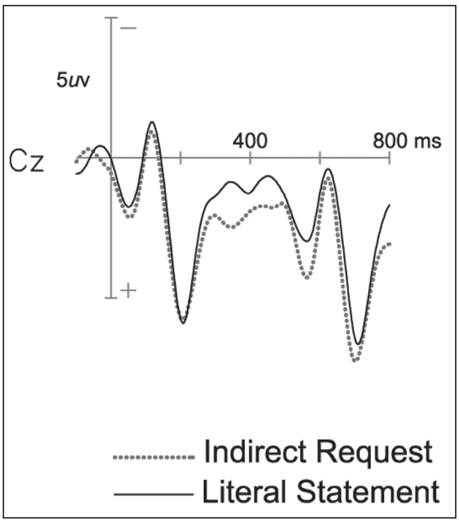

Figure 3. Phasic ERPs time-locked to the onset of the fifth word in target utterances. On average, the fifth word was the point in the sentence where the exact nature of the request became evident. ERPs to literal statements (solid line) were more negative than to indirect requests (dotted line). By convention, negative voltage is plotted upwards.

At word 5, there was a significant effect of sentence type in the 400-700 ms time-window [Sent. Type $F(1,19) = 5.57$, $p < 0.05$], as ERPs to literal statements were more negative than indirect requests (Fig. 3). This effect appears to be largest at frontal and fronto-central electrode sites. At words 4, 6, and 7, there were no significant effects found during the single word analyses. Similarly, single word analyses revealed no significant effects in the 300-500 ms (N400) time window for any of the words.

5. Discussion

The present study suggests that the exact same sentence induces different brain activity depending on whether it can be interpreted as a literal statement or as an indirect request. In this study, ERPs were recorded as healthy adults read seven-word target utterances such as *My soup is too cold to eat* presented after minimally different story contexts, one designed to invite interpretation as a literal statement (e.g., about the temperature of the soup), the other as an indirect request (e.g., that the addressee heat up the soup). Story contexts were thus 3-4 sentence scenarios that varied pragmatic cues such as the status of the interlocutor (e.g., fellow customer vs. waiter), the locations of interlocutors (e.g., close to as opposed to far away from a light switch), and frame or schema (e.g., workplace, restaurant, etc.).

Target utterances designed to invite interpretation as indirect requests elicited ERPs that differed at a number of points in the sentence from those designed to be interpreted as literal utterances. Relative to literal statements, the second and third word of indirect requests elicited a larger LPC 700-900 ms after word onset. Further, the fifth word of literal statements was more negative 400-700 ms than indirect requests, especially over anterior scalp regions. Finally, slow cortical potentials elicited by indirect requests were more positive than those elicited by literal statements, between the second and sixth word of our 7-word target utterances.

The LPC to requests 700-900 ms observed at words 2 and 3 is likely due to the reader drawing on information presented in the preceding story context. Similar late positivities have been observed in a number of studies of figurative language comprehension. For example, Coulson & Van Petten (2002) found larger late positivities for metaphorical than literal meanings of the same words. Larger positivities were interpreted as indexing the retrieval of information from semantic memory necessary for the correct interpretation of the metaphors.

Similarly, the critical words in one-line jokes have elicited larger positivities than words in non-funny control stimuli matched for word length, word frequency, and expectedness in the sentence context (Coulson & Kutas 2001; Coulson & Lovett 2004; Coulson & Williams 2005). Moreover, joke-related probe words (such as *infidelity*) elicited larger positivities after jokes (*A replacement player hit a home run with my girl*) than non-funny controls (*A replacement player hit a home run with my ball*) (Coulson & Wu 2005).

The thing that unites metaphors, jokes, and the non-conventional indirect requests used in the present study is the importance of situational context and real-world knowledge for correctly inferring the speaker's intended meaning. The late positivity may thus index neural processing underlying the retrieval of contextually relevant information and its integration into the situation model. In the present study, where pragmatic cues in the prior discourse contexts allowed the reader to anticipate a request, participants may have been activating information in long-term memory to predict what might happen next (e.g., activating the restaurant script in which waiters routinely perform actions requested by the customers), and this cognitive activity was reflected in the late positivity. The larger LPC observed for indirect requests suggests the retrieval and integration demands were greater for sentence intermediate words in these stimuli than for the literal statements.

Besides the late positivities to indirect requests observed early in the sentence, another phasic ERP effect was observed at word 5, namely ERPs to words in literal statements were more negative than those to indirect requests between 400 and 700 ms after the onset of the word. Interestingly, the critical word in target utterances was (on average) the fifth word of the sentence (see Tab. 2 for examples of target utterances). Thus, the precise nature of the indirect request often became clear at the fifth word of the sentence.

This negativity occurs slightly later than other well-known negative ERP effects such as the N400 and the LAN. Moreover, its prominence over frontal scalp differentiates it from the N400 (typically largest over centro-parietal sites), and its bilateral distribution differentiates it from the LAN (larger over the left hemisphere). The scalp distribution of the observed negativity bears some resemblance to the referential context effect reported by Van Berkum and colleagues (Van Berkum et al. 1999; Van Berkum et al. 2003), in which noun phrases (e.g., *the girl*) elicited larger frontal negativities in discourse contexts with multiple possible referents (e.g., a story with more than one girl) than in contexts with a unique referent (e.g., a story with a single girl). However, in the present study, a larger negativity was observed to literal statements than to requests, making it unlikely that the observed negativity derives from referential ambiguity – presumed to be greater in the indirect requests than the literal statements.

We suggest that the frontal negativity to literal statements is most similar to the concreteness effect first reported by Kounios & Holcomb (1994). Concrete words such as *bicycle* and *watermelon* have been found to elicit larger frontal negativities 300-700 ms post-word onset than abstract words such as *honesty* and *bravery* with similar word length and frequency (e.g., Holcomb et al. 1999). Moreover, recent research suggests concreteness effects can be induced by placing the same noun (e.g., *book*) in contexts that emphasize its concrete (e.g., *green book*) versus abstract (e.g., *interesting book*) characteristics (Huang et al. 2010). In the present study, discourse context may have rendered a more concrete reading of adjectives such as *cold* when they were interpreted as literal statements than when they were indirect requests. At *cold*, the reader may imagine the coldness of the soup in the literal statement, while, in the indirect request, *cold* serves as an important clue to the speaker's intentions.

Finally, the long over-sentence averages shown in Fig. 1 reveal a larger positivity to indirect requests as compared to literal statements, beginning at word 2 and resolved by the end of the sentence. Similar low-frequency over-sentence effects have been argued to index ease of processing (King & Kutas 1995), perhaps due to reduced demand on working memory (Münte et al. 1998). Our finding of more positive slow potentials to sentences interpreted as indirect requests than literal statements may suggest message-level processing was actually less taxing in the non-literal (indirect request) condition than it was in the literal condition. This differs from prior work with proverbs, in which slow cortical potentials were more positive for proverbs interpreted literally than figuratively. However, the scenarios in the present study were designed specifically to promote a reading of target utterances as indirect requests, and as such may have served as particularly constraining contexts, rendering the requests easier to process than the literal statements.

The findings of the present study are thus not easily commensurable with any of the existing models of indirect request comprehension. Data argue most clearly against the two-stage (or Standard Pragmatic) Model, in which the literal meaning of the entire utterance is computed first, followed by the application of pragmatic considerations. This model predicts substantial differences in brain activity only at the final word of the sentence. In fact, no ERP effects were observed at sentence final words. More importantly, we *did* detect differences in brain activity beginning at the second word of the sentence, indexing comprehension differences at both word- and the message-levels of processing. In keeping with work by Van Berkum and colleagues (see Van Berkum 2009 for a review), these data suggest that rather than being confined to the sentence wrap-up stage, pragmatic factors such as discourse context can influence the real-time processing of sentences themselves.

Results are more compatible with the direct access (Gibbs 1994) and constraint satisfaction (Katz & Ferretti 2001) models that propose an early impact of discourse context on the computation of non-literal meaning. In positing a discreet distinction between literal and non-literal meanings, however, such models are insensitive to the role of literal meaning for the construction of a contextually relevant non-literal meaning (Coulson & Matlock 2001; Coulson & Oakley 2005). For example, in the story about the couple having dinner together, it is possible to infer that the woman's remark is a request simply by integrating the fact that it is addressed to the waiter with salient aspects of the contextually activated restaurant schema. However, the phrase *My soup* allows the waiter (and the reader) to infer that the request involves the woman's soup; and *is too cold to eat* allows the waiter (and the reader) to infer that the new bowl of soup should be hot. The import of the literal meaning is thus not its irrelevance (as suggested by Grice 1975), but rather its relevance for deriving an appropriate inference about the speaker's request (Sperber & Wilson 1995).

6. Conclusions

In sum, ERPs to the very same utterances differed as a function of whether they were interpreted as literal statements or indirect requests. Results argue against the Standard Pragmatic Model, as differences in brain activity emerged as early as the second word in the utterance, and were not evident at the sentence-final word. Phasic ERPs to the second and third words of the utterances suggest requests prompted more retrieval of information from semantic memory than did literal statements, while ERPs to the fifth word of utterances suggest literal statements prompted a more imagistic representation of word meaning than did the requests.

Results of the present study, however, require replication, as the signal-to-noise ratio in the present dataset was less than optimal due to the relatively small number of stimuli and the fact that, due to eye movements, some trials were not included in the averages. Further, rather than simply looking at ERPs each word in the sentence, future researchers should pre-identify words in target utterances likely to provoke more retrieval of background information for requests than statements. On the account here, these words would be predicted to elicit larger late positivities. Similarly, future work should begin with the identification of words expected to result in a more imagistic interpretation in statements than in requests, and where ERP concreteness effects would be predicted.

The present study also revealed more positive slow potentials to indirect requests than literal statements, suggesting that participants found it easier to construct a situation model for the former interpretation. Although this result goes against the assumption that it is more difficult to understand non-literal than literal language, it is compatible with the constraint-based model proposed by Katz & Ferretti (2001). Future work could more directly test that account by operationalizing the contextual factors that promote request interpretations, and observing how the presence of more versus less constraining contexts modulates slow cortical potentials. There is no shortage of exciting topics in the emerging field of neuropragmatics.

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