Give me a verb! Give me a noun!: An ERP investigation of perceptual words with

ambiguous word classes

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Abstract

Previous research has demonstrated that retrieving a verb from memory elicits different neural activity than retrieving a noun, however, what about words that can be both? It has been found that the context surrounding a target word hold primary importance in the classification of a word as being either a verb or a noun in the case of an ambiguous target word. Using Event-Related Potentials as a physiological instrument to measure cognitive processes through the means of a lexical decision task; the current study will examine brain activity when context is manipulated for words that are considered both verbs and nouns. The target words consisted of 5 English words: view, watch, witness, notice, sense. During the task, there were 2 sets of conditions presented to the participants twice. The first condition consisted of the words 'to' and 'the' preceding the target word in a random order. The second condition consisted of the word 'this' preceding or succeeding the target word in a random order. After the completion of all conditions, participants were prompted to complete a counterbalanced 9-point likert scale for each target word. They were asked to rate their opinion of how strongly each word was classified as a verb or a noun. Resulting ERP data was examined for contextual differences across word context category and between regions of interest montages.

Keywords: Event-Related Potentials, lexical decision task, ambiguous target words

An ERP investigation of perceptual words with ambiguous word classes

In the history of psycholinguistic research, studies thus far have typically focused on different word categories that represent specific functions such as face-, arm-, and leg-related verbs in the context of visual action verbs (Pulvermüller, Härle, & Hummel, 2001). There is not a considerable amount of research thus far on studies that involve word categories that are more ambiguous instead of concretely being defined as visual action verbs. Through the use of Event-Related Potentials, we hypothesize that there will be a difference from other studies due to the manipulation of prior studies methodology, thus, attaining a greater breadth of knowledge on the subject of ambiguous word classes as well as for abstract words, both which will be further discussed.

In a study by Pulvermüller and colleagues; three types of word categories were used: face-, arm-, and leg-related. In the experiment, the participants were asked to perform a lexical decision task where they were asked to press a button if they saw a real word and to not respond when they noticed a pseudo word. From the fMRI data, it was concluded that words that were related to the face resulted in the fastest decision from the participants, and words that were related to the legs had the slowest decision (Pulvermüller et al., 2001). Thus, it was proposed that the results obtained were due to the theory of associative learning, meaning that the small-dispersion of neurons for face-related words was related to the fast reaction time. Conversely, since leg-related words had a larger distribution of neurons, it led to a slower reaction time (Pulvermüller et al., 2001). Additionally, since the leg-related words had a larger area to activate, the increased area of co-activation was a main factor in the slower decision of leg-related words in comparison to face-related words.

Much research since has supported the theory of associative learning and has furthered the research by Pulvermüller and his colleagues. Many of these studies have focused on the importance of visual action verbs, or verbs in general, and consequently, there is little research on words that have ambiguous word classes; meaning that they are not exclusively verbs or nouns, and can in fact be considered both verbs and nouns.

Verbs and Nouns

Nouns are used in the English language as words referring to objects that include people, places, and things; on the contrary, verbs are used in the English language as a word that specifically refers to an action that is being performed (Mestres-Missé, Rodriguez-Fornells, & Münte, 2010).

With no uncertainty, verbs and nouns are considerably different, both the function and the construction of the words are distinct and exclusive. Thus, due to these differences, it is likely to assume that the dissimilarities are equally as distinct in the brain. Warrington and McCarthy furthered the evidence on uniqueness of verbs and nouns by proposing that most verbs are associated with the motor actions (Warrington & McCarthy, 1987). For instance, the word 'evacuate' is associated with the motor action that is associated to evacuating a place, which would namely be the action of running away. Whereas, nouns are better explained to be associated with visual representations (Warrington & McCarthy, 1987); for instance, with the word 'dog', it would be expected that one would recall a mental image of an animal that is covered in hair and has two ears and a tail. At a physiological level, it has been proposed based on evidence from lesioned brains, that nouns and verbs have very distinctive neural networks in the brain (Pulvermüller, Preissl, Lutzenberge, & Birbaumer, 1996). Specifically, it has been proposed that areas of the frontal lobe are more likely to be associated with the processing of

verbs while the cortices involved in the temporal-occipital lobes are primarily responsible for processing of nouns (Pulvermüller et al., 1996).

Additional research using EEG data has contributed to the legitimacy of previous findings. Pulvermüller and colleagues found that verbs had stronger motor associations in comparison to nouns, with the specific activation being focused primarily in the frontal lobe and around the areas of the motor cortices (Pulvermüller et al., 1996). This solidifies the information by noting that the motor cortices were in fact involved in the processing of verbs. In the case of nouns though, they were reported as having stronger visual associations in comparison to verbs; additionally, activation is usually reported to be in the frontal, temporal and the occipital lobes (Pulvermüller et al., 1996). The results were consistent with the current knowledge of brain function. As the temporal lobe is primarily responsible for memory and the occipital lobe is more associated to visual processes, as nouns were having more activation in those regions is certainly congruent with the understanding of neuroanatomy. However, taking an empirical approach, verbs are learnt in reference to the action that is associated to the word (Pulvermüller, Lutzenberger, & Preissl, 1999). For instance, the word 'throw' is associated to the action of throwing an object, thus, this act establishes a connection between the word 'throw' and the action. Conflictingly, nouns are learnt in reference to the object that is related to the word (Pulvermüller et al., 1999). For example, the word 'baseball' is associated to the mental representation that one makes of that actual object. So from here, we wonder, is there a similarity or difference for words that can be both verbs and nouns?

Verbs and Nouns: Manipulating context

As we now know, the verbs and nouns are quite distinct, however, complexity arises when words are considered both verbs and nouns; meaning that they are words that have an

ambiguous word class. For instance, the word 'question' is considered both a verb and a noun; specifically, when 'question' is used as a verb, it is defined as to ask or to inquire about something, on the contrary, when 'question' is used as a noun, it is defined as an inquisitive sentence that is directed to an individual in the expectation of a response (Merriam-Webster, 2014). The question remains, how can words be manipulated into being classified as a verb or a noun if they are ambiguous; the answer is by manipulating the context.

The context surrounding a target word is a primary importance in the classification of a word as either a verb or a noun in the case of an ambiguous target word. The simple procedure of altering the surrounding word and/or its position can have a great impact on how the target word is perceived. For instance, if you were 'to address' someone, this would be considered a verb as you are performing an action by speaking to an individual, however, using the same word, if you were looking for 'the address' of a restaurant, it would be considered a noun as you are inquiring about a specific place. As you can see, altering the word that came before 'address' changed the meaning of the word entirely from being definitely a verb to becoming a noun.

In a study by Federmeier and colleagues, they completed a similar method as the previously mentioned example. In their research, they used the same method of to/the preceding the target word as described previously. Behavioural results had suggested that the participants were focusing primarily on the stimuli and even more importantly, were possibly processing it for meaning given their strong ability to restate the previous stimuli (Federmeier, Segal, Lombrozo, & Kutas, 2000). The study used words that were more concrete, meaning that they had specific mental images in regards to the words. Additionally, there were four categories of target words: word class ambiguous items (e.g., drink, smoke), unambiguous nouns (e.g., desk), unambiguous verbs (e.g., grow), and pronounceable pseudo words (e.g., 'dight' in relation to

'fight') (Federmeier et al., 2000). The procedure for the study was similar to the previously mentioned example; the words 'to' and 'the' were used interchangeably before the target word in order to alter the word class perception of the target word. For instance, a sentence that was used in the study was "he learned to joke and became the life of the party", in this situation, joke would be considered to be a verb in reference to the word 'to' preceding it, altering its context (Federmeier et al., 2000). The results demonstrated that in that study, participants who were exposed to ambiguous words had a slower frontal negativity around 200 ms after the target word was presented using Event-Related Potentials (Federmeier et al., 2000). To add to, Federmeier and colleagues also found that ambiguous words had an increase in frontocentral negativity, specifically between 200 and 450 ms in the instances where the target word was considered a noun instead of a verb (Federmeier et al., 2000). Given the results and as they used quite concrete words, researchers wonder if there would be similar or differing results for more abstract words.

Embodiment of words: Abstract versus concrete

When speaking in relation to word classification and linguistic studies, it would be impossible to not discuss the embodiment theory. Embodiment is described as the relationship between the body and its related words and its association with higher cognitive processes (Maouene, Sethuraman, Laakso, & Maouene, 2011). Essentially, the theory is the way by which an individual is able to mentally visualize the object or task without doing that specific task. There are two categories that are used in discussing the embodiment of words; firstly, there are concrete words, as the name suggests they are more tangible and are also related to concrete actions and objects (Thomas, Chamberland, & Dickinson, 2013). As described by Thomas and colleagues, concrete words are described as things that can be verified by the senses; for

instance, the words: run, walk, talk, and kick all describe words that are recognizable through the five senses (Thomas et al., 2013). On the other hand, abstract words are less easily defined; they are words that do not have a verifiable action or object for the individual to recognize (Thomas et al., 2013). Instead, abstract words are usually more defined as a concept, or something that cannot be observed through the five senses; for instance, the words: perceive, see, hear, and listen are all words that are considered abstract as they cannot be mentally represented and observed (Thomas et al., 2013).

Event-Related Potentials

Event-related brain potentials (ERPs) are an objective measure of post-synaptic brain activity that represents changes in voltage during the presentation of a certain stimuli with the use of an electroencephalography (EEG) (Luck, 2005). Once the averages are completed, a grand average waveform across all participants can be presented visually as a method to view all of the participants' responses for each stimulus.

A common ERP component found in language related ERP studies is the N400 component. The N400 component is most likely to be elicited in a research study when a word is presented with an incongruent word, and the participant has to break their semantic expectancies (Luck, 2005). It has been noted that the N400 component is typically largest over the central and parietal electrodes on the electroencephalograph net (Luck, 2005). Additionally, there is higher amplitude found over the right hemisphere in comparison to the left hemisphere, however, it has been reported that the N400 component is generated largely by the left temporal lobe (Luck, 2005). As stated by the Federmeier and colleagues study, a significant effect was found at the N400 component between 250 and 450 ms (Federmeier et al., 2000). They implied that nouns generated more negativity in the N400 component than verbs (Federmeier et al., 2000). The

implications of these findings could suggest that the stimuli that were considered unambiguous nouns could have been considered to have more meaning to the participants as the negativity of the N400 has roots in meaningfulness of the presented stimuli (Kutas & Federmeier, 2000).

Current Study

Many previous psycholinguistic studies have focused primarily on the differences between concrete verbs and concrete nouns; specifically, in the Federmeier and colleagues study, they used words that were more concrete in nature. On the other hand, the focus of the current study is to examine how individuals process different perceptual words that are abstract and also have an ambiguous word class.

There are many implications for the importance and integration of this study. Firstly, if there is a significant difference between the previous Federmeier study and the current study, then it could be implied that due to the incorporation of the second condition ('this' preceding or succeeding the target word), that the Federmeier study may have fallen victim to an word effect; as the words "to" and "the" are very different words, that may be contributing to the differences that they found. The incorporation of a second unique trial will attempt to rule out any word effects or other confounding variables such as the Federmeier study using full sentences instead of simply two words. If there is a similar effect in the current study as in the Federmeier study, it could be implied that there is not a significant difference between abstract and concrete words in terms of how they are processed in the brain. On the other hand, if there are differences found between the two studies, it will contribute to the literature on the differences between abstract and concrete words, the latter hypothesis is more probable than the former hypothesis.

Using Event-Related Potentials as a physiological instrument to measure cognitive processes through the means of a lexical decision task; the current study will examine the regions

of interest (ROI) in response to the manipulated presentation of ambiguous words, as well as to provide additional information on the differences between words that are considered both verbs and nouns. By using ambiguous word class target words and manipulating the context they were presented in, we can observe if the participant's decisions are altered, as well as how that difference may look neurologically, using the Event-Related Potential data.

Methods

Participants

A total of 12 participants (1 male; 11 female) participated in the research study. All of the participants were undergraduate Laurentian University students with an age range between 18 and 21 years ($M = 19.25$ years, $SD = .97$). All participants who took part in the research study spoke English as their first language; however, their level of bilingualism was not a component of interest in this study. Additionally, only participants who identified as being right handed were able to participate in the study. As left-handed and right-handed individuals have physiological differences; specifically, due to language being processed primarily in the left hemisphere, participants who are right handed will have a left dominant hemisphere, which may bias the results (Pashek, 1997). Once the researcher collected the completed informed consent from the participant, the study began. To mention, students who contributed in the study were eligible for extra course credit in appreciation for their participation.

Materials

The current study used a lexical decision task that was constructed using the E-prime software (v. 20) (Schneider, Eschman & Zuccolotto, 2002). All stimuli were presented to the participants via the same E-prime software. The target words consisted of 5 English words and 5 pseudo words that were visually presented to the participants (See Table 1 for a list of all stimuli used). The length of the words did not differ significantly between them; additionally, all of the words had 1 or 2 syllables. The words used were considered both verbs and nouns; for instance the word "watch" was used, it is considered to be both a verb and a noun. Pseudo words have been generated for each target word; these pseudo words have been created to be

orthographically dissimilar to the real words, but they are meant to still resemble the real word. The pseudo words have also been matched with word length and syllabicity to the real word.

Table 1: *Stimuli used*

Target words	Pseudo word
view	veuw
watch	wotch
witness	wytness
notice	notiss
sense	senss

Procedure

The consenting participants underwent approximately an hour session consisting of 2 blocks with 2 conditions presented in each. Additionally, each block had 200 stimuli presented in them. After the EEG net was applied to the participant's head, each block lasted approximately 10 minutes; additionally, impedance levels were also checked during each break. The participants were seated in a sound attenuated booth where they sat approximately 25 inches from the monitor. Once seated, the participants viewed an instruction screen, which told them to press the button on the response box if a real word was presented to them on the screen, and to do nothing if there was a pseudo word presented. During the study, a fixation point was first presented on the screen for an interstimulus interval between 1000 and 2000 ms in order to reduce anticipatory responding. Next, the target word was presented on the screen for 250 ms, and then was followed by a blank screen for 1000 ms, giving time for the participant to respond,

and then the sequence would restart. Participants were also instructed to keep eye blinking to a minimum.

During the 4 blocks, there were 2 sets of conditions presented to the participants twice. The first condition consisted of the words 'to' and 'the' preceding the target word in a random order; this procedure has been obtained from the previously mentioned Federmeier and colleagues study that used common, everyday words. However, the second condition consisted of the word 'this' preceding or succeeding the target word in a random order (e.g., this watch, watch this). This condition has been incorporated in order to rule out any confounds that the previous study may have encountered, such as only having one condition; thus, the integration of a second set of condition should allow for a greater breadth of information to analyze.

After the completion of all 4 blocks, the participant was prompted to complete a 9-point likert scale for each of the 5 words. They were asked to rate their opinion of how strongly each word was classified as a verb or a noun. In order to reduce confounding variables, the likert scale was counterbalanced between each word, meaning the noun and verb classification on either end of the scale would change positions randomly.

ERP Recording

Event-related potentials were recorded from a 64-electrode HydroCel Geodesic Sensor Net (Electrical Geodesics, Inc., Eugene, OR). Data acquisition was done using the NetStation software, version 4.4.1 (Electrical Geodesics, Inc., Eugene, OR) and digitized with a sampling rate of 250 Hz, using the vertex as reference electrode. Data were re-referenced off-line to the average mastoid reference. EEG data was filtered on-line using a 0.1 Hz high pass filter and stored on a computer for off-line analysis.

ERP data were filtered off-line using a 0.1-30 Hz band pass filter and segmented into 600

ms epochs that were sorted by instruction. Epochs began 100 ms before stimulus onset and extended 500 ms after the appearance of the stimulus, refer to Table 2 for descriptions on the epochs chosen for the current study. Using NetStation v.4.4.1 (Electrical Geodesics, Inc., Eugene, OR), data were examined for artifacts using an eye-blink threshold of 100μV and a threshold of 5μV for horizontal eye movements, and were visually checked afterwards. An average was calculated for each subject and epochs were baseline-corrected using the 100 ms interval before stimulus onset. Grand averages were then calculated across all participants.

Table 2: *ERP components examined*

Component	*Duration (ms)*
P200	180-230
N200	290-360
P300	440-530
N400	530-630
LPP	780-890

Results

ERP Data

During the experiment, Event-Related Potential data was analyzed with a 2 (condition: to/the, this/this) x 2 (word type: verb, noun) x 4 (ROI: frontal, frontal left, frontal right, central) repeated measures ANOVA for the P200, N200, N400 and LPP related time windows. Additionally, the P300 component was analyzed with a 2 (condition: to/the, this/this) x 2 (word type: verb, noun) x 3 (ROI: occipital parietal, parietal left, and parietal right) repeated measures ANOVA. The results from the Event-Related Potential were analyzed separately for each individual epoch.

P200. There was a significant Context x Montage interaction found in the P200 component, $F(3,33)=3.17$, $p < .05$, $\eta^2=.22$, shown in Figure 1. Post hoc tests (LSD) revealed that the verb context words had significantly greater P200 amplitudes for three regions of interest: frontal ($p=.003$), frontal left ($p=.043$) and central montages ($p=.019$).

*
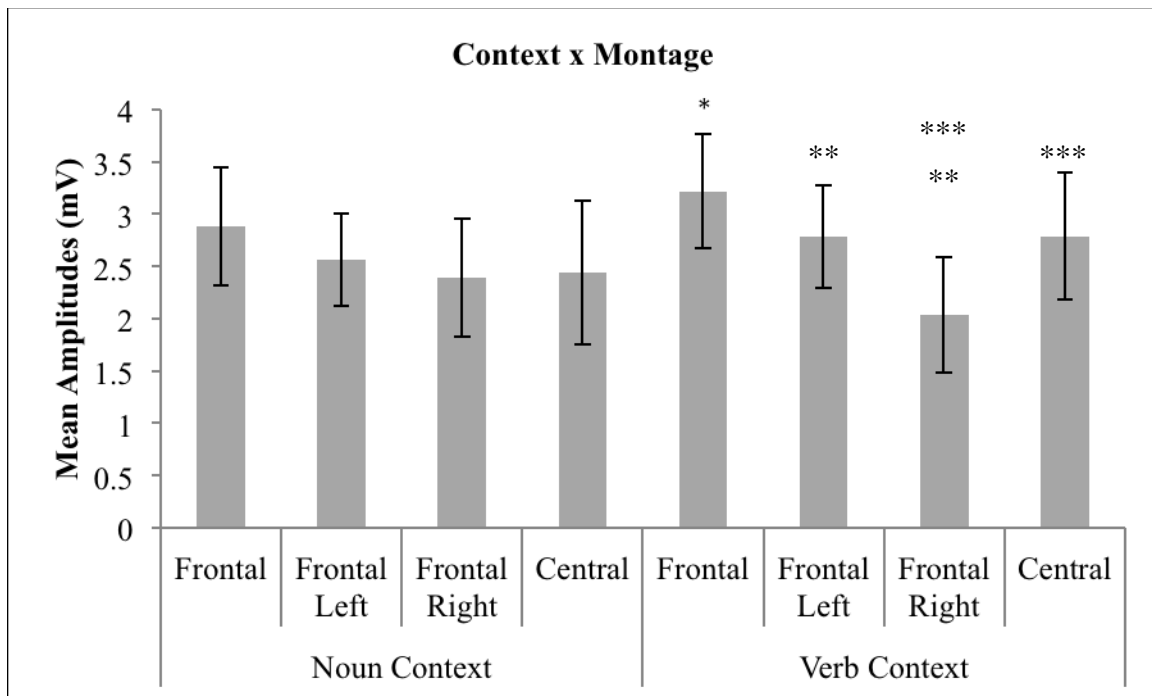
N200.

Figure 1: *Significant context x montage for the P200 component.*
During the analysis

of the N200 component, there was a significant Context x Montage interaction, $F(3,33)=3.24$, p

$< .05$, $\eta^2=.23$, shown in Figure 2. Based on the results from the post hoc analyses, it has been

found that verb context words had greater amplitudes in the frontal right montage in comparison

to the frontal left montage ($p=.032$) and the central montage ($p=.005$). For noun context words,

post hocs revealed that the frontal montage had larger amplitudes than the frontal right ($p=.004$).
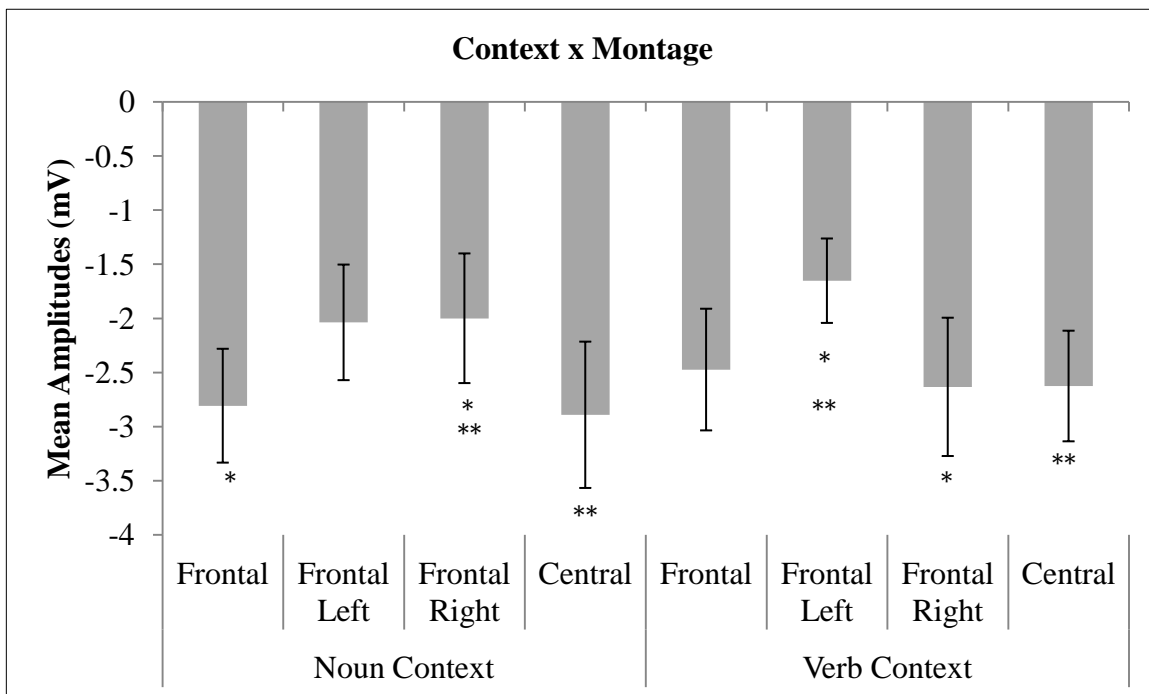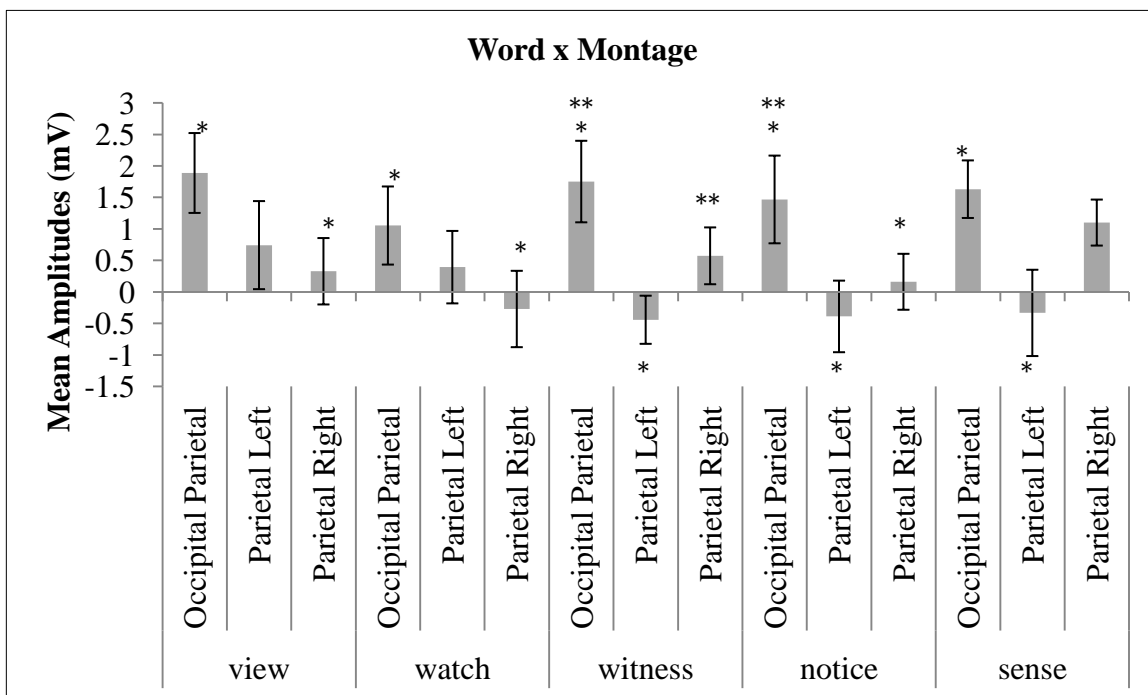
Figure 2: *Significant context x montage for the N200 component*

P300. A significant interaction was found in the P300 component, this interaction was Word x Montage, $F(8,88)=2.59$, $p < .05$, $\eta^2=.19$, shown in Figure 3. Post hocs examinations showed that for all of the five target words, there were greater occipital parietal mean amplitudes in comparison to parietal right and parietal left.

Figure 3: *Significant word x montage for the P300 component*

N400. There were multiple interactions found in the N400 component during data analyses, the first was Word x Montage interaction, $F(12,132)=1.85$, $p < .05$, $\eta^2=.14$, shown in

Figure 4. Investigating the post hocs showed that the words view and watch revealed no significant difference, whereas, witness and notice had a much larger N400 mean amplitude in the frontal, frontal left frontal and central frontal montages in comparison to the frontal right montage. Also, sense had a larger N400 component in the frontal left montage than in the frontal right.
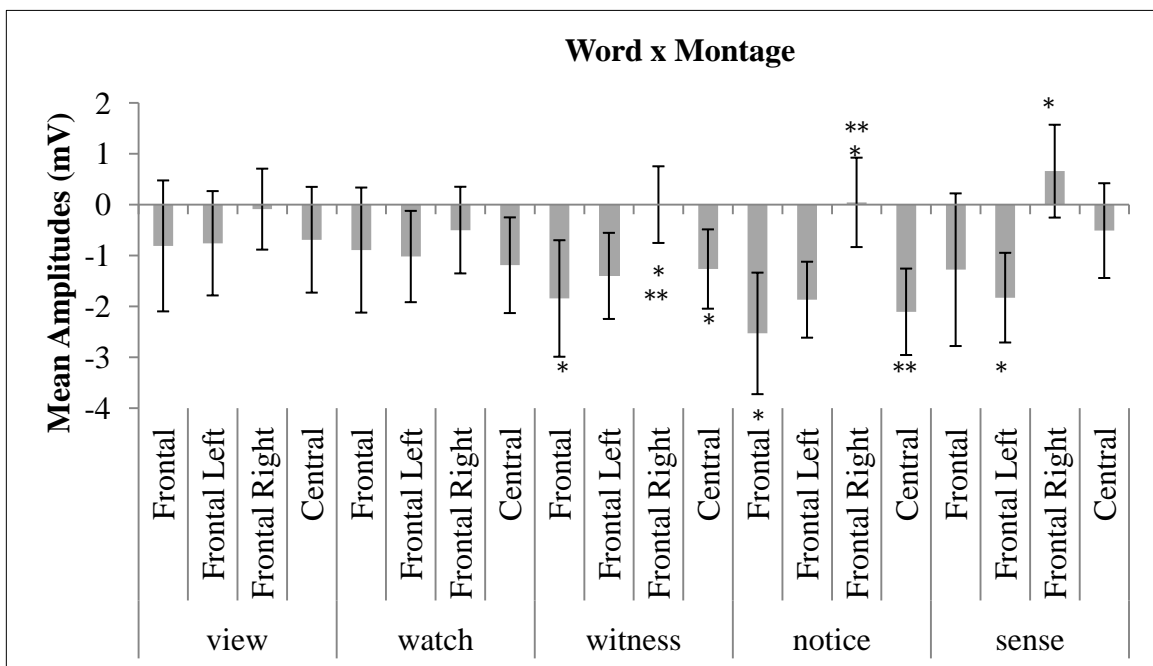

Figure 4: *Significant context x montage for the N400 component*

There was another significant interaction in the N400 component, Condition x Context x Montage, $F(3,33)=3.53$, $p < .05$, $\eta^2=.24$, shown in Figure 5. For the first condition (to view/the view), there were no differences found between verb context words and noun context words in

any of the montages. For word context differences, noun context words, the frontal montage was near significant ($p=.056$). For verb context words, the frontal left montage and central montage had significantly larger mean amplitudes than the frontal right montage.

For the second condition, it was revealed that the noun context words had larger N400 mean amplitude than verbs in the frontal left montage, on the other hand, verb context words had greater N400 mean amplitudes in the frontal right montage in comparison to nouns.

Figure 5: *ERP waveforms for the significant condition x context x montage interaction*

LPP. There was a significant Context x Montage interaction found in the LPP component, $F(3,33)=5.14$, $p < .05$, $\eta^2=.32$, shown in Figure 6. Upon analyzing the post hocs, it was discovered that the interaction was driven by the frontal left significance ($p=.029$). The frontal left montage had a greater LPP component for verb context words in comparison to noun context words. Other regions of interest were nearly significant: the frontal montage ($p=.056$) had a greater LPP for verb context words than for noun context words. Similarly, the central montage ($p=.061$) also had a greater LPP for verb context words than for noun context words. There was no significance found for the frontal right montage.
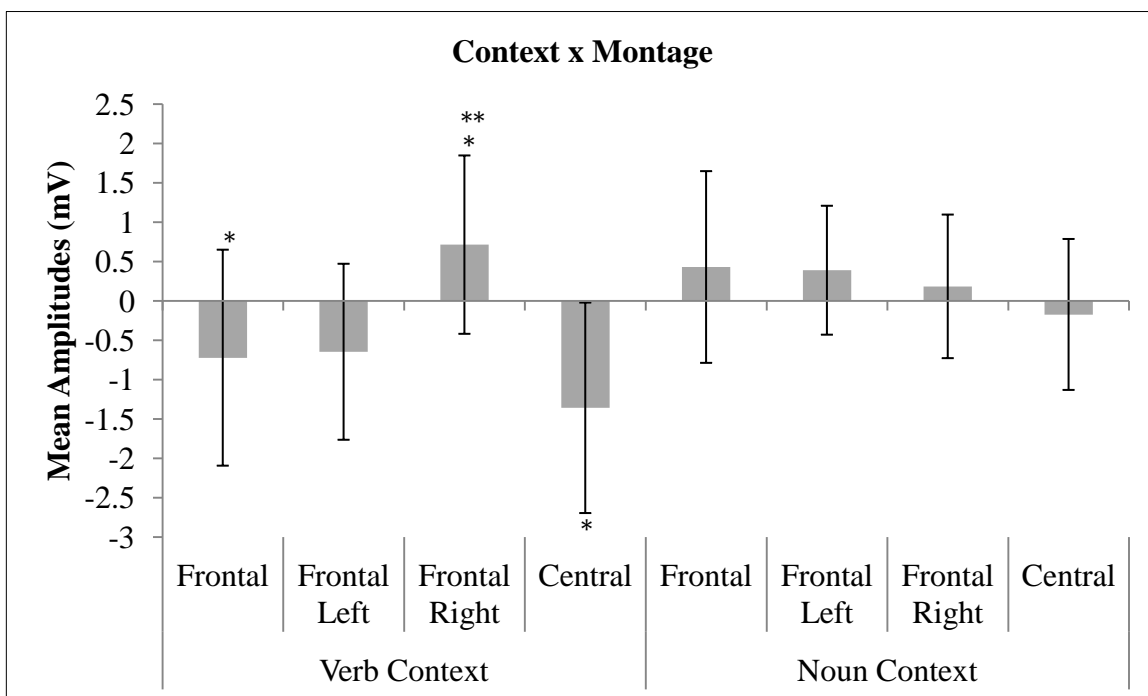
Figure 6: *Significant context x montage for the LPP component*

Likert Scale Ratings

After the completion of the four conditions, participants were asked to complete a 9-point likert scale for each target word in order to assess the degree to which they believed each word to be more of a verb or a noun. As the likert scales were counterbalanced, they were reordered so that a score of 1 always meant strongly classified as a noun, whereas a score of 9 represented undoubtedly a verb. The results from the likert scale are displayed in Table 3 below.

From smallest means to largest means, there was witness ($M = 3.92$), watch ($M = 6.33$), sense ($M = 6.92$), view ($M = 7.75$) and notice ($M = 7.83$). Also, given the results, it was found that the word notice had the smallest standard deviation ($SD = 1.59$), meaning that there was less variability between participant's decisions of the word. On the contrary, witness had the greatest variability between decisions ($SD = 2.91$).

Table 3: *Likert scale ratings from participants*

Target words	Mean	Std. deviation
view	7.75	2.26
watch	6.33	2.60
witness	3.92	2.91
notice	7.83	1.59
sense	6.92	2.07

Discussion

ERP Analysis

  P200. The P200 component was analyzed for this research study between 180 and 230 ms; it is also typically associated with differences in attention (Luck, 2005). Given the results, it may be implied that word context is having an impact within the context of the current research study. To explain, as the same five target words were presented in the noun context and in the verb context, if there were no effect, there would be no noteworthy differences found between the noun context words and the verb context words. However, as the verb context words had significantly larger mean amplitudes in the frontal, frontal left and in reference to the noun context, it can be assumed that there were differences between the manipulated noun context words and verb context words.

  As the P200 component is characteristically related to differences in attention (Luck, 2005), there may be greater attentional resources given to verb context words than noun context words. As there were greater mean amplitudes in the majority of the verb context word montages, it may imply that participants could be directing more attention to the actions associated with the verbs, which consequently could be resulting in a larger P200 component.

  N200. The N200 component is the second major negative peak in an ERP waveform typically found in Event-Related Potentials studies (Luck, 2014). The N200 was examined at an epoch time window of 290 to 360 ms. There were greater mean amplitudes in the frontal, frontal right and central montages, in comparison to the frontal left montage, which was quite minute in comparison to the other montages. Interestingly, there were similar results found between both noun context words and verb context words. These were unexpected results, especially in comparison to other Context x Montage interactions, for instance in the P200. In the P200

Context x Montage interaction, verb context words had significantly larger P200 mean amplitudes in comparison to the noun context words. It could be assumed, as the same words were presented equally, that the N200 Context x Montage interaction would result in some difference as well. As the N200 component is typically associated with changes in repetitive stimuli presentations, as typically found in an Oddball task (Luck, 2014), the lack of difference may possibly be due to the fact that the participants were presented with target words and pseudo words equally within the current study, thus they may have been less likely to form any repetitions that are typically found in an Oddball task as there were equal presentations of both words.

P300. The P300 component is one of the more readily studied ERP components. The researchers examined the P300 for an epoch between 440 and 530 ms. In research, a larger P300 component is typically associated with a presentation of an unanticipated stimuli (Luck, 2014). In addition, it has been proposed in research that the P300 component may be associated with allocating more resources to a specific task, as the P300 typically increases when there is more effort given (Luck, 2014).

Given the results, it was found that the occipital parietal montage had considerably larger mean amplitudes in comparison to the parietal left and parietal right montages for all of the five target words. As there was not a significant difference between any of the words, just in the montages, it can be implied that there is more activity occuring the occipital parietal montage in comparison to the parietal left or parietal right.

Additionally, the interaction was driven primarily by the differences of the word sense. Sense had significantly greater mean amplitudes in the P300 in comparison to both watch and notice. A justification for these results may be that sense required more attention and resources

during the lexical decision task in comparison to watch and notice. Perhaps the difference could be due to fact that sense is a very abstract word, meaning that it is the hardest word to visualize from the word list, this may have caused participants to have a difference in responding, as it may require less resources to understand watch in comparison to sense.

    N400. In literature, it has been noted that a smaller N400 component is likely to be elicited when a word is presented with a related word, however, there is a larger N400 component when a word is presented with an unrelated word (Kutas & Federmeier, 2000). The N400 components were analyzed between 530 to 630 ms after the presentation of the stimulus. There was a Word by Montage interaction discovered in the N400 component. An explanation for view and watch having no significance and the other words having significance could be due to the fact that view and watch are slightly more visual words, however, witness, notice and sense are more non-modality specific words; which is a component of other research that will be examined in the future.

    Given the results, there was another significant interaction in the N400 component: Condition x Context x Montage interaction, the first condition (to view/the view) was not significant, whereas the second condition (this view/view this) was significant. The results were in opposition to the previous Federmeier study.

    An explanation for the differences for both interactions in the N400 may be simply due to the differences between abstract and concrete words. As the previous study used extremely concrete words and the current study used quite abstract, perceptual words, it is possible that the differences found could possibly be due to those differences, and nothing more. For instance, comparing both the previous study and the current study; the previous study used very concrete words such as 'drink'. It may be possibly that participants may have seen the phrases "to drink"

and "the drink" as more familiar and understandable than "to sense" and "the sense", thus causing an increase in the N400 component. However, important to note, as only one condition had an effect and not in the other, it may be due to a confound. As such, the researchers are hesitant to further interpret the result until further data has been collected.

LPP. A large LPP or late positive potential is a component of ERP research that has gone relatively unstudied. However in research, it has been indicated that a large LPP component is associated with the presentation of an incongruent stimuli (Cacioppo et al., 1993). In this research, the LPP component was examined between 780 and 890 ms. Given the significant LPP Context x Montage interaction, it can be implied that there is a difference in processing noun context words and verb context words. As verb context words had greater LPP in comparison to noun context words, it may be implied that verb context word manipulation was considered more unrelated than the noun context manipulation.

Likert Scale Analysis

As the results from the likert scale indicated that witness had the smallest mean (M = 3.92), it is indicative that witness was the word that was most considered a noun. Conversely, notice had the largest mean (M = 7.83), and as a large mean in this research study is suggestive that the word was most considered a verb, it is clear that notice was the word that was most considered a verb. To add to, notice also had the smallest standard deviation, meaning that there was less variability between the participant's decisions, meaning that most of them believed notice was the strongest verb.

In further analyzing the five target words, the MRC Psycholinguistic Database was used in order to examine the uniqueness of each target word. As shown in Table 4, the level of concreteness and imaginability of the five target words were examined as a way to possibly

expound on the rating differences from the likert scale. Firstly, the concreteness of the words were examined. In the MRC database, the concreteness category is formed from a culmination of Pavio, Colerado, and Gilhooly-Logie norms (Wilson, 1988). The concreteness category had a range of 100 to 700 with a mean of ($M = 438$), with a standard deviation of ($SD = 120$) (Wilson, 1988). The word sense had the lowest concreteness score of 316, whereas the word watch had the highest score of 487. Even though the word sense is more of a perceptual word in comparison to the word watch being more of a visual word, it is not necessarily reflective in the likert scale ratings; as watch had a likert scale rating of $M = 6.33$ and sense had a likert scale rating of $M = 6.92$.

The imaginability category was also examined, it has a range of 100 to 700 with a mean of ($M = 450$), and a standard deviation of ($SD = 108$) (Wilson, 1988).The word sense had the lowest imaginability score of 368, and watch had the highest score of 525. As the word sense is very much an abstract word, it is significantly less imaginable in comparison to some of the other words used in the word list. On the other hand, the word watch is slightly more able to be imagined; for instance, watch can be perceived as a noun (i.e., a wrist watch) and as a verb, (i.e., visually looking at something). Therefore, the word watch may infact be easier to comprehend in comparison to the word sense as it is more comprehendible.

Table 4: *Word characteristics from MRC database*

Target words	Concreteness	Imaginability
view	379	430
watch	487	525
witness	459	467
notice	479	467
sense	316	368

General Discussion

As there were inconsistent findings for some of the significant components through the use of Event-Related Potentials, it will be necessary to continue to further research as a way to possibly explain the differences between the previous Federmeier study and the current study. As there were some inconsistencies in the results, there is hesitation to provide clear rationalizations for the results until further data has been collected.

A limitation to the current study, especially for the ERP results, was that there was a relatively small sample size. Most notable in the error bars for many of the figures, they was a large amount of variability, meaning that there was more variability between participant's responding, due to the smaller sample size.

Future Research

In terms of future research, as there were opposing results found in comparison to the previous research, through the addition of a second condition and changing the target words, it

will be necessary to perform an additional study in order to examine if the potential changes were due to differences between abstract and concrete words. For the future study's methodology, both abstract and concrete words should be use in the methodology as a way to further explain the differing results. Additional research could also examine the neurological differences between ambiguous words and unambiguous words within the context of abstract and concrete words using Event-Related Potentials.

Conclusions

     As the current research contribution is a small component to a larger research question it has multiple implications. A question in current research is how are researchers able to come up with definitions of abstract words, meaning it is impossible to verify that an idea of 'view' is commonly understood, between all individuals. Given the difficulty of abstract words, a common definition of them is nearly impossible to define. The current contribution will aid in the development of word lists for future research, as previous studies have made the error of using words lists that include both verbs and context ambiguous words. Given the current research study, it is known that verbs had an impact in word context; therefore, future research may choose manipulate context ("to view") in order to classify ambiguous words as verbs, while still using distinct verbs within the word list.

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