INTEGRATIVE AND PREDICTIVE PROCESSES IN TEXT READING: THE N400

ACROSS A SENTENCE BOUNDARY

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In the present study we used two experiments to test whether readers use integrative (retrospective), predictive (prospective), or both processes when reading words across a sentence boundary. We used Experiment 1 to determine whether prediction and integration could be measured as distinct processes. Response times (RTs) to determining whether probe words occurred in a previous sentence were measured. Critical probes were either high or low predictable words, given a context sentence. Both word types were easy to integrate, fitting well with the previous sentence. Results showed high predictable words had longer RTs than low predictable words, demonstrating that prediction and integration are distinct processes. In Experiment 2 we aimed to determine which processes were used when reading across a sentence boundary using event-related potentials (ERPs). The ERP component of interest was the N400, an indicator of semantic fit. We measured processing differences for high and low predictable words that were matched for integrability in sentence pairs. In a control condition, words were unpredictable and difficult to integrate. There was no difference in word processing (indicated by N400 amplitudes) between high and low predictable words across a sentence boundary. However, both word types were easier to process (reduced N400s) than control conditions. Findings show semantic overlap from word- and sentence-level activations facilitate integration in cross-sentence boundary reading.

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1.0 INTRODUCTION

When comprehending a text, readers incrementally form and update their mental understanding, or situation model, of the text (van Dijk & Kintsch, 1983; Just & Carpenter, 1980; Kendeou, Smith, & O'Brien, 2013; Myers & O'Brien, 1998; Yang, Perfetti, & Schmalhofer, 2007). As readers gain new information in a text, they face a choice of adding information to the current situation model or starting a new situation model (i.e., shifting; Gernsbacher, 1991). The choice between shifting and continuing to build a situation model is especially important at the beginning of a new sentence, which may begin a new topic. If the topic shifts, readers need to form a new situation model around the new topic. If the topic continues across sentences, readers must link upcoming words with the situation model to maintain text coherence.

Two processes that aid incremental updating are prediction and integration. Prediction involves prospectively activating a specific word whereas integration involves assimilating a word into a mental representation. Take the following sentence for example: *After drawing five cards from the deck, Sebastian cautiously laid down his money*. If readers use integrative processes, a word that relates to the topic (e.g., *bet*) should be easy to process. If readers use predictive processes and predict *bet*, it should be even easier to process because *bet* is the word they predicted and it fits well with the situation model. In both outcomes, readers require integration but not prediction to successfully understand the text. In fact, when readers encounter

unpredicted words that defy their predictions, they require more processing effort for those words. (Van Petten & Luka, 2011). Because of the potential for prediction costs and for a shift in topic across a sentence boundary, we aim to answer the following question: Are integrative, predictive, or both processes used in cross-sentence boundary reading?

1.1 PREDICTIVE PROCESSES IN TEXT COMPREHENSION

Predictive processes likely play a major role in facilitating word processing during comprehension, however much past research has focused on prediction within a sentence boundary. Predictive processes involve activating lexical items or features (e.g., tense, word-class) before encountering them based on prior information. Predictions can be specific or general. Specific predictions provide information about a specific lexical item (Kutas & Federmeier, 2011; Van Petten & Luka, 2011). General predictions are broad expectations, including activations of related features or word-class (Lau, Phillips, & Poeppel, 2008). Much past research focuses on specific predictions. Evidence for predictive processing comes from semantic priming and sentence-reading paradigms with highly constrained contexts for words in sentence medial or final positions (Brothers, Swaab, & Traxler, 2015; Federmeier & Kutas, 1999; Federmeier, Wlotko, De Ocha-Dewald, & Kutas, 2007; Kutas & Federmeier, 2011; Kutas & Hillyard, 1980; Van Petten & Luka, 2011). One motivation for the current study is to determine whether these predictive processes are used across sentence boundaries.

To assess the role of predictive processes across sentence boundaries, word predictability can be measured with cloze probability tasks. In these cloze tasks, individuals are requested to

provide predictions for upcoming words after receiving context information., which can include general world knowledge and information gained from a text (Cook, Limber, & O'Brien, 2001; Schmalhofer et al., 2002; Seifert, Robertson, & Black, 1985). Predictability is then calculated as the number of responses for a particular word divided by the total number of responses.

Support for predictability effects within a sentence boundary stems eye-tracking, behavioral, and electrophysiological studies. In an eye-tracking study, Rayner and Well (1996) found that readers fixated on low predictable words longer than high and moderate predictable words. Authors concluded that it is easier to process more-predictable words because features related to the words are active. Cook et al. (2001) showed similar results in a word naming study. More-predictable words had shorter naming times than less-predictable words. In addition to behavioral and eye-tracking studies, electrophysiological studies are designed to measure cognitive processes involved in prediction as indications of a mismatch between a predicted word and the word that actually occurred within a text. These electrophysiological measures allow for online measures of cognitive processes with high temporal resolution. In particular, the most widely established electrophysiological marker for assessing prediction is an event-related potential (ERP) component termed the N400.

1.1.1 The N400 in prediction research

The N400 is widely used to test effects of context on word processing. Kutas and Hillyard (1980) first discovered a negative deflection in ERP recordings occurring between 300 and 500 milliseconds (ms) after an anomalous stimulus relative to a stimulus congruent with the established context. Since its discovery, this negative deflection peaking at 400 ms has been used

as an index of semantic fit. Words that semantically fit with a previous context evoke reduced N400 amplitudes relative to words that do not semantically fit with the prior context. Researchers have also found greater N400 amplitudes for unpredictable words compared to predictable words (Brothers et al., 2015; DeLong, Urbach, & Kutas, 2005; Federmeier & Kutas, 1999).

Examining changes in N400 amplitude as a function of context, Federmeier and Kutas (1999) manipulated how sentence-final words related to predicted words obtained from a cloze task. The first sentence provided context information with ERPs measured at the final word of the second sentence. The final word could be related congruous (high-cloze), related incongruous (semantically related to the high-cloze word but incongruent with the context), or unrelated incongruous (not semantically related to the high-cloze word and incongruent with the context). An example stimulus from their experiment follows.

(1) They wanted to make the hotel look more like a tropical resort. So along the driveway, they planted rows of palms/pines/tulips.

Palms had the highest cloze probability followed by pines, then tulips. Unrelated incongruous words (tulips) had increased N400 amplitudes compared to related incongruous (pines) and related congruous (palms). Related congruous words had the smallest N400 amplitude. Reduced N400 amplitudes for *pines*, which is semantically related to the predicted item *palms*, indicated a semantic relationship advantage for words related to the predicted word. Regarding the prediction and expectation differentiation, a specific prediction could be made for *palms*. There could also be a general expectation for tropical plants, and *palms* fits best with this scenario.

While much work has focused on context incongruence in reading nouns, researchers have recently examined ERPs at adjectives and articles preceding target nouns (Boudewyn et al., 2015; DeLong et al., 2005; Laszlo & Federmeier, 2009; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005), providing clearer evidence for specific lexical item predictions. DeLong et al. (2005) visually presented sentences and used the "a/an" contrast in English to explore how individuals engage in predictive processes. DeLong and colleagues examined target nouns and their preceding articles in a single sentence context. For example in the sentence: *The day was breezy so the boy went outside to fly* a kite/an airplane, "a kite" is the more predictable noun phrase ("a" cloze probability = .86; "kite" cloze probability = .89). Cloze probabilities on the articles and nouns were measured independently by asking individuals to fill in either nouns or articles. Because the articles do not differ in meaning, any differences in N400 amplitudes on "a/an" would indicate that readers predicted the upcoming noun or noun phrase. Compared with articles whose forms were inconsistent with predicted nouns, articles consistent with predicted nouns evoked reduced N400 amplitudes. On the whole, evidence for predictive processing in reading has been established across nouns, adjectives, and articles. Despite the variety in these word forms, predictive processes have been examined largely at the within-sentence level without accounting for the integrative processes necessary to maintain coherence.

1.2   INTEGRATIVE PROCESSES IN TEXT COMPREHENSION

Integration involves memory-based processes for text comprehension. In the process of word-to-text integration (WTI), readers continually integrate words into a situation model. In the WTI

paradigm, researchers focus on how readers integrate words across a sentence boundary (Perfetti & Stafura, 2014). Predictability is relatively low in cross-sentence boundary reading. For example, Stafura and Perfetti (2014) manipulated association strength between the final word of the first sentence and first word of a second sentence. Though they included a strong association condition and a control condition, overall cloze probabilities were low (strong association: $M = .053$, SD = .1; control: $M = .007$, $SD = .03$; Stafura & Perfetti, 2014).

In cross-sentence boundary reading, new information is referenced back to a previous sentence or paragraph. If a word fits well with previous contextual information, processing on that word will be easier relative to a word that did not fit well with previous contextual information. Cook and Guéraud (2005) also emphasize the importance of world knowledge on reading comprehension and lexical item processing in which familiarity with general concepts influences how easily upcoming information is integrated into the situation model. Contextual information also allows facilitation or feature activations for upcoming words (Stanovich & West, 1981). Words that are strongly associated with prior information have greater facilitation and are easier to integrate (Brown & Hagoort, 1993).

Different inference procedures and referential overlap among lexical items allow readers to draw links between a prior sentence and the beginning of a new sentence. Sometimes, these links are between pronouns (referents) and a previously established entity (antecedent; Gordon, Grosz, & Gilliom, 1993). In other situations, links among sentences are not as transparent. For example, comprehension processes involved in cross-sentence boundary reading might require readers to make inferences about upcoming words (Graesser, Singer, & Trabasso, 1994). More fundamentally, readers can make backward or bridging inferences during text reading as they adjust their mental representation of the text to accommodate the newly encountered word

(Keenan, Baillet, & Brown, 1984). Bridging inferences are especially necessary when an antecedent is absent, resulting in no explicit connection between referent and prior text information. Take the following sentences from Yang et al. (2007) as an example.

> *(2) After being dropped from the plane, the bomb hit the ground and blew up. The*
>
> *explosion was quickly reported to the commander.*

Here, *explosion* refers to the event *blew up*. A reader can connect the referent to the antecedent because *explosion* refers to a similar concept of a bomb blowing up (Dijk & Kintsch, 1983; Johns, Gordon, Long, & Swaab, 2014; Perfetti & Stafura, 2014). However, when no antecedent is present (e.g. *After being dropped from the plane, the bomb hit the ground.)* one must make a bridging inference and infer the relationship between *explosion* and the bomb hitting the ground, because no clear antecedent in the first sentence exists.

1.2.1   The N400 in Integration research

Yang et al. (2007) tested the hypothesis that readers have increased processing for words that do not have an obvious relationship to a previous context. They used the N400 as index of integration difficulty. Using example (2) above, Yang and colleagues found increased N400 amplitudes when words had to be integrated (e.g. …*hit the ground. The explosion*…), relative to when an inference was unnecessary to maintain coherence (e.g. …*hit the ground and blew up. The explosion*…). These results support the view that processing effort is based on how easy it is to integrate an incoming word into the situation model.

In a recent study on integration, researchers analyzed forward and backward associations (FA and BA, respectively) and found support for both predictive and integrative processing

across a sentence boundary (Stafura, Rickles, & Perfetti, 2015). The paradigm was identical to the Yang et al. (2007) paradigm, and experimenters manipulated the direction of lexical associations between the final word of the first sentence and the first content word of the second sentence. A strong association from word A to word B indicates a FA. A backward association involves a stronger association from word B to word A; this is a retrospective process. For example, the word *rage* makes one think of *anger* (FA) but encountering *anger* does not make one think of *rage* (BA; Stafura et al., 2015). The latter is an example of a backward association in which *rage* is retrospectively associated with *anger*. Results indicated a slight difference in the time course for FA and BA conditions. At a central site (Cz), the FA and BA conditions had reduced N400 amplitudes compared a control condition. However, the FA and BA conditions were not different from each other. In the same N400 time window at a left-lateralized parietal site (P3), the BA condition had a greater positivity than both the FA and control conditions. A principal components analysis showed a differentiation between the FA and BA conditions relative to a control condition at an earlier time-point (380 ms) and a difference between BA and FA conditions at a later time-point (434 ms). The results indicate that when prospective and retrospective effects are observed, prospective effects occur prior to retrospective effects.

The experimenters also found a P600 effect in a 500 to 700 ms time window. The P600 is a positive deflection occurring between 500 and 700 ms post-stimulus and has been reported as an indicator of revising the mental model (Burkhardt, 2007; Van Petten & Luka, 2011). In their study, Stafura et al. (2015) found a greater positivity for control conditions relative to the FA condition. The greater positivity could reflect the revision process required to maintain text coherence after predictive and integrative processes have occurred.

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1.3 CURRENT EXPERIMENTS

The current experiments used two methods, one behavioral and one ERP, to show whether readers use predictive and/or integrative processes in cross-sentence boundary reading. We seek to test whether predictability effects occur across a sentence boundary when controlling for integrability. Of note, predictability and integrability are correlated; words can be highly predictable and easily integrated. However, words can also have low predictability and be easily integrated with a given context (Yang, Wang, Tong, & Rayner, 2012). To test predictability effects, two conditions with words that had high predictability or low predictability given a single context sentence were used. The core feature here is that in both conditions words were similarly easy to integrate. Any differences in conditions would be due to prediction playing a role beyond integration.

Experiment 1 served two purposes. First, we aimed to determine whether prediction and integration could be measured as distinct processes using a rapid serial visual presentation (RSVP) paradigm. The quick presentation rate of words in this design encourages rapid processing of words and discourages the memorization of words in a list format. With this paradigm, differences in predictability are measured by differences in response times (RTs); more predictable words should have longer RTs. The second aim of Experiment 1 was to measure the implicit effects of predictability with stimuli that would be used in Experiment 2.

Much past research on word predictability using cloze probabilities has focused on words within a sentence. Connecting a word across a sentence boundary to a previous sentence might be different than connecting a word within a sentence boundary. After establishing that predictability effects can occur with materials from Experiment 1, we used Experiment 2 to

determine whether readers use integrative and/or predictive processes when reading across a sentence boundary in the WTI paradigm. This paradigm allows for passive text reading across sentence pairs and ERPs allow for online measures of processing (e.g., the N400 and P600).

An additional characteristic of our two experiments is reading mode. In Experiment 1, readers make judgments (rather than passive reading) on critical words that differ in predictability. Therefore, when reading critical words, readers would not need to incorporate that word into their situation model. However, in Experiment 2, readers would passively read sentence pairs and they would need to integrate critical words into a situation model to maintain text coherence. Simply, in Experiment 1 the reading mode is to make a judgment on critical words, whereas in Experiment 2, the reading mode is passive reading.

Before implementing Experiments 1 and 2, we first conducted a series of norming studies to measure predictability and integrability for items used in Experiments 1 and 2.

2.0   PREDICTABILITY AND INTEGRABILITY NORMING STUDIES

Two hundred and nine sentence pairs were adapted from the Stafura et al. (2015) and Yang et al. (2007) studies. The first sentence of each sentence pair and first word from the second sentence were used (e.g., *After drawing five cards from the deck, Sebastian cautiously laid down his money. The*). We implemented norming studies using Amazon Mechanical Turk (www.mturk.com) and the University of Pittsburgh's Psychology subject pool. Predictability and integrability measures were collected on all items used in Experiments 1 and 2.

2.1   PREDICTABILITY SCORES

We used a cloze probability task to obtain predictability ratings. Cloze probabilities were obtained by presenting 352 participants with one context sentence and asking them to complete the subsequent sentence fragment with the word they thought fit best. Each participant saw a random set of 30 items, with each item receiving 45-50 responses. The large sample size allowed for a range of responses that would later be used to obtain integration values. Sentence fragments began with a determiner or pronoun and participants provided a second word for the fragment. Participants were told responses should be one word only and each response to a given sentence received a cloze probability.

We used several criteria to select stimuli. Words with the same root morpheme (e.g. *bet* and *bets*) counted as one response. To eliminate the possibility of repeated word effects, only words not seen in the context sentence were retained. The number of unique responses per item ranged between 4 and 29 ($M = 14.4$), $SD = 4.8$). The average cloze probability was .04 ($SD = .07$), ranging from .02 to .76. From these items High and Low Predictability groups were created. Based on the range of predictability values, words > .15 cloze were in the High Predictability condition ($M = .33$, $SD = .13$) and words < .05 cloze were in the Low Predictability condition ($M = .02$, $SD = .01$). Items that did not fit into either category were excluded.

2.2   INTEGRABILITY SCORES

One hundred and one items from the predictability normed data were used to acquire integrability scores on the words in relation to the previous context sentence. Fifty participants provided ratings ranging from 1 – 7 (easy to difficult), rating how difficult it was to see the connection between a sentence fragment (e.g. *The bet…*) and its previous sentence (e.g. Sebastian laying down his money). Three lists were created such that each participant rated approximately one third of the items. Z-scores were computed on the responses to control for individual differences related to response patterns. A total of 84 items in each condition was retained for the current studies. Stimuli were selected such that no critical word was provided more than twice for different contexts. The High Predictability condition had an average integration score of -.49 ($SD = .30$) and the Low Predictability had an average integration score of -.28 ($SD = .38$).

3.0   EXPERIMENT 1: BEHAVIORAL STUDY

We used an RSVP task to determine whether prediction and integration could be measured as separate processes. Participants had to indicate whether a probe word had occurred in the just-presented RSVP sentence. The critical probe words varied in predictability and integrability as measured in norming studies. The critical probe word had not been present in the context sentence, but was a plausible continuation of the second sentence. (e.g., *After drawing five cards from the deck, Sebastian cautiously laid down his money. The; BET?*)

We hypothesized that highly predictable words would receive greater activation from the RSVP sentence and, as a result, more time and effort would be needed to evaluate whether the probe word actually occurred in the previous sentence. Based on this hypothesis, RTs for high predictable words should be longer relative to low predictable words. Baseline or control items that were low in predictability and difficult to integrate were also included. Because baseline items were not related to the context sentence, these words should receive less activation and participants should have little trouble deciding if probe words were in the previous sentence. Both high and low predictable words that were easy to integrate should have longer RTs than baseline items.

3.1   METHOD

3.1.1   Participants

Participants were 60 undergraduate students, 26 females and 34 males with an age range of 18 – 25 ($M = 19.05$, $SD = 1.29$), recruited from the University of Pittsburgh's Psychology subject pool. Data from one participant whose native language was not English were excluded. All other subjects were native English speakers with no visual or reading impairments.

3.1.2   Materials

3.1.2.1 Experimental and baseline conditions The experimental design was a modified 2 (predictability) x 2 (ease of integration) factorial design, with: one Low Predictability (low predictability and easy to integrate) condition, one High Predictability (high predictability and easy to integrate) condition, and two Baseline (low predictability and difficult to integrate) conditions. (A condition in which words were high in predictability but difficult to integrate was not included because of the correlation between predictability and integrability. Predictable words should be easy to integrate.) These baseline conditions were created to control for word effects. Therefore, all High and Low Predictability critical probes appeared as critical probes in the corresponding baseline conditions (Table 1). Any differences between baseline and experimental conditions would be due to predictability and/or integrability rather than word characteristics (e.g., word length, word frequency, etc.).

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Table 1. Sample passages for each condition

Condition	Sample passage	Prediction Score	Integration Score
Sample 1			
High predictability	After drawing five cards from the deck, Sebastian cautiously laid down his money. The **bet**	0.38	-0.50
Low predictability	After drawing five cards from the deck, Sebastian cautiously laid down his money. The **stakes**	0.02	-0.41
High predictability baseline	Ian would have to cook food more often at home after today. The **bet**	0.00	2.17
Low predictability baseline	After Sebastian moved to a new city, he began looking for a house. The **stakes**	0.00	2.39
Sample 2			
High predictability	For Memorial Day picnic, the family cooked up a large batch of chicken. The **food**	0.24	-0.67
Low predictability	For Memorial Day picnic, the family cooked up a large batch of chicken. The **meat**	0.02	-0.67
High predictability baseline	For the 4th of July, the class made plans to spend the day together. The **food**	0.00	1.04
Low predictability baseline	For the Memorial Day picnic, the family fixed a very large Caesar salad. The **meat**	0.00	0.99

Note. Words underlined in bold denote probe words that were scored for predictability and ease of integration. Response time (RT) to these probe words were recorded for all analyses. Predictability scores reflect cloze probabilities. Integration scores are based on z-transformations from a likert scale of integration difficulty (1 - 7). Smaller integration scores indicate greater sentence fit.

We obtained predictability and integrability scores for the baseline critical probe words using the procedure outlined above. Thirty-two participants provided cloze probabilities as predictability scores. Of the 30 participants who provided integration ratings, seven participated in a previous Mturk study, and we excluded their data from the analysis. We matched the

baseline sentences on word length $\pm$4 words to their experimental counterparts. In addition to predictability and integrability scores, word length, sentence length, orthographic neighborhood size, and logarithmic frequency were measured (Davis, 2005; Table 2). We also used a latent semantic analysis (LSA) to measure semantic associations between critical words and the context sentence (http://lsa.colorado.edu/). Higher LSA scores indicate words had greater semantic overlap with context sentences than lower LSA scores.

Table 2. Word characteristics of stimuli

Condition	Integration	Prediction	Critical word length	Sentence Length	N	LSA	Log frequency	Mean RT
Experiment 1 full data: N = 73								
High predictability	-0.48 (0.31)	0.32 (0.13)	5.2 (1.6)	18.50 (4.50)	6.20 (5.60)	0.18 (0.17)	1.63 (0.66)	859 (154.5)
Low predictability	-0.28 (0.39)	0.02 (0.01)	5.8 (1.6)	18.50 (4.50)	4.30 (4.90)	0.12 (0.15)	1.33 (0.67)	829 (152.6)
High predictability baseline	1.38 (0.96)	0.00 (0.01)	5.2 (1.7)	17.80 (3.60)	6.00 (5.60)	0.03 (0.08)	1.55 (0.67)	793 (141.9)
Low predictability baseline	1.72 (0.78)	0 .00 (0.00)	5.8 (1.5)	18.30 (4.40)	4.40 (5.00)	0.06 (0.08)	1.35 (0.68)	794 (142.0)
Experiment 1 subset data: N = 57								
High predictability	-0.44 (0.29)	0.30 (0.12)	5.14 (1.67)	17.74 (5.99)	6.23 (5.48)	0.18 (0.17)	1.60 (0.66)	861 (157.5)
Low predictability	-0.38 (0.31)	0.02 (0.00)	6.05 (1.60)	18.46 (5.19)	3.88 (4.58)	0.14 (0.16)	1.27 (0.61)	831 (150.7)
High predictability baseline	1.55 (0.87)	0.00 (0.01)	5.20 (1.69)	17.78 (3.70)	5.96 (5.39)	0.02 (0.08)	1.56 (0.68)	797 (143.0)
Low predictability baseline	1.77 (0.70)	0.00 (0.00)	6.02 (1.59)	18.63 (4.61)	3.95 (4.59)	0.06 (0.08)	1.27 (0.61)	794 (143.3)
Experiment 2 (ERP) data: N = 84								
High predictability	-0.48 (0.32)	0.32 (0.13)	5.30 (1.62)	18.56 (4.45)	5.79 (5.54)	0.11 (0.15)	1.65 (0.62)	---
Low predictability	-0.45 (0.45)	0.02 (0.01)	5.93 (1.46)	18.56 (4.45)	3.65 (4.78)	0.10 (0.15)	1.24 (0.63)	---
High predictability baseline	1.42 (0.86)	0.00 (0.01)	5.34 (1.64)	17.49 (3.69)	5.63 (5.52)	0.01 (0.06)	1.59 (0.63)	---
Low predictability baseline	1.68 (0.81)	0.00 (0.00)	5.90 (1.45)	18.33 (4.39)	3.69 (4.80)	0.04 (0.08)	1.24 (0.63)	---

Note. Integration scores are z-transformed. Prediction is the cloze probability. N = number of items per experimental condition. Standard deviations are in parentheses. Mean reaction times (RTs) are back transformations of a reciprocal transformation.

Some critical probe words were used in two different experimental sentence contexts. In these cases, it was necessary to create a baseline filler probe so that each experimental critical word only had one corresponding baseline sentence (Table 3). Of the total probes, 97% of the trials had critical probes and 3% had filler baseline probes.

In the final analysis we excluded 11 of the baseline items, because they had predictability or integrability scores similar to the experimental conditions. Word characteristics for the remaining 73 stimuli can be found in Table 2. High Predictability critical probes had lower integrability scores than baseline critical probes, indicating that they were easier to integrate. Similarly, Low Predictability critical probes had lower integrability scores than corresponding baseline critical probes. Both baseline critical probes had average cloze probabilities of zero. Although both experimental critical probes were easier to integrate than their respective baseline critical probes, High Predictability critical probes were easier to integrate than Low Predictability critical probes.

Table 3. Sample filler baseline passage

Condition	Sample Passage
Sample 1	
High predictability	For Memorial Day picnic, the family cooked up a large batch of chicken. The **food**
High predictability baseline	For the 4th of July, the class made plans to spend the day together. The **food**
Sample 2	
High predictability	Sarah was excited to try out the new recipe and made a large dish. The **food**
Filler baseline	Marge was elated to try the new ride at the amusement park. The **safety**

Note. Filler baseline probe words were not analyzed. Because experimental conditions could have the same response (e.g. food), only one baseline sentence was needed.

3.1.3   Design and procedure

Three lists were created so that every participant saw each condition and probe words did not repeat. The lists were counterbalanced across subjects and did not differ in probe word length or frequency. Each list contained a total of 224 stimuli; 112 were critical probes with negative responses. Of the critical probes there were 28 items per condition (High Predictability, Low Predictability, High Predictability Baseline, and Low Predictability Baseline). Additionally, there were 112 filler probes with positive responses. These filler probes occurred at the beginning (first 1 – 3 words; $N = 37$), middle (within the middle third of the sentence; $N = 37$), and end (final word of a sentence; $N = 38$) of context sentences.

Participants completed an RSVP task in which they were shown words with a stimulus onset asynchrony (SOA) of 100 ms and an interstimulus interval (ISI) of 0 ms (Masson, 1986). Masson found that comprehension could still be achieved with this rapid stimulus presentation. The fast presentation rate discourages rehearsal and memorization of word lists.

The experiment was conducted using E-prime 2.0 software (Psychology Software Tools, Inc., Pittsburgh, PA) and lasted about 15 minutes. Before the start of each sentence a fixation cross appeared on the screen for 500 ms followed by words presented one at a time. Probe words were shown capitalized with a question mark after the first word of the second sentence. Participants used "k" and "d" on a keyboard for "yes" and "no" responses. Participants were instructed to respond quickly and accurately, and received accuracy feedback after each trial. Participants pressed the "spacebar" to continue to the next trial. The experiment had three blocks of trials, with two 75 trial blocks and one 74 trial block. Participants had a maximum of three

minutes for their breaks between blocks. All items were randomized for each subject and participants had 10 practice trials before the start of the experiment.

3.1.4 Measures

After the RSVP task, participants completed reading comprehension, vocabulary, and working memory (WM) assessments and scores were later used to test associations with RT.

3.1.4.1 Reading comprehension and vocabulary The Nelson-Denny Reading Test is a paper and pencil test that includes a measure of reading comprehension and vocabulary competence. The comprehension section contained eight short passages and a total of 36 multiple choice questions. Test takers had a maximum of 15 minutes to complete this portion of the test. The vocabulary section contained 100 multiple choice vocabulary questions, and participants had 7.5 minutes to complete this section.

3.1.4.2 Working memory Automated Word Operation Span (Aospan) is a test of working memory (Daneman, & Carpenter, 1980; Unsworth & Engle, 2005; Unsworth, 2007). In this task participants remembered words while performing simple mathematic operations. Participants completed 15 trials, between two and six words in length. At the beginning of each trial a math problem was shown (e.g. $2 + 3 = 5$) followed by a question mark. Participants pressed "d" or "k" on a keyboard to indicate whether the answer was correct or incorrect. A word followed the response and was replaced by another math operation until the end of the trial. Participants then had to recall the words in the order they were presented. An accuracy of 85% on the math

operations was required of all participants. Total Aospan scores for all correctly remembered items and partial Aospan scores for items remembered in the correct order were measured.

3.2   RESULTS AND DISCUSSION

3.2.1   Descriptive data

The results are based on data from 59 participants, following the exclusion of data from one non-native English speaker.

3.2.1.1 Comprehension, vocabulary, and WM Nelson-Denny composite comprehension and vocabulary scores were calculated as one point for each correct response and minus one fifth of a point for blank or incorrect responses (see Table 4). The average scores were within one standard deviation of the scores of 6,501 participants in the Pittsburgh Adult Reading Database for comprehension ($M = 17.89$, $SD = 7.04$) and vocabulary scores ($M = 39.09$, $SD = 18.73$).

Participants had an average total WM (Automated Operation Span) score of 52.15 ($SD = 6.3$). Total Aospan scores were computed as the total number of correctly recalled items per participant regardless of input order and the possible scores range from 0 to 60. Partial Aospan scores were calculated as the total number of words recalled in order (Table 4).

Table 4. Correlations among assessments

Assessment	1	2	3	4	5
1. Comprehension	---				
2. Vocabulary	0.62**	---			
3. Partial Ospan	-0.04	-0.20	---		
4. Total Ospan	0.24	0.10	0.23	---	
5. Response Time	-0.23~	-0.25~	-0.06	0.19	---
Mean (*SD*)	19.14 (6.9)	41.65 (18.8)	4.68 (3.3)	52.15 (6.3)	818 (144.5)

Note. ~ $p < .1$; ** $p < 0.01$ level. The number of items used is 73. Response times were back transformed after a reciprocal transformation. $N = 59$.

3.2.2 Responses to critical probe words

The key data are the response times to critical probes on correct negative trials (average accuracy = 94.3%, *SD* = 4.2%). We ran analyses on the 73 critical probe words that were different in predictability and integrability scores across experimental and baseline conditions. Finding that the High Predictability condition had longer RTs than the Low Predictability condition would be evidence of predictability effects beyond integrability effects.

We took several data processing steps before running analyses. Because RTs to critical probe words were highly positively skewed, RTs were transformed to reciprocals. Words with RTs faster than 200 ms were not included in analyses. Additionally, words greater than 2 standard deviations above the mean for each individual were excluded from further analyses. Based on these criteria, 3.57% of trials were excluded.

Both experimental conditions had longer RTs than their respective baseline conditions. Importantly, the High Predictability condition had longer RTs than the Low Predictability condition. Results indicate that predictability effects existed when controlling for integrability.

A Repeated Measures ANOVA confirmed significant differences among the four conditions, $F(3, 174) = 50.14$, $\eta^2 = .46$, $p < .001$ ([Figure 1](#)). Planned comparisons between experimental conditions (High vs. Low Predictability) and experimental vs. baseline conditions (High Predictability vs. High Predictability Baseline; Low Predictability vs. Low Predictability Baseline) confirmed the following: both experimental conditions were significantly different from their baseline conditions, High Predictability-Baseline: $t(58) = 9.53$, $p < .001$; Low Predictability-Baseline: $t(58) = 5.88$, $p < .001$. Most importantly, there was a significant difference between the High and Low Predictability conditions, $t(58) = 4.28$, $p < .001$.
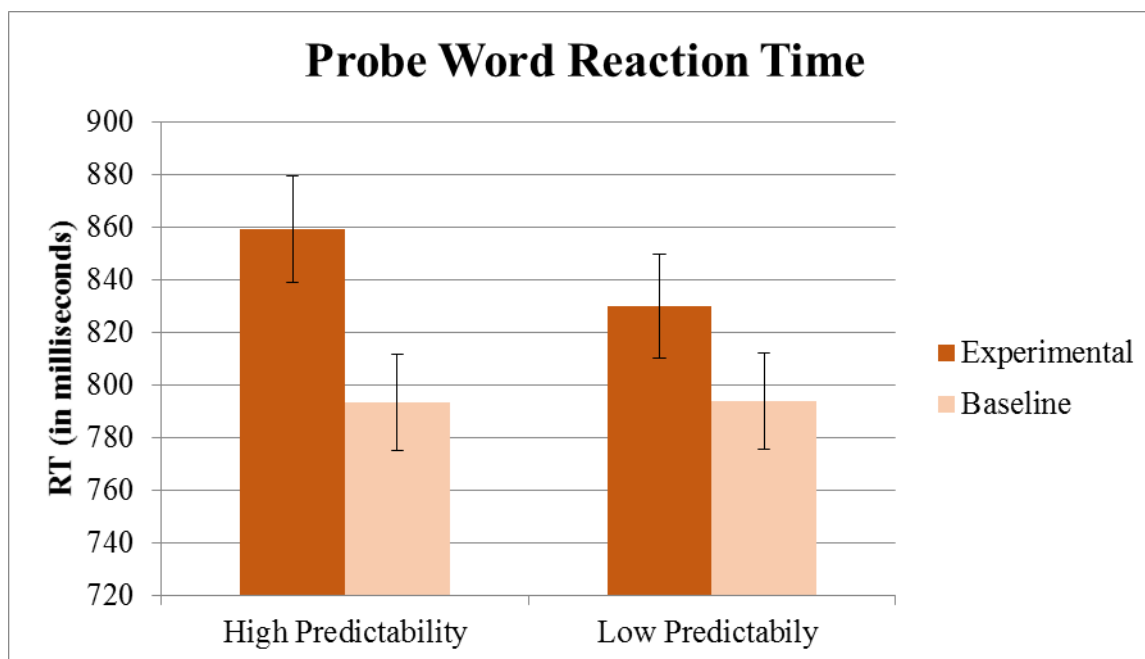

Figure 1. Response times (RTs) to detecting a probe word in a previous context sentence. Note values were back transformed after a reciprocal transformation.

Because High and Low Predictability conditions significantly differed on integrability, $t(72) = -3.49$, $p = .001$), we used a subset of the data to verify that the current findings were due

to differences in predictability and not integrability. Out of the total 73 experimental items, 57 were selected such that integrability scores between High and Low Predictability conditions were similar, $t(56) = 1.24$, $p = .220$. Results from the subset data were comparable to the full dataset for the omnibus ANOVA, $F(3, 174) = 46.48$, $\eta^2 = .36$, $p = < .001$, and paired t-tests. Planned comparisons confirmed that both experimental conditions were significantly different from their baseline conditions, High Predictability-Baseline: $t(58) = 9.85$, $p < .001$; Low Predictability-Baseline: $t(58) = 5.70$, $p < .001$. There was a significant difference between High and Low Predictability conditions, $t(58) = 3.40$, $p < .001$.

We also explored associations among comprehension, vocabulary, working memory, and RT. Comprehension and vocabulary were marginally negatively correlated with RT, $r = -.23$, $p = .08$; $r = -.25$, $p = .06$. Automated Operation Span was not correlated with RT (Tabl4).

Results indicate our memory search RSVP task was able to show that integration and prediction can be separated as distinct processes (at least to some extent). Specifically, the High Predictability condition had longer RTs than the Low Predictability condition. The same parameters for these two conditions can therefore be used in the ERP study to determine whether cognitive processes rely on integrative, predictive, or both processes in cross-sentence boundary reading.

4.0   EXPERIMENT 2: ERP STUDY

With Experiment 1 establishing that predictive processes could be measured separately from integrative processes, the goal of Experiment 2 was to test the effects of predictability while accounting for integrability in text reading. N400 amplitudes serve as indicators of predictive and integrative processes. If readers predict across a sentence boundary, reduced N400 amplitudes would be observed in the High Predictability relative to the Low Predictability condition. A difference in amplitudes would indicate that predictive processes operate above and beyond integrative processes. However, if integrative processes are dominant in cross-sentence boundary reading, N400 amplitudes should be similar in the two conditions. Regarding P600 effects, if word predictability influences processing, low predictable words should have greater positivity than high predictable words.

4.1   METHOD

4.1.1   Participants

Thirty-three individuals (14 females, 19 males) with an age range of 18 – 52 ($M = 22$, $SD = 8.05$) recruited through the University of Pittsburgh's subject pool participated in the study. All participants were right-handed, native English speakers, with no neurological, visual, or reading impairments.

4.1.2   Materials

Many of the same stimuli, excluding the 112 positive filler sentences from Experiment 1, were included in Experiment 2. To ensure critical probe word integrability differences between the High and Low Predictability conditions were negligible, we ran an additional Mechanical Turk study ($N = 23$) with a new set of low predictable critical words from the original predictability norming study. Low predictable words were then selected to match the integrability scores of the High Predictability condition. This resulted in 16 low predictable words being exchanged to better match the high predictable words on integrability, t (166) = -.522, $p = .602$. Baseline stimuli from Experiment 1 that were above ideal predictability and integrability levels were modified and tested again using the same norming procedures from Experiment 1 ($N = 20$). Additionally, LSA scores between experimental conditions were similar (Table 2). The fragments from Experiment 1 were extended, resulting in sentence pairs. The following is a sentence pair for sample passage 1 in the Table 1 High Predictability condition.

26

(3) After drawing five cards from the deck, Sebastian cautiously laid down his money.

*The **bet** he put forth caused him to lose as his friend had a much better hand.*

These full sentence pairs encouraged participants to read for comprehension.

4.1.3   Design and procedure

Three lists were created, counterbalanced across participants so that each participant viewed 28 stimuli from each of the four conditions. Participants saw the sentences presented one word at a time to minimize saccade artifacts. Words were presented with an SOA of 600 ms and an ISI of 300 ms.

Subjects were instructed to read the sentences for comprehension with short True/False comprehension questions following 50% of the sentences. One half of the correct answers were true. The Nelson-Denny vocabulary and comprehension measures were administered at the conclusion of the EEG recording session.

4.1.4   Apparatus, ERP recording and processing

EEG recordings were obtained using a 128 electrode Geodesic sensor net (Tucker, 1993) containing Ag/AgCl electrodes and the Net Amps 400 amplifier (Electrical Geodesics 5.0, Inc., Eugene, OR). All subjects were fitted with the appropriate sized net. Participants then sat in a soundproof and electrically shielded booth and EEG signals were collected using Net Station Acquisition software. During the recording session EEG impedances remained below 40kΩ

(Ferree, Phan, Gerald, & Tucker, 2001). Stimuli were presented on a CRT monitor with a refresh rate of 60 Hz.

During the recording session the central vertex electrode (Cz) served as the reference, with six electrodes around the eyes to monitor eye movements. Continuous EEG data were recorded at the rate of 1000 Hz. An experimenter instructed participants to read short passages for comprehension. After the recording session, EEG data were filtered through a low-pass finite impulse filter of 30 Hz at 6dB/octave and a high-pass filter of .1 Hz. After filtering, EEG data were segmented into 1000 ms epochs. Segments contained EEG data 200 ms before the critical word and 800 ms after the critical word. The epochs were then run through an artifact detection tool using Net Station 5 software.

Artifact detection was based on a regression model from Gratton, Michael, and Donchin (1983). A channel removal threshold was set during a time window of 80 ms. Channels showing an amplitude $\pm$ 200μV on over 20% of trials were removed. Segments for particular trials were removed using the following three benchmarks: if more than 12 channels were removed in the aforementioned step, if amplitudes were $\pm$ 140μV (eye blinks), or if amplitudes were $\pm$ 55μV (saccades). Two subjects had less than 60% of trials retained and their data were not included in further analyses.

After the artifact rejection process, an average of 5.45 ($SD = 1.71$) electrode channels was removed and an average of 24.29 ($SD = 1.54$) trials per condition remained. Data for removed channels were replaced using spherical spline interpolation (Ferree, 2006). Segments were baseline corrected using a 200 pre-stimulus time period and subsequently re-referenced using the average reference. Data were then exported to EP Toolkit v2.49 (Dien, 2010) and SPSS 23.0 for statistical analyses.

4.2   RESULTS AND DISCUSSION

4.2.1   Descriptive data

4.2.1.1 Nelson-Denny The average Nelson-Denny comprehension score was 20.11 (SD = 6.53). The average vocabulary score was 42.82 (SD = 18.37). Similar to Experiment 1, comprehension and vocabulary scores were within one standard deviation of average scores from the Pittsburgh Adult Reading Database.

4.2.1.2 Text comprehension questions Participants had an average accuracy of 91.7% (SD = 5.01) for comprehension questions. Conditions were similar on comprehension question accuracy (F (3, 90) = 1.55, p = .215). This indicates that although the first content word of the second baseline sentence was not predicted or easily integrated with the previous sentence, as complete texts the sentences were comprehensible.

4.2.2   ERP results

4.2.2.1 Analysis procedure We ran an ANOVA on averaged data from 31 subjects using electrode clusters selected based on previous N400 topography using the 10/20 system. Figure 2, shows the electrodes used for each cluster. These clusters were centered on frontal (Fz), central (Cz, C3, and C4), and parietal (Pz, P3, P4) sites. Analyses targeted midline (Fz, Cz, and Pz) and

lateral centro-parietal lateral sites (C3, P3, C4, and P4). The comparisons of interest (High vs. Low Predictability, High Predictability vs. High Predictability Baseline, and Low Predictability vs. Low Predictability Baseline) were tested through planned comparisons. Bonferroni contrasts were conducted on electrode clusters. We used the Greenhouse-Geisser correction when sphericity assumptions were violated. Degrees of freedom are reported with original values and the corrected p-values are reported. Two time windows from 300 to 500 ms (N400) and from 500 to 700 ms (P600) were analyzed.
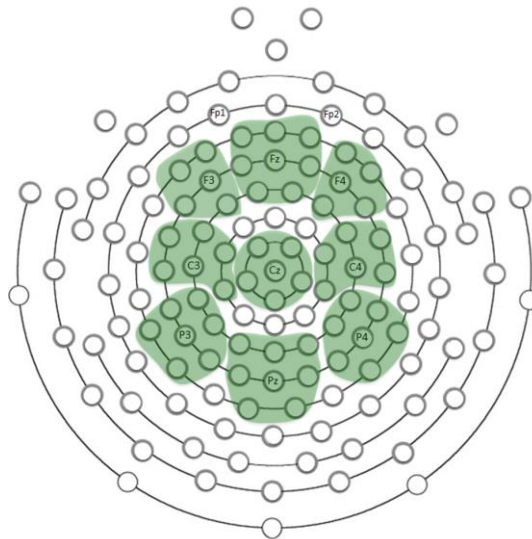
Figure 2. Electrode clusters from the 128 electrode HydroCel Geodesic Sensor Net 1.0.

4.2.2.2 Mean amplitude analysis: N400 Experimental conditions had reduced negativity relative to baseline conditions in the N400 time window. Importantly, there were no differences between the High and Low Predictability conditions.

The findings are a result of a 4 (Condition) x 3 (Electrode) repeated measures ANOVA at midline clusters (Fz, Cz, and Pz), which revealed a significant main effect of condition, $F (3, 90)$

= 9.14, η^2 = .23, $p < .001$, and a significant main effect of cluster, $F(3, 90) = 12.23$, = .29, p < .001. There was no significant interaction, $F(6, 180) = 1.79$, $\eta^2 = .07$, $p = .129$. Planned comparisons confirmed a significant difference between High and Low Predictability conditions and their baseline conditions, High Predictability-Baseline: $t(30) = 5.61$, $p < .001$; Low Predictability-Baseline: $t(30) = 2.51$, $p = .018$ (Figure 3). No differences occurred between High and Low Predictability conditions, $t(30) = .96$, $p > .3$.
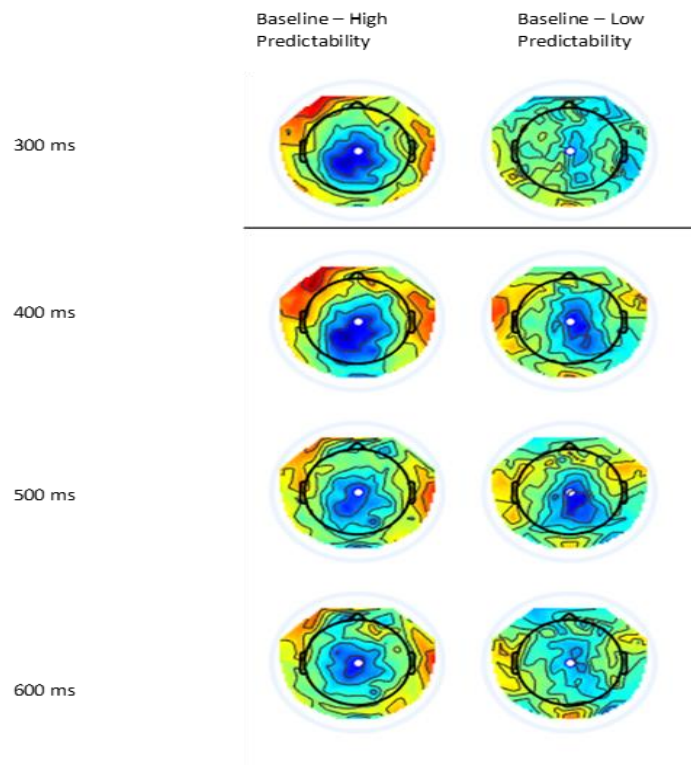
Figure 3. Topography of conditions

Cz and Pz clusters were more negative than the Fz cluster. Bonferroni corrected contrasts confirmed that both Cz ($M = -1.03$, $SD = .18$) and Pz (M = -.97, $SD = .19$) clusters had more negative amplitudes than the anterior Fz cluster ($M = .33$, $SD = .24$; Fz vs. Cz, $p < .001$; Fz vs. Pz, $p = .002$). There was no significant difference between Cz and Pz clusters ($p = .801$).

Analyses were also conducted on C3, C4, P3, and P4 centro-parietal clusters. A 4 (Condition) x 2 (Laterality) x 2 (Anteriority) repeated measures ANOVA was conducted at these four sites. An omnibus ANOVA revealed: a main effect of Condition, $F(3, 90) = 6.84$, $\eta^2 = .19$, $p = .001$, a main effect of Laterality, $F(1, 30) = 34.21$, $\eta^2 = .53$, $p < .001$, and a main effect of Anteriority, $F(1, 30) = 7.45$, $\eta^2 = .20$, $p = .011$. An interaction of Condition x Laterality x Anteriority, $F(3, 90) = 5.67$, $\eta^2 = .16$, $p = .017$, was significant. Following this interaction, ANOVAs were performed at each electrode cluster to further explore the effect of Condition.
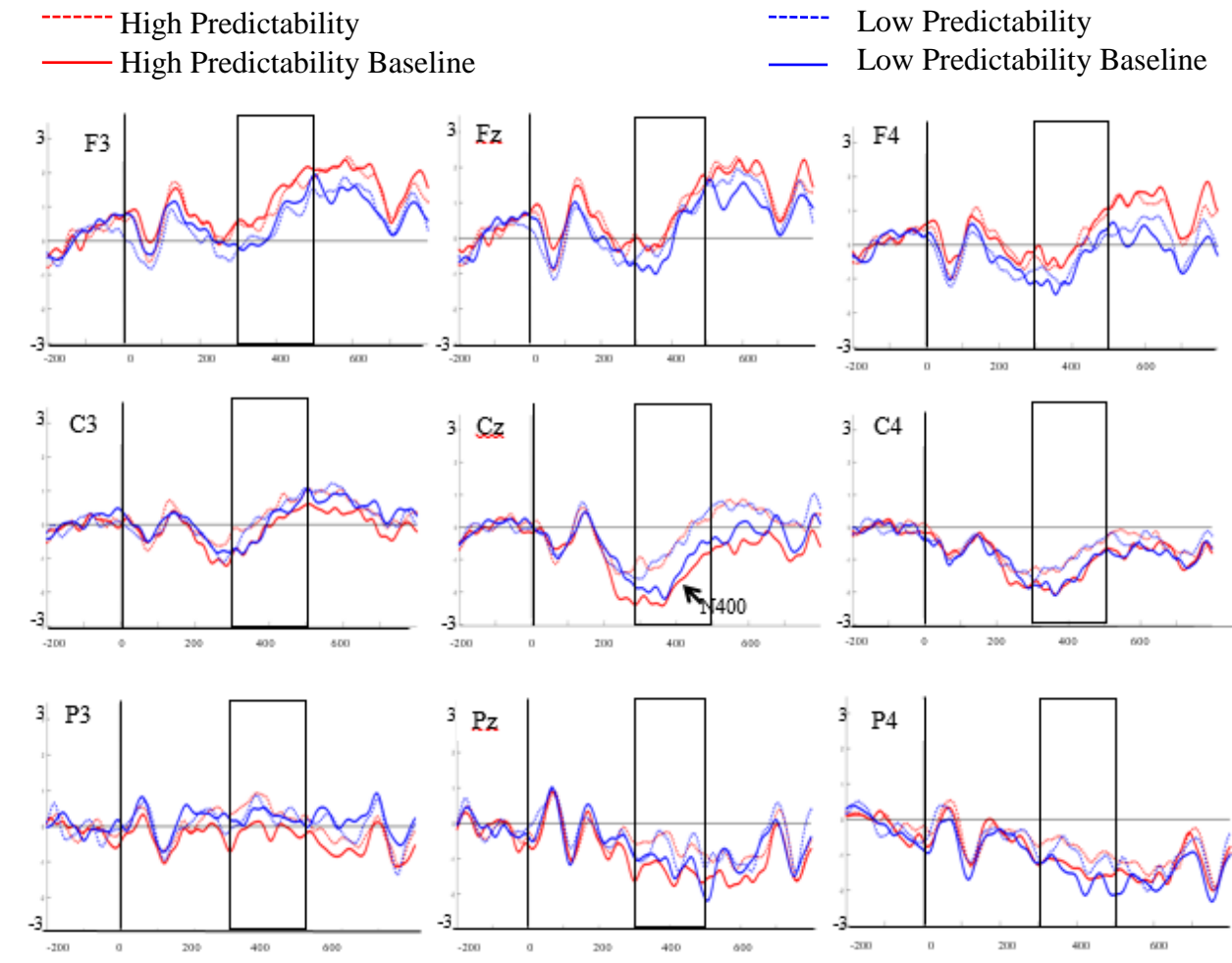
Figure 4. ERP waveforms at the critical word (e.g. *bet*). Waveforms were averaged across all subjects. N400 effects (300 to 500ms) can be seen at Cz, C4, Pz, and C4 (centro-parietal sites). The vertical line at the left of each waveform at time zero indicates the stimulus onset.

Condition had a significant effect on N400 amplitudes at the C4 cluster, $F(3, 90) = 3.373$, $\eta^2 = .11$, $p = .019$. Experimental conditions had a greater positivity than their respective Baseline conditions, High Predictability-Baseline: $t(30) = 3.03$, $p = .005$; Low Predictability-Baseline $t(30) = 2.06$, $p = .048$ (Figure 4). The two experimental conditions were not significantly different, $t(30) = .007$, $p = .994$. Analyses at the P4 cluster yielded similar results. A main effect of Condition, $F(3, 90) = 3.38$, $\eta^2 = .12$, $p = .012$, was again due to High and Low Predictability conditions having greater positivity than the baseline conditions, High Predictability-Baseline: $t(30) = 2.59$, $p = .015$; Low Predictability-Baseline: $t(30) = 2.05$, $p = .049$. Additionally, the experimental conditions did not differ from one another, $t(30) = .90$, $p > .3$. C3 and P3 clusters exhibited no effects of Condition, $F(3, 90) = 1.93$, $\eta_p^2 = .06$, $p = > .1$, $F(3, 90) = 2.13$, $\eta^2 = .08$, $p > .1$, respectively.

Midline and lateral analyses revealed a greater negativity at right lateralized, centro-parietal sites for difficult-to-integrate words. The results are consistent with previous WTI research and broader research on N400 as an indicator of semantic fit.

4.2.2.3 Post-hoc and P600 time window analyses Due to a left lateralized frontal positivity (Figure 3), we conducted a 4 (Condition) x 2 (Electrode) repeated measures ANOVA on F3 and Fp1 frontal sites in a 500 to 700 ms time window. The analysis showed only a marginal effect of Condition, $F(3, 90) = 2.53$, $\eta^2 = .06$, $p = .071$.

At midline sites, we found an extended N400 effect for the experimental conditions relative to the baseline conditions in this P600 time window (500-700 ms). An effect of Condition, $F(3, 90) = 4.77$, $\eta^2 = .14$ $p = .004$, was due to significant differences between the experimental conditions and their baseline conditions, High Predictability-Baseline: $t(30) = 3.24$,

p = .003; Low Predictability-Baseline: *t*(30) 2.79, *p* = .047. Further comparisons showed no significant differences between the two experimental conditions, *t*(30) = .53, *p* = .603.

We conducted a 4 (Condition) x 2 (Anteriority) x 2 (Laterality) repeated measures ANOVA in the 500 – 700 ms time window at lateral centro-parietal sites. An omnibus ANOVA revealed no significant effects of Condition, $F(3, 90) = 2.082$, $\eta^2 = .07$, $p = .124$.

Results from Experiment 2 indicate an ease of processing for words that were easy to integrate, indicated by reduced N400 amplitudes compared to baseline conditions. However, there was no effect of predictability in the N400 time window. Because the experimental conditions were matched on integrability, the similar N400 amplitudes for high and low predictable words demonstrate the importance of integrative processes in cross-sentence boundary reading.

5.0   GENERAL DISCUSSION

The combined results from Experiments 1 and 2 demonstrate that prediction and integration are separate processes and readers depend on integrative processes when reading across a sentence boundary. Results from Experiment 1 demonstrate that our materials produced predictability effects when people had to judge whether a word occurred in a preceding sentence. An important aspect of the RSVP paradigm was that the rapid presentation rate did not allow an opportunity for *controlled* predictive processes based on task-specific characteristics. Through this novel task we could dissociate prediction and integration.

In Experiment 2, when subjects read passively for comprehension we found no cross-sentence boundary predictive effects; i.e., no significant differences in N400 amplitudes between words that were more predictable and easily integrated compared to words that were less predictable and easily integrated. Some research has postulated that integrative effects occur later in processing, in the P600 time window (Burkhardt, 2007). However, these late effects might be more reflective of using predicate information within a sentence to revise the situation model. We found no P600 effects in the current ERP experiment, signifying integrative processes involve updating the mental model rather than revising information. Additionally, although predictive effects were not observed, the results were consistent with past research on semantic

fit (Federmeier & Kutas, 1999; Kutas & Hillyard, 1980; Lau, Holcomb, & Kuperberg, 2013; Van Berkum et al., 2005) and the memory-based view of integration (Perfetti & Stafura, 2014).

We introduce the view that integration and prediction serve the same underlying process. When readers encounter a word in a text, its meaning interacts with previous contextual information and serves as a retrieval cue for that information. This passive activation occurs as the critical word is being read, and is highlighted by the fact that LSA (measured as the semantic association between critical words and context sentences) and integrability scores were controlled in Experiment 2. If words that are easy to integrate receive the same amount of semantic activation, they should be similarly easy to process. Passive activation from the situation model leads to facilitated integrative processing for words semantically associated with the situation model. .

Considering the two experiments together, we note that Experiment 1 showed effects of predictability and, possibly, integrability whereas Experiment 2 only showed integrability effects. The different result patterns are a product of differences in reading mode and experiences within the experimental task (Lau et al., 2013; Wlotko & Federmeier, 2015). Experiment 1 required individuals to make decisions on critical words, therefore those words elicited an action and were not integrated into the situation model. However, in Experiment 2 individuals read sentence pairs passively, and critical words were read as part of the text rather than as a response cue. This difference in reading mode allowed us to establish predictive and integrative processes are separable (Experiment 1) and that contextual information facilitates word integration in cross-sentence boundary reading (Experiment 2).

In an ERP study by Lau et al. (2013) that did not require sentence reading, word pairs were used to examine predictive processing. The first word served as a prime and was either

related or unrelated to the target based on forward semantic associations. The task in the study was for participants to press a button when they saw the name of an animal. Prime-target pairs occurred in high or low relatedness proportion blocks. In the high relatedness block 50% of prime-target items were semantic associates whereas in the low relatedness block, 10% of prime-target stimuli were semantic associates. Results showed a larger N400 effect for related targets in the low relatedness proportion group relative to the high relatedness proportion group.

Because Lau and colleagues (2013) manipulated the proportion of prime-target pairs that were semantically associated, individuals were more likely to actively predict words in the high relatedness proportion block. These predictions lead to a facilitation of word processing when the target was encountered. Wlotko and Federmeier (2015) found similar results using sentence pairs and different blocks that either increased or decreased the likelihood of individuals making predictions. Thus, similar to differences in our Experiments 1 and 2, the types of processes used in reading depend on task environment and stimuli characteristics.

In our Experiment 2 a new sentence introduces a new portion of a situation model and the onset of the sentence leads to different processing strategies than words encountered down-stream within a sentence boundary (Gernsbacher, 1991). In the beginning stages of a sentence, there are more possible continuations than at the end of a sentence. Our results from norming studies and Experiment 2 indicate that predictive effects weaken at a sentence boundary as a reader closes the sentence meaning (Just & Carpenter, 1980). Although it is unclear if shifting to a new situation model is the default strategy for readers when confronted with a sentence boundary, the possibility of a new topic is larger across a sentence boundary than within a sentence boundary. However, when the topic continues across sentences, propositions must be carried across a sentence boundary.

Our results have two possible explanations. The first is that predictability ratings were lower in our study than in previous ERP studies. In the present two experiments, high predictability was > .15 cloze and low predictability was < .05 cloze and our conditions may not have been different enough in predictability scores to elicit a predictability effect. ERP research on predictability effects within a sentence boundary has higher cloze ratings on average (usually between .5 and .97; Brothers et al., 2015; DeLong et al., 2005; Federmeier & Kutas, 1999; Lau et al., 2013; Wlotko & Federmeier, 2015) than the present study. However, cloze values at the beginning of a sentence that equate values measured at the end of a sentence are unlikely. In a recent auditory ERP study with sentence pairs, researchers manipulated global and local coherence. In their high contextual constraint condition, in which target words occurred mid-sentence and were globally predictable and locally consistent, the cloze probability was .55 (Boudewyn, Long, & Swaab, 2015). One can imagine if these words were to occur earlier, closer to the sentence boundary of the preceding sentence, the cloze probability would be reduced.

A second, more likely, explanation of the current findings is that there is facilitated processing for words across a sentence boundary based on semantic congruence rather than specific predictions. Whether the facilitation from memory-based activation leads to broad or more specific expectations (e.g., semantic activations vs. a lexical item) may depend on how much information a reader has encountered within a sentence. If a reader is processing information at the beginning of a sentence, facilitation may be broader, as seen in the present study. Therefore, we argue that specific predictions do not occur across a sentence boundary. Instead, activations from memory and activations from presently read words influence each other. Overlap from activations in memory facilitates integrative processes, and integration is essential for text coherence.

APPENDIX A

EXPERIMENT 1 MATERIALS

Table 5. Experiment 1 materials

Number	Condition	Context sentence and probe word
1	HighP/LowP	In order to cook with the fruit, one must remove the apple's center. The CORE?/SEEDS?
	Baseline High	Different planets have many interesting properties, and Earth in particular is very special. The CORE?
	Baseline Low	In order to live a happy life, one must be kind to others. The SEEDS?
2	HighP/LowP	After seeing the zombie movie, the faces would stay in Julie's mind all night and scare her. To SLEEP?/MAKE?
	Baseline High	It is nearly impossible to watch a horror film without feeling slightly afraid. To SLEEP?
	Baseline Low	After seeing the zombie movie, Julie wanted to play a zombie video game with her close friends. To MAKE?

3	HighP/LowP	Sarah was excited to try out the new recipe and made a large dish. The FOOD?/OUTCOME?
	Baseline High Filler	Marge was elated to try the new ride at the amusement park. The SAFETY?
	Baseline Low	Sarah was excited to try out for the volleyball team and practiced every week. The OUTCOME?
4	HighP/LowP	In order to stay organized during the field trip, the teacher distributed the class's schedule. The STUDENTS?/TIMETABLE?
	Baseline High Filler	In order to visit all of the exhibits at the museum, the teacher gave each room a time limit. The CLASS?
	Baseline Low	In order to stay successful, one must make a plan and always abide by it. The TIMETABLE?
5	HighP/LowP	Gavin threw on his coat and headed down the little road. The WEATHER?/PATH?
	Baseline High	Joshua grabbed his hat and headed for the door. The WEATHER?
	Baseline Low	Tony threw on his coat and walked toward the wooden door. The PATH?
6	HighP/LowP	The scream Sue heard in the middle of the night filled her with fear. The SOUND?/TERROR?
	Baseline High	The players were sitting on the side of the stage, waiting for their turn. The SOUND?

	Baseline Low	In the middle of the night, Sue went to get a glass of water. The TERROR?
7	HighP/LowP	Walking on frozen ponds in early winter can be a danger. The ICE?/SNOW?
	Baseline High	The couple was surprised by the lack of cars on the road. The ICE?
	Baseline Low	Walking at night alone by the pond can be a danger. The SNOW?
8	HighP/LowP	After drawing five cards from the deck, Sebastian cautiously laid down his money. The BET?/STAKES?
	Baseline High	Ian would have to cook food more often at home after today. The BET?
	Baseline Low	After Sebastian moved to a new city, he began looking for a house. The STAKES?
9	HighP/LowP	Catlin had a bad headache so she went to the cabinet and swallowed an aspirin pill. The PAIN?/RELIEF?
	Baseline High Filler	Cathy had a lot of things to do, but the migraine she had prevented her from working. The HEADACHE?
	Baseline Low	Caitlin received a bad grade so she went to a tutor and got help on the subject. The RELIEF?
10	HighP/LowP	After buying a tree for the backyard, my dad handed me a shovel and instructed me to dig a hole. The GROUND?/LABOR?
	Baseline High	After buying a tree for the backyard, my dad handed me a camera

	Baseline Low	and instructed me to take a picture. The GROUND? My father handed me a brand new bike, instructed me to get on, and we rode around for hours. The LABOR?
11	HighP/LowP	George got yelled at for running around the pool because it was against a rule. The LIFEGUARD?/CAUTION?
	Baseline High	Hector never followed orders and it caused him to miss out on fieldtrips with his friends. The LIFEGUARD?
	Baseline Low	George got yelled at for forgetting to pick up his little sister from the pool. The CAUTION?
12	HighP/LowP	When Travis found out his dog had died he could barely contain his sorrow. His SADNESS?/LOSS?
	Baseline High	Trevor was not expecting the information and had to call in a favor to leave work early. The SADNESS?
	Baseline Low	When Travis found out he got a new dog he could barely contain his excitement. The LOSS?
13	HighP/LowP	After running the marathon, Tim was extremely thirsty. The WATER?/DRINK?
	Baseline High	Tyler loved to play outdoors during the summer. The WATER?
	Baseline Low	After running errands, Tim met with his friend. The DRINK?
14	HighP/LowP	After falling on the sidewalk and hurting my ankle, the nurse wrapped it with a bandage. The PAIN?/BROKEN?
	Baseline High	After running a full marathon, Julia celebrated with a close group

		of friends. The PAIN?
	Baseline Low	After falling on the sidewalk and dropping my books, my friend helped me pick them up. The BROKEN?
15	HighP/LowP	For Memorial Day picnic, the family cooked up a large batch of chicken. The FOOD?/MEAT?
	Baseline High	For the 4th of July, the class made plans to spend the day together. The FOOD?
	Baseline Low	For the Memorial Day picnic, the family fixed a very large Caesar salad. The MEAT?
16	HighP/LowP	When the alarm went off, Oscar was still tired so he closed the drapes. The SUN?/CURTAINS?
	Baseline High	Oliver switched rooms with his brother because it was on the other side of the hallway. The SUN?
	Baseline Low	When the alarm went off, Oscar got up to get ready for work. The CURTAINS?
17	HighP/LowP	When Nathan was rude to Sam at the bar last night, they got in a fight. The BARTENDER?/ALTERCATION?
	Baseline High	Matt and Sean made a pact to work together so they entered the facility to submit their resumes. The BARTENDER?
	Baseline Low	When Nathan was mad at Sam last night, the two discussed the issue and made up. The ALTERCATION?
18	HighP/LowP	Jogging in the early morning, Frank swore he saw something

		emerging out of the fog. The FIGURE?/MYSTERIOUS?
	Baseline High	Fred always jogged early in the morning and never had any troubles on his route. The FIGURE?
	Baseline Low	Jogging in the early morning, Frank swore he heard the sound of birds singing. The MYSTERIOUS?
19	HighP/LowP	Lola saved her money for the concert and was excited to listen to her favorite music live. The BAND?/ARTIST?
	Baseline High	Lea had many hobbies outside of school and her friends wondered how she had so much free time. The BAND?
	Baseline Low	Lola saved he money for the ticket and was excited to go see her idol in person. The ARTIST?
20	HighP/LowP	During the first night in her new place, Flora heard many strange noises. The SOUNDS?/EERIE?
	Baseline High	During the first week in a new city, Scarlett was amazed by the lights at night. The SOUNDS?
	Baseline Low	During the first night in her new place, Celia stayed up very late. The EERIE?
21	HighP/LowP	Jack and Dean get into the '49 Hudson, eager to begin this trip. The CAR?/JOURNEY?
	Baseline High Filler	Henry and Owen got into the sports car, ready to start their travels. The VEHICLE?
	Baseline Low	Jake and Dean get into the '49 Hudson, eager to start playing

		music. The JOURNEY?
22	HighP/LowP	Working full time all summer made Bryan extremely eager for the upcoming vacation. The TRIP?/HOLIDAY?
	Baseline High	Brice lost his phone and he did not want purchase another. The TRIP?
	Baseline Low	Working full time all summer made Bryan extremely eager for the upcoming winter. The HOLIDAY?
23	HighP/LowP	Staring across the grand canyon, we were impressed by how wide it was. The VIEW?/CHASM?
	Baseline High	The trees in our backyard were growing quickly and provided much shade during hot summer days. The VIEW?
	Baseline Low	Staring across the large valley, we were impressed by how beautiful it was. The CHASM?
24	HighP/LowP	After the hurricane, everyone was instructed to leave the affected area. The STORM?/DISASTER?
	Baseline High	Everyone was gathered around the chief, listening to his wise words. The STORM?
	Baseline Low	After the event, everyone was instructed to exit the large stadium. The DISASTER?
25	HighP/LowP	Jane was anxious to leave the bar because she found it to be too loud. The NOISE?/PEOPLE?
	Baseline High	Abby was ready to go to the party and have an enjoyable time

	Baseline Low	with her friends. The NOISE?
		Jane was anxious to enter because her bland clothes did not match the dress code. The PEOPLE?
26	HighP/LowP	While swimming in the shallow water near the rocks, Sharon stepped on a piece of glass and injured her foot. The CUT?/GASH?
	Baseline High	Shannon was out in her garden when a stray cat walked by and distracted her from her task. The CUT?
	Baseline Low	While swimming in the shallow water near the rocks, Sharon spotted a pretty piece of crystal near her right foot. The GASH?
27	HighP/LowP	No longer able to control his fury, the boyfriend hurled the delicate, porcelain vase against the wall and shattered it into bits. The PIECES?/POLICE?
	Baseline High	Jose could not believe it when he found out his girlfriend cheated on him with his best friend. The PIECES?
	Baseline Low	No longer able to control his fury, the boyfriend yelled at the top of his lungs and paced back and forth angrily. The POLICE?
28	HighP/LowP	Mary was having hard labor pains, so she went to the hospital to have her baby. The DOCTOR?/BIRTH?
	Baseline High Filler	Nora was having second thoughts about her school choice. The NURSE?
	Baseline Low	Sophie was having stomach pains, so she went to the hospital to

		talk with her doctor. The BIRTH?
29	HighP/LowP	After being dropped from the plane, the bomb hit the ground and blew up. The EXPLOSION?/DEBRIS?
	Baseline High	When Max entered the room, his classmates were talking very loudly when the teacher suddenly yelled. The EXPLOSION?
	Baseline Low	After being dropped from the plane, the supplies slowly floated towards the marooned sailors. The DEBRIS?
30	HighP/LowP	The driver looked up and saw the bus headed straight for her, but it was too late to stop the collision. The CRASH?/TRAGEDY?
	Baseline Low	The driver looked up and saw the bus headed towards the school, but it turned right before the school parking lot. The TRAGEDY?
	Baseline High Filler	The store owner never expected to be on the news retelling the horrific event that lead to her shop's closure. The ATTACK?
31	HighP/LowP	Patty had a headache and a fever and finally realized she had this year's virus. The FLU?/ILLNESS?
	Baseline High	After taking a nap, Betty woke up and was ready to eat a warm meal. The FLU?
	Baseline Low	Alyssa had a bad habit of always eating a lot when she was under stress. The ILLNESS?
32	HighP/LowP	The drunk driver was speeding at 70 mph towards a tree when he lost control of his car and wrecked. The CRASH?/IMPACT?
	Baseline High	The truck driver was heading down the highway when he

		encountered a roadblock. The CRASH?
	Baseline Low	The drunk driver was speeding at 70mph down the highway when the police pulled him over on the deserted road. The IMPACT?
33	HighP/LowP	Doris had already postponed seeing her mother several times when she grabbed some clothes and packed her suitcase to stay with her. The TRIP?/TRAVEL?
	Baseline Low	Daisy had already postponed talking with her mother several times when she grabbed the phone and dialed the number to contact her. The TRAVEL?
	Baseline High Filler	Arial had already put her career on hold several times when she grabbed her partner's hand and prepared for her speech. The TREK?
34	HighP/LowP	Ann opened her mouth as the dentist bore into her tooth. The DRILL?/CAVITY?
	Baseline High	Aiden had slowly moved towards the edge of the river when the employees motioned for him to stop. The DRILL?
	Baseline Low	Ann opened her bag as the receptionist asked her for the payment. The CAVITY?
35	HighP/LowP	The dishonest man stuck a hanger in the vehicle's window, opened the door, and in no time at all drove off with the car. The THIEF?/CROOK?
	Baseline High	The man went to the door and listened carefully for any noises,

	Baseline Low	and suddenly opened it to find something in the room. The THIEF? The man grabbed a hanger from the closet in the house, put on one of the blue coats, and headed outside to his friends. The CROOK?
36	HighP/LowP	Allison had hurt her knee, and she quickly fell behind the other runners and eventually came in last. The RACE?/LOSER?
	Baseline High	Angie was ready to leave when she remembered that she had to give her dog a bath. The RACE?
	Baseline Low	Allison had hurt her knee, and she had to slow down as she walked towards the finish line. The LOSER?
37	HighP/LowP	The banker felt sorry for the homeless, reached for his checkbook and made a large financial contribution. This DONATION?/CHARITY?
	Baseline High	The baker felt sorry for the poor, and made a few extra pastries to be taken home. This DONATION?
	Baseline Low	The banker felt sorry for the client, reached for the keyboard, and looked up her missing information. The CHARITY?
38	HighP/LowP	The hostile swarm of bees hurried out of the hive and began attacking Joan's hand. The STINGS?/HONEY?
	Baseline High	While the group of girls was on a camping trip, they knocked over a large object. The STINGS?

	Baseline Low	The hostile swarm of ants hurried out of their home and began attacking Jan's hand. The HONEY?
39	HighP/LowP	When Mildred, a Las Vegas salesgirl, carelessly dropped her cigarette near the woods, the result was tragic flames. The FIRE?/SMOKE?
	Baseline High	Leah spent many days lost in the wilderness, waiting for someone to come save her. The FIRE?
	Baseline Low	When Annette, a Las Vegas salesgirl, dropped something in the woods, everyone raced to the scene in response. The SMOKE?
40	HighP/LowP	Steve saw that the grass was dry and went outside and turned on the hose and sprinkler. The WATER?/GARDEN?
	Baseline High Filler	Jackson saw that the floor was dirty and went into the closet to grab the vacuum. The HAIR?
	Baseline Low	Aaron saw that his car was dirty, went outside, turned on the hose, and cleaned it. The GARDEN?
41	HighP/LowP	After his three day fishing trip, Charles accidentally forgot the fish he caught in his trunk for one week, leaving a horrible stench. The SMELL?/STINK?
	Baseline High Filler	During the brutal battle, Tony was unprepared for the huge wave of dust that made it impossible to see the man. The ENEMY?
	Baseline Low	After his three day fishing trip, Louis accidentally forgot the fish he caught by the river, leaving him without dinner for the night.

		The STINK?
42	HighP/LowP	The little girl was quietly walking on the sidewalk when a vicious dog chased her and sunk its teeth into her. The BITE?/WOUND?
	Baseline High	Sophie was happily playing with the family cat in the living room when the cat got startled by the door opening. The BITE?
	Baseline Low	The little girl was quietly walking on the sidewalk when a cute dog ran up to her and licked her hand. The WOUND?
43	HighP/LowP	At Cape Canaveral, the rocket was sitting on the ground waiting for a signal to be given for it to be blasted off. The COUNTDOWN?/TAKEOFF?
	Baseline High	Enjoying their first time in New York City, the group of friends went shopping until it was well into the night. The COUNTDOWN?
	Baseline Low	At Cape Canaveral, the blue toy was sitting on the ground unmoving until the owner replaced the batteries and pressed the green button. The TAKEOFF?
44	HighP/LowP	The wooden sailing ship cruised through the ice-cold sea, struck the iceberg with a tremendous crunch, and went under the water. The PASSENGERS?/DISASTER?
	Baseline High	The family went on a vacation to the Bahamas and the children were joyfully playing with each other. The PASSENGERS?

	Baseline Low Filler	The wooden sailing ship cruised through the ice-cold sea, and the passengers put on extra layers of clothing to keep warm. The ACCIDENT?
45	HighP/LowP	Brad fumbled through the dark until he located the box of matches and struck one. The FLAME?/ROOM?
	Baseline High	Seth was sitting on the beach that night waiting for his girlfriend to return with their food. The FLAME?
	Baseline Low	Brad fumbled through the dark cave until he located the one other person with him. The ROOM?
46	HighP/LowP	It was Nicole's birthday and she eagerly picked up the biggest present and unwrapped it. The GIFT?/BOW?
	Baseline High	Baca parked her car near the curb and walked towards their friend's house carrying something heavy. The GIFT?
	Baseline Low	It was Nicole's favorite season and she woke up excited and ready for the day. The BOW?
47	HighP/LowP	The male robin climbed out of the nest, spread his wings, and took off. He FLEW?/SOARED?
	Baseline High	The captain went into the small store to buy an energy drink. He FLEW?
	Baseline Low	The head of the household walked to the office to turn on the television. He SOARED?
48	HighP/LowP	In the final seconds of the game, the football floated into the

	Baseline High	hands of the receiver in the end zone and the team scored six points. The CROWD?/CHEERS? In the final minutes of the movie, the main actor hit the villain with a spinning kick, defeating him and saving the woman. The CROWD?
	Baseline Low	In the final seconds of the recess, the children collectively ran towards the ball which floated into the depth of the muddy puddle near the fence. The CHEERS?
49	HighP/LowP	The linguistics professor had not eaten anything for several days and stood in the front of the large class where she became increasingly dizzy and collapsed. Her STUDENTS?/FAINTING?
	Baseline High	The banker had not eaten anything for many hours and stood in front of the long line where she became increasingly dizzy and collapsed. Her STUDENTS?
	Baseline Low	The physics professor had not taught anything for several days and stood in front of the class where she began her lecture on the new topic. Her FAINTING?
50	HighP/LowP	Near the end of his first marathon, the fatigued jogger barely finished the race and then fell to the ground. His LEGS?/ACHING?
	Baseline High	Near the end of the hallway in the apartment, the small mouse barely escaped from the ferocious tabby cat. The LEGS?

	Baseline Low	Near the end of his first marathon, the excited jogger smoothly finished the race and ran across the finish line. His ACHING?
51	HighP/LowP	The director and the cameraman were preparing to shoot close-ups of the actress on the edge of the roof on the 14th story building, when suddenly the actress fell and was killed. Her BODY?/CORPSE?
	Baseline High	The actors were preparing for their next action scene on the balcony of the tallest building when the director informed them filming was over for the day. The BODY?
	Baseline Low	The director and the cameraman were preparing to shoot close-ups of the lead actress on the bench in the church on the corner of 14th street, when suddenly the power went out. Her CORPSE?
52	HighP/LowP	Jason needed to have his appendix removed immediately and was rushed to the hospital for the operation. The DOCTOR?/PROCEDURE?
	Baseline High	Liam needed to have his home checked immediately and called in professionals to fix his problem. The DOCTOR?
	Baseline Low	Cooper needed to retake his test immediately and was sent to the cafeteria for a quiet space. The PROCEDURE?
53	HighP/LowP	Peter did not have the money for the fancy sports car, so he went to the bank to borrow some money. The LOAN?/LENDER?
	Baseline High	Noah loved to paint and create art, but did not have the proper

		materials to create the painting . The LOAN?
	Baseline Low	Adrian only had enough time to take a quick shower so he went to the locker room to get a towel. The LENDER?
54	HighP/LowP	When Tom was sound asleep his cat that had collected fleas sneaked into his bed and the fleas irritated his skin. The BITES?/RASH?
	Baseline High	Ethan was so exhausted from his long day of work that he got lost on his walk home. The BITES?
	Baseline Low	Leon was sound asleep next to his cat until he suddenly bolted upright and was unable to resume his slumber. The RASH?
55	HighP/LowP	Jimmy was playing a game that involved throwing rocks at targets, when he hit a car door and damaged it. The OWNER?/FINE?
	Baseline High	Logan was playing a song on a guitar that involved strong plucking when he accidentally broke the strings. The OWNER?
	Baseline Low	Tristan was playing a game that involved throwing rocks into the river, when he heard an animal in the bushes. The FINE?
56	HighP/LowP	Mary, who had become a real junk food addict, went to McDonalds and ordered a large patty. The BURGER?/MEAL?
	Baseline High	Emma, who was a recent college graduate, went to her first interview in the city. The BURGER?
	Baseline Low	Sydney, who had become a junk food addict, went to the candy

		store and bought a lollipop. The MEAL?
57	HighP/LowP	Without having found any gas station in the Nevada desert, Frank drove his buik until it ran out of gas and came to a halt. The CAR?/TANK?
	Baseline High	Luke didn't find the set of keys and had to sleep outdoors because he could not get into his house. The CAR?
	Baseline Low	Without having found any inn in the Nevada desert, Declan drove his Buick until he found a house owned by a woman with many animals. The TANK?
58	HighP/LowP	The telephone had already rung five times before Rob reached over and picked it up. The CALLER?/ANSWER?
	Baseline High	Evan was frustrated at his supervisor when he heard about the scandal in the office. The CALLER?
	Baseline Low	The postman had already knocked five times before Will got up and opened the door. The ANSWER?
59	HighP/LowP	The den was much sunnier than he liked, so the decorator walked over and shut them. The BLINDS?/SHUTTERS?
	Baseline High	The loft was much dimmer than she liked, so the designer walked over and turned on the lamp. The BLINDS?
	Baseline Low	The den was much hotter than he liked, so the man walked out of the room. The SHUTTERS?
60	HighP/LowP	The milk had been left out in the hot kitchen for a week before

		anyone realized it was rancid. The SMELL?/ODOR?
	Baseline High	The drink had been sitting in the fridge for a month before the husband realized it was on the shelf. The SMELL?
	Baseline Low	The milk had been bought earlier that week and was going to be used to create a large meal. The ODOR?
61	HighP/LowP	The star athlete stretched his muscles and assumed a ready position at the line, heard the starter gun fire and took off. The RACE?/TRACK?
	Baseline High Filler	The volunteer stretched his back and checked-in all of the participants, directed them to their stations, and ended his shift. The EVENT?
	Baseline Low	The star actor stretched his muscles, assumed a laid back position in front of the camera, and heard the director's signal. The TRACK?
62	HighP/LowP	Angela had lost her car keys until she checked her nightstand. She FOUND?/GRABBED?
	Baseline High	April loves animals and she is always helping any creature in need. She FOUND?
	Baseline Low	Angela picked up her car keys and headed towards the garage. She GRABBED?
63	HighP/LowP	During the race, Michael accelerated his Ferrari before the turn, and continued gaining on his competitor before finally leaving

	Baseline High	him behind. He WON?/PASSED?
		During the break, Caleb moved from aisle to aisle trying to entertain the guests before they left the auditorium. He WON?
	Baseline Low	Before the competition, Leon continued listening to music and mentally prepared for his event against the best competitor in the league. He PASSED?
64	HighP/LowP	The teacher was preparing the cake for the party, so she put it in the oven to cook it. She BAKED?/HEATED?
	Baseline High	Samantha was not a social person, so she often stayed at home watching television and working on her hobby. She BAKED?
	Baseline Low	The teacher was preparing a surprise for her class, so she spent extra time on the details for the event. She HEATED?
65	HighP/LowP	After standing through the three-hour debate, the tired speaker walked over to his chair and plopped down into it. He SAT?/SANK?
	Baseline High	After surveying the scene, the energetic announcer walked to the stage and made a strong declaration. He SAT?
	Baseline Low	After watching the three-hour movie, the guest speaker walked over to the podium and began his speech. He SANK?
66	HighP/LowP	Mark was out walking in the park and was completely unprepared for the sudden downpour which drenched him. His CLOTHES?/SOAKED?

	Baseline High	In the afternoon, Caleb wanted to go to the market, so he waited on the roadside for the bus. His CLOTHES?
	Baseline Low	Carson was running towards his house because he remembered he left the stove on in the kitchen. The SOAKED?
67	HighP/LowP	While waiting for the water to fill her bathtub, Jan accidentally fell asleep on her bed for several hours and water poured over the edge of the tub. The FLOOD?/SPILL?
	Baseline High	Kiera went on vacation for two weeks to spend some time alone and to enjoy a change of scenery, removing herself from a stressful environment. The FLOOD?
	Baseline Low	While waiting for the deliveryman to come, Jane accidentally fell asleep on her bed for several hours and woke-up with a start when the doorbell rang. The SPILL?
68	HighP/LowP	Having just finished reciting their wedding vows, Kristi and Tom were positively glowing as they smooched. The COUPLE?/EMBRACE?
	Baseline High	After reciting the poem about his life, Carter received a standing ovation from the audience. The COUPLE?
	Baseline Low	Having just finished the concert, Kristi and Elliot were positively glowing from the applause. The EMBRACE?
69	HighP/LowP	While repairing the rip in her blouse, Jessica slipped with the needle and stuck her finger. The BLOOD?/PRICK?

	Baseline High	While serving a new dish to the customer, Amelia slipped and the plate fell to the floor. The BLOOD?
	Baseline Low	While tending to her garden, Piper looked up as her daughter held her hand out towards her. The PRICK?
70	HighP/LowP	Jason had almost fallen asleep in the canoe, when he finally felt a pull on the line and realized he had snagged a fish. He REELED?/TOOK?
	Baseline High	Oliver had found a quiet spot near the vacation house in the woods and sat down to gather items for his meal. He REELED?
	Baseline Low	Cole had almost fallen asleep in the canoe, when he finally noticed it was raining and began rowing towards the riverbank. He TOOK?
71	HighP/LowP	Donald was walking very quickly and didn't notice how uneven the sidewalk was until he stumbled accidentally. The FALL?/SLIP?
	Baseline High	Dylan was sprinting down the street when he noticed a little girl sitting on the sidewalk, crying. The FALL?
	Baseline Low	Donald was walking on the sidewalk towards his girlfriend's house when he noticed something on the ground. The SLIP?
72	HighP/LowP	The cowboy shot the gangster at high noon and then dug a large enough hole to put him in the ground. The GRAVE?/DIRT?
	Baseline High	The policeman arrested the gangster at dawn, placed him in a

		holding cell, and searched for the victim. The GRAVE?
	Baseline Low	The cowboy shot the gangster at high noon and then announced to the bystanders that he would always take care of any threat. The DIRT?
73	HighP/LowP	Emily was very hungry, so she got out the chicken and threw some vegetables in a pan and started making dinner. She COOKED?/SAUTEED?
	Baseline High	Hailey was very tired, so when she got home, she turned music on and took a quick nap. She COOKED?
	Baseline Low	Chloe really wanted tea, so she went to the kitchen and turned on the kettle to boil hot water. She SAUTEED?

EXPERIMENT 2 MATERIALS

Table 6. Experiment 2 materials

Number	Experimental Conditions	Full Sentence	Control Conditions	Full Sentence
1	HighP	In order to cook with the fruit, one must remove the apple's center. The **core** would not make a good filling because it is bitter.	Baseline High	Trees can produce all types of fruits, and apples are one of them. The **core,** however, is not edible, so they should not be given to small children.
	LowP	In order to cook with the fruit, one must remove the apple's center. The **seeds** would not make a	Baseline Low	Apples are one of Josh's favorite fruits and he eats one every day. The **seeds** in the center of the

		good filling because they are bitter.		apples should not be eaten though.
2	HighP	When Patricia came to college in the city, she was saddened by all the poor people. The **poverty** was so bad she decided to volunteer at a soup kitchen.	Baseline High	Many countries undergo varying types of leadership, with some good rulers and some bad ones. The **poverty** that results from bad rulers is terrible.
	LowP	When Patricia came to college in the city, she was saddened by all the poor people. The **ghetto** was not a place she envisioned living.	Baseline Low	When Patricia came to college in the city, she was excited to start her new life. The **ghetto** was not where she expected to end up, however.
3	HighP	After seeing the zombie movie, the faces would stay in Julie's mind all night and scare her. To **sleep,** the girl needed a nightlight.	Baseline High	It is nearly impossible to watch a horror film without feeling slightly afraid. To **sleep** afterwards and not have nightmares is very

				difficult.
	LowP	After seeing the zombie movie, the faces would stay in Julie's mind all night and scare her. To **frighten** the girl was very easy to do.	Baseline Low	After seeing the interesting movie, Julie wanted to play a video game with her close friends. To **frighten** her was difficult and she played with gusto.
4	HighP	Sarah was excited to try out the new recipe and made a large dish. The **food** was tasty and fed her whole family.	Baseline High Filler	Marge was elated to try the new ride at the amusement park. The **safety** of the roller coaster did not matter at all.
	LowP	Sarah was excited to try out the new recipe and made a large dish. The **dessert** was tasty and it fed her whole family.	Baseline Low	Sarah was excited to try out for the volleyball team and practiced every week. The **dessert** she brought to the practices made her popular.

5	HighP	In order to stay organized during the field trip, the teacher distributed the class's schedule. The **students** would walk in pairs to make sure no one got lost.	Baseline High Filler	In order to visit all of the exhibits at the museum, the teacher gave each room a time limit. The **class** moved along quickly to see everything.
	LowP	In order to stay organized during the field trip, the teacher distributed the class's schedule. The **timetable** would ensure that everyone saw all of the exhibits.	Baseline Low	In order to stay successful, one must make a plan and always abide by it. The **timetable** one creates dictates how much work is accomplished.
6	HighP	Gavin threw on his coat and headed down the little road. The **weather** was not good, so he came back to his house immediately.	Baseline High	Joshua grabbed his hat and headed for the door. The **weather** outside was not good, so he turned on the lamp for light.

	LowP	Gavin threw on his coat and headed down the little road. The **alley** was not well lit, so he turned on a flashlight.	Baseline Low	Tony threw on his coat and walked toward the wooden door. The **alley** he had to walk through to get to the store was creepy.
7	HighP	The scream Sue heard in the middle of the night filled her with fear. The **sound** sent chills down her spine as she looked for her husband.	Baseline High	The players were sitting on the side of the stage, waiting for their turn. The **sound** of the audience gave them courage to perform.
	LowP	The scream Sue heard in the middle of the night filled her with fear. The **terror** sent chills down her spine as she looked for her husband.	Baseline Low	In the middle of the night, Sue went to get a glass of water. The **terror** she experienced in her nightmare had woken her.
8	HighP	Walking on frozen ponds in early winter can be a danger. The **ice** can give way beneath	Baseline High	The couple was surprised by the lack of cars on the road. The **ice** they slipped on later

		even the lightest of people.		down the street provided a clear explanation.
	LowP	Walking on frozen ponds in early winter can be a danger. The **snow** can make it difficult to see where the pond starts and ends.	Baseline Low	Walking at night alone by the pond can be a danger. The **snow** can make it difficult to see where the pond starts and ends.
9	HighP	Sally was about to turn in her math test when she noticed her final answer was not correct. The **teacher** allowed her to change the answer only this one time.	Baseline High	Cindy was visiting her old job when she saw a familiar face and stopped to chat with the person. The **teacher** laughed at a joke the old principal told.
	LowP	Sally was about to turn in her math test when she noticed her final answer was not correct. The **panic** she felt of turning in the wrong answer was strong.	Baseline Low	Grace was walking through her neighborhood when she saw a kid playing with a small blue toy. The **panic** she felt as a dog ran towards him left her

				immobile.
10	HighP	After drawing five cards from the deck, Sebastian cautiously laid down his money. The **bet** he put forth caused him to lose as his friend had a much better hand.	Baseline High	Ian would have to cook food more often at home after today. The **bet** he lost to his roommates dictated he make dinner three times a week.
	LowP	After drawing five cards from the deck, Sebastian cautiously laid down his money. The **stakes** he raised caused him to lose as his friend had a much better hand.	Baseline Low	After Sebastian moved to a new city, he began looking for a house. The **stakes** of choosing incorrectly were high, so he asked his friend to help him search.
11	HighP	Catlin had a bad headache so she went to the cabinet and swallowed an aspirin pill. The **pain** finally went away after fifteen minutes.	Baseline High Filler	Cathy had a lot of things to do, but the migraine she had prevented her from working. The **headache** from being overly stressed had lasted for days.

	LowP	Catlin had a bad headache so she went to the cabinet and swallowed an aspirin pill. The **relief** finally came after fifteen long minutes.	Baseline Low	Caitlin asked the teacher if she could retake the test because she had a bad headache. The **relief** from the pressure allowed her to do much better.
12	HighP	After buying a tree for the backyard, my dad handed me a shovel and instructed me to dig a hole. The **ground** was very hard and it took hours to finish.	Baseline High	After buying a tree for the backyard, my dad handed me a camera and instructed me to take a picture. The **ground** was unstable, causing me to trip, and drop the camera.
	LowP	After buying a tree for the backyard, my dad handed me a shovel and instructed me to dig a hole. The **labor** was very hard and it took hours to finish.	Baseline Low	After lining the floor with newspaper, my father handed me the small paintbrush and the took the larger one. The **labor** of painting the whole house felt like a

				punishment rather than bonding.
13	HighP	George got yelled at for running around the pool because it was against a rule. The **<u>lifeguard</u>** he stood in front of was very angry.	Baseline High	Hector never followed orders and it caused him to miss out on fieldtrips with his friends. The **<u>lifeguard</u>** had banned him from visiting the swimming pool.
	LowP	George got yelled at for running around the pool because it was against a rule. The **<u>caution</u>** he failed to take could harm others.	Baseline Low	George got yelled at for forgetting to pick up his little sister from the pool. The **<u>caution</u>** he failed to take with his sister's safety could harm her.
14	HighP	After biting into the candy the girl winced because it was so sour. The **<u>taste</u>** of the tart snack made her spit it out immediately.	Baseline High	After walking along the beach for several minutes the girl ran inside. The **<u>taste</u>** from her meal came rising up as she smelled rotten

				fish.
	LowP	After biting into the candy the girl winced because it was so sour. The **look** of surprise was evident because the store owner told her it would be sweet.	Baseline Low	After walking his girlfriend home, the man noticed something on the sidewalk. The **look** of fear on his face was evident as he backed away from a rabid dog.
15	HighP	When Travis found out his dog had died he could barely contain his sorrow. His **sadness** affected him for the rest of the week and he could not work properly.	Baseline High	Trevor was not expecting the information and had to call in a favor to leave work early. The **sadness** in his mother's voice when she called made him feel uneasy.
	LowP	When Travis found out his dog had died he could barely contain his sorrow. His **loss** affected him for the rest of the week and he could not	Baseline Low	When Travis found out he got a new dog he could barely contain his excitement. The **loss** of his old dog was overshadowed by this

		work properly.		joy.
16	HighP	After running the marathon, Tim was extremely thirsty. The **water** at the finish line was very refreshing and relieved his thirst.	Baseline High	Tyler loved to play outdoors during the summer. The **water** of the pool is always warmer because of the sun.
	LowP	After running the marathon, Tim was extremely thirsty. The **coolers** at the finish line were filled with many water bottles.	Baseline Low	After running errands, Tim met with his friend. The **coolers** he had in his trunk were heavy and he needed help.
17	HighP	After falling on the sidewalk and hurting my ankle, the nurse wrapped it with a bandage. The **pain** would not last long and I felt better in days.	Baseline High	After running a full marathon, Julia celebrated with a close group of friends. The **pain** in her legs was diminished by the festivities.
	LowP	After falling on the sidewalk and hurting my	Baseline Low	After falling on the sidewalk and dropping

		ankle, the nurse wrapped it with a bandage. The **sprain** would prevent me from competing in my next race.		my books, my friend helped me pick them up. The **sprain** I had in my wrist made them difficult to carry.
18	HighP	For Memorial Day picnic, the family cooked up a large batch of chicken. The **food** was delicious and the picnic was a success.	Baseline High	For the 4th of July, the class made plans to spend the day together. The **food** they volunteered to bring would be delicious.
	LowP	For Memorial Day picnic, the family cooked up a large batch of chicken. The **meat** was delicious and the picnic was a success.	Baseline Low	For the Memorial Day picnic, the family fixed a very large Caesar salad. The **meat** in the salad was very tender and delicious.
19	HighP	When the alarm went off, Oscar was still tired so he closed the drapes. The **sun,** thankfully, was blocked by the curtains	Baseline High	Oliver switched rooms with his brother because it was on the other side of the hallway. The **sun** could not wake him up

		and he went back to sleep.		on this side of the house.
	LowP	When the alarm went off, Oscar was still tired so he closed the drapes. The **curtains,** thankfully, blocked out the sun and he went back to sleep.	Baseline Low	When the alarm went off, Oscar got up to get ready for work. The **curtains** could not block out the sun, so he was wide awake.
20	HighP	When Nathan was rude to Sam at the bar last night, they got in a fight. The **bartender** had to intervene and stop the violence quickly.	Baseline High	Matt and Sean made a pact to work together so they entered the facility to submit their resumes. The **bartender** told them to sit and wait for the manager.
	LowP	When Nathan was rude to Sam at the bar last night, they got in a fight. The **alcohol** had caused both of them to be more aggressive.	Baseline Low	When Nathan was mad at Sam last night, the two discussed the issue and made up. The **alcohol** they had that night made them forget

				everything.
21	HighP	Jogging in the early morning, Frank swore he saw something emerging out of the fog. The **<u>figure</u>** slightly ahead of him turned out to be his neighbor.	Baseline High	Fred always jogged early in the morning and never had any troubles on his route. The **<u>figure</u>** he passed, however, gave him the creeps.
	LowP	Jogging in the early morning, Frank swore he saw something emerging out of the fog. The **<u>mysterious</u>,** slightly disfigured sight in front of him was only a friendly dog.	Baseline Low	Jogging in the early morning, Frank swore he heard the sound of birds singing. The **<u>mysterious</u>** source turned out to be a recording from the neighborhood bird watcher.
22	HighP	Lola saved her money for the concert and was excited to listen to her favorite music live. The **<u>band</u>** she loved sounded	Baseline High	Lea had many hobbies outside of school and her friends wondered how she had so much free time. The **<u>band</u>** she

		great live.		was in, however, knew how little she slept.
	LowP	Lola saved her money for the concert and was excited to listen to her favorite music live. The **artist** she loved sounded great live.	Baseline Low	Lola saved he money for the ticket and was excited to go see her idol in person. The **artist** she loved sounded great live.
23	HighP	During the first night in her new place, Flora heard many strange noises. The **sounds,** though creepy, were harmless and she soon got used to them.	Baseline High	During the first week in a new city, Scarlett was amazed by the lights at night. The **sounds** of live jazz music matched perfectly with the illuminated streets.
	LowP	During the first night in her new place, Flora heard many strange noises. The **eerie,** though harmless, sounds kept her from sleeping that night.	Baseline Low	During the first week in a new city, Scarlett was amazed by the lights at night. The **eerie** feeling she got, however, made her double check her bolted door.

24	HighP	Jack and Dean get into the '49 Hudson, eager to begin this trip. The **car** is old, but it will get them to their destination.	Baseline High Filler	Henry and Owen got into the sports car, ready to start their travels. The **vehicle** was new and they were excited for the drive.
	LowP	Jack and Dean get into the '49 Hudson, eager to begin this trip. The **journey** is long, but it will certainly hold good memories.	Baseline Low	Jake and Dean get into the '49 Hudson, eager to start playing music. The **journey** was enjoyable as they sang the whole time.
25	HighP	Working full time all summer made Bryan extremely eager for the upcoming vacation. The **trip** was relaxing and he felt recharged for work again.	Baseline High	Brice lost his phone and he did not want to purchase another. The **trip** she made was for nothing as she left empty handed.
	LowP	Working full time all summer made Bryan extremely eager for the	Baseline Low	Working full time all summer made Bryan extremely eager for the

		upcoming vacation. The **holiday** was relaxing and he felt recharged for work again.		upcoming winter. The **holiday** would allow him to spend time with his family.
26	HighP	Staring across the grand canyon, we were impressed by how wide it was. The **view** was very nice and we took many pictures to remember our trip.	Baseline High	The trees in our backyard were growing quickly and provided much shade during hot summer days. The **view** from under the trees felt like a forest.
	LowP	Staring across the grand canyon, we were impressed by how wide it was. The **chasm** was very large and we took pictures to remember our trip.	Baseline Low	Staring across the large valley, we were impressed by how beautiful it was. The **chasm** on the other side looked to be the size of a large, dried up river.
27	HighP	After the hurricane, everyone was instructed to leave the affected area. The **storm** caused	Baseline High	Everyone was gathered around the chief, listening to his wise words. The **storm**

		a lot of destruction to the community.		outside did not bother the group as they listened intently.
	LowP	After the hurricane, everyone was instructed to leave the affected area. The **disaster** caused a lot of damage to the community.	Baseline Low	After the event, everyone was instructed to exit the large stadium. The **disaster** caused by the strong winds resulted in a lot of chaos.
28	HighP	Jane was anxious to leave the bar because she found it to be too loud. The **noise** did not bother her friends though, so she stayed.	Baseline High	Abby was ready to go to the party and have an enjoyable time with her friends. The **noise** from the music made it nearly impossible to hear each other.
	LowP	Jane was anxious to leave the bar because she found it to be too loud. The **people** did not notice as she quietly left	Baseline Low	Jane was anxious to enter because her bland clothes did not match the dress code. The **people** at the party

		the place and headed home.		stared as she walked through the door.
29	HighP	While swimming in the shallow water near the rocks, Sharon stepped on a piece of glass and injured her foot. The **cut** was large and she would need stitches for the injury.	Baseline High	Shannon was out in her garden when a stray cat walked by and distracted her from her task. The **cut** from the clippers was small and her attention returned to her flowers.
	LowP	While swimming in the shallow water near the rocks, Sharon stepped on a piece of glass and injured her foot. The **gash** was large and she would need stitches for the injury.	Baseline Low	While swimming in the shallow water near the rocks, Sharon spotted a pretty piece of crystal near her right foot. The **gash** she received from picking it up was large.
30	HighP	No longer able to control his fury, the boyfriend hurled the delicate, porcelain vase	Baseline High	Jose could not believe it when he found out his girlfriend cheated on him with his best friend.

	LowP	against the wall and shattered it into bits. The **pieces** were scattered all over the floor. No longer able to control his fury, the boyfriend hurled the delicate, porcelain vase against the wall and shattered it into bits. The **police** were called by worried neighbors.	Baseline Low	The **pieces** of broken glass on the floor portrayed his anger. No longer able to control his fury, the boyfriend yelled at the top of his lungs and paced back and forth angrily. The **police** had been called because of the commotion.
31	HighP	Mary was having hard labor pains, so she went to the hospital to have her baby. The **doctor** was very patient and helpful during the long labor.	Baseline High Filler	Nora was having second thoughts about her school choice. The **nurse** she was friends with told her bad things about the institution.
	LowP	Mary was having hard labor pains, so she went to the hospital to have	Baseline Low	Sophie was having stomach pains, so she went to the hospital to

		her baby. The **birth** was not easy and the mother went through a long labor.		talk with her doctor. The **birth** of her last child had caused internal injuries.
32	HighP	After being dropped from the plane, the bomb hit the ground and blew up. The **explosion** made a large impact and several buildings were destroyed.	Baseline High	When Max entered the room, his classmates were talking very loudly when the teacher suddenly yelled. The **explosion** outside had caused her to panic.
	LowP	After being dropped from the plane, the bomb hit the ground and blew up. The **debris** made it difficult to look for any survivors.	Baseline Low	After being dropped from the plane, the supplies slowly floated towards the marooned sailors. The **debris** on the ground made it difficult to collect the supplies.
33	HighP	The driver looked up and saw the bus headed straight for her, but it	Baseline High Filler	The store owner never expected to be on the news retelling the

		was too late to stop the collision. The **crash** was terrible, but thankfully everyone survived.		horrific event that lead to her shop's closure. The **attack** had destroyed the entire building.
	LowP	The driver looked up and saw the bus headed straight for her, but it was too late to stop the collision. The **tragedy** was on the news later that night.	Baseline Low	The driver looked up and saw the bus headed towards the school, but it turned right before the school parking lot. The **tragedy** was avoided and no one was harmed.
34	HighP	Patty had a headache and a fever and finally realized she had this year's virus. The **flu** would prevent her from going to work.	Baseline High	After taking a nap, Betty woke up and was ready to eat a warm meal. The **flu** she had was finally starting to go away.
	LowP	Patty had a headache and a fever and finally realized she had this year's virus. The **illness**	Baseline Low	Alyssa had a bad habit of always eating a lot when she was under stress. The **illness** she

		would prevent her from going to work.		caught, however, reduced her appetite.
35	HighP	The drunk driver was speeding at 70 mph towards a tree when he lost control of his car and wrecked. The **crash** killed all four passengers.	Baseline High	The truck driver was heading down the highway when he encountered a roadblock. The **crash** earlier had not been cleaned and there would be a delay.
	LowP	The drunk driver was speeding at 70 mph towards a tree when he lost control of his car and wrecked. The **impact** killed all four passengers.	Baseline Low	The drunk driver was speeding at 70mph down the highway when the police pulled him over on the deserted road. The **impact** of the car and a rock busted his tire.
36	HighP	Doris had already postponed seeing her mother several times when she grabbed some	Baseline High Filler	Arial had already put her career on hold several times when she grabbed her partner's

		clothes and packed her suitcase to stay with her. The **trip** to her mother's house would take days.		hand and prepared for her speech. The **trek** across the lobby to human resources was nerve wracking.
	LowP	Doris had already postponed seeing her mother several times when she grabbed some clothes and packed her suitcase to stay with her. The **bag** was heavy as she dragged it to her car.	Baseline Low	Daisy had already postponed talking with her mother several times when she grabbed the phone and dialed the number to contact her. The **bag** next to her fell as she talked.
37	HighP	Ann opened her mouth as the dentist bore into her tooth. The **drill** was loud but not painful.	Baseline High	Aiden had just closed his eyes when he heard the faint sound. The **drill** was loud as the dentist hummed.
	LowP	Ann opened her mouth as the dentist bore into her tooth. The **cavity** was filled quickly and	Baseline Low	Sophie opened her bag as the receptionist asked her for the payment. The **cavity** she had filled

		painlessly.		cost a lot of money.
38	HighP	After being announced the winner, the contestant was overwhelmed with emotion and she started to sob. Her **tears** of joy made the other contestants feel bad.	Baseline High	When Isaac lost to his best friend in the competition, he didn't know how to react. The **tears** fell from his eyes and he tried to hide them.
	LowP	After being announced the winner, the contestant was overwhelmed with emotion and she started to sob. Her **prize** of $2,000 would fund her upcoming trip.	Baseline Low	After the findings were announced, the woman was surprised by the outcome and grabbed her husband. The **prize** of a two week cruise was hers.
39	HighP	Suzie was lucky enough to notice her mistake before she turned in her test, so she ran back to her desk and fixed it.	Baseline High	Grace was great at everything she tried and always won first place. The **teacher** was proud of her success and knew

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		The **teacher** was glad she caught it.		she would achieve great things.
	LowP	Suzie was lucky enough to notice her mistake before she turned in her test, so she ran back to her desk and fixed it. The **luck** resulted in an A**.**	Baseline Low	Jamila was lucky to notice the additional question before she turned in her test, so she ran back to her desk to answer it. The **luck** resulted in an A.
40	HighP	The dishonest man stuck a hanger in the vehicle's window, opened the door, and in no time at all drove off with the car. The **thief** was found by the police the next day.	Baseline High	The man went to the door and listened carefully for any noises, and suddenly opened it to find something in the room. The **thief** stole the diamond necklace on the dresser.
	LowP	The dishonest man stuck a hanger in the vehicle's window, opened the door, and in no time at all drove off with the	Baseline Low	The man grabbed a hanger from the closet in the house, put on one of the blue coats, and headed outside to his

		car. The **crook** was found by the police the next day.		friends. The **crook** had stolen multiple items from the house.
41	HighP	Allison had hurt her knee, and she quickly fell behind the other runners and eventually came in last. The **race** was not what she expected it to be.	Baseline High	Angie was ready to leave when she remembered that she had to give her dog a bath. The **race** he was in earlier left him very dirty.
	LowP	Allison had hurt her knee, and she quickly fell behind the other runners and eventually came in last. The **loser** was disappointed in herself at the outcome.	Baseline Low	Alberta had hurt her knee, and she had to slow down as she walked towards the finish line. The **loser** kept her head down as she walked by other contestants.
42	HighP	Shortly after the patient was wheeled into the operating room, the doctor arrived and	Baseline High	The woman entered the airport for her early flight, checked in, and sat down to wait for her

		immediately placed the anesthesia mask over the patient to put her under. She **slept** for hours after the operation.		group to be called. She **slept** during the entire three hour flight**.**
	LowP	Shortly after the patient was wheeled into the operating room, the doctor arrived and immediately placed the anesthesia mask over the patient to put her under. She **relaxed** for a while before falling asleep.	Baseline Low	Shortly after the patient was wheeled out of the operating room, the doctor followed and immediately informed the patient of the results after her long surgery. She **relaxed** against the pillows as she heard the news.
43	HighP	The banker felt sorry for the homeless, reached for his checkbook and made a large financial contribution. This **donation** would be used wisely.	Baseline High	The baker felt sorry for the poor, and made a few extra pastries to be taken home. This **donation** was very kind.

	LowP	The banker felt sorry for the homeless, reached for his checkbook and made a large financial contribution. This **charity** would be remembered forever.	Baseline Low	The banker felt sorry for the client, reached for the keyboard, and looked up her missing information. The **charity** would be remembered.
44	HighP	The hostile swarm of bees hurried out of the hive and began attacking Joan's hand. The **stings** from the insects hurt a lot and she needed ice.	Baseline High	While the group of girls was on a camping trip, they knocked over a large object. The **stings** from the bees that escaped the hive were painful.
	LowP	The hostile swarm of bees hurried out of the hive and began attacking Joan's hand. The **honey** from the hive was not worth the trouble.	Baseline Low	The hostile swarm of ants hurried out of their home and began attacking Jan's hand. The **honey** on her hand kept the ants from releasing their hold on her skin.

45	HighP	When Mildred, a Las Vegas salesgirl, carelessly dropped her cigarette near the woods, the result was tragic flames. The **fire** spread across the forest and many trees died.	Baseline High	Leah spent many days lost in the wilderness, waiting for someone to come save her. The **fire** she made finally attracted someone's attention.
	LowP	When Mildred, a Las Vegas salesgirl, carelessly dropped her cigarette near the woods, the result was tragic flames. The **smoke** spread across the forest and polluted the air.	Baseline Low	When Annette, a Las Vegas salesgirl, dropped something in the woods, everyone raced to the scene in response. The **smoke** from the fire caused by her cigarette was thick.
46	HighP	Heidi found out that her spouse was not faithful to her and went to a lawyer to end their marriage. The **divorce** required a six week	Baseline High	Elena discovered that her parents could not watch her daughter for the weekend because of personal reasons. The **divorce** they were going

		waiting period.		through was taking up much of their time.
	LowP	Heidi found out that her spouse was not faithful to her and went to a lawyer to end their marriage. The **betrayal** required her husband to pay a large alimony.	Baseline Low	Jeannine found that her spouse had stayed up late and watched the new season of a mystery show last night. The **betrayal** made her feel very upset.
47	HighP	Steve saw that the grass was dry and went outside and turned on the hose and sprinkler. The **water** was quickly absorbed into the ground.	Baseline High Filler	Jackson saw that the floor was dirty and went into the closet to grab the vacuum. The **hair** on the floor was disgusting and needed to be removed.
	LowP	Steve saw that the grass was dry and went outside and turned on the hose and sprinkler. The **drought** was severe so he could only do this	Baseline Low	Aaron saw that his car was dirty, went outside, turned on the hose, and cleaned it. The **drought** was so severe, he could only use the hose on

		once a week.		certain days.
48	HighP	After his three day fishing trip, Charles accidentally forgot the fish he caught in his trunk for one week, leaving a horrible stench. The **smell** was too horrible to bear.	Baseline High Filler	During the brutal battle, Tony was unprepared for the huge wave of dust that made it impossible to see the man. The **enemy** attacked while his opponent was blinded.
	LowP	After his three day fishing trip, Charles accidentally forgot the fish he caught in his trunk for one week, leaving a horrible stench. The **stink** was too horrible to bear.	Baseline Low	After his three day fishing trip, Louis accidentally forgot the fish he caught by the river, leaving him without dinner for the night. The **stink** from the rotten fish spread across the area.
49	HighP	The little girl was quietly walking on the sidewalk when a vicious dog chased her and sunk	Baseline High	Sophie was happily playing with the family cat in the living room when the cat got startled

		its teeth into her. The **bite** took two weeks to heal.		by the door opening. The **bite** the cat gave Sophie was painful.
	LowP	The little girl was quietly walking on the sidewalk when a vicious dog chased her and sunk its teeth into her. The **wound** took two weeks to heal.	Baseline Low	The little girl was quietly walking on the sidewalk when a cute dog ran up to her and licked her hand. The **wound** from last week didn't bother her at all.
50	HighP	At Cape Canaveral, the rocket was sitting on the ground waiting for a signal to be given for it to be blasted off. The **countdown** caused a huge roar.	Baseline High	Enjoying their first time in New York City, the group of friends went shopping until it was well into the night. The **countdown** for the new year began and they were excited.
	LowP	At Cape Canaveral, the rocket was sitting on the ground waiting for a signal to be given for it	Baseline Low	At Cape Canaveral, the blue toy was sitting on the ground unmoving until the owner replaced

		to be blasted off. The **takeoff** caused a huge roar.		the batteries and pressed the green button. The **takeoff** was immediate and the toy soared.
51	HighP	Ron picked up his guitar, opened the sheet music to his favorite song, and started to strum. His **fingers** sped through the chords.	Baseline High	Hunter watched a video of his favorite violinist playing a classic song and increased the volume. His **fingers** moved along with the notes.
	LowP	Ron picked up his guitar, opened the sheet music to his favorite song, and started to strum. His **music** sped faster as he played.	Baseline Low	Harry picked up his favorite object, looked towards his friends, and began to create a wonderful masterpiece. The **music** was beautiful.
52	HighP	Julie ate some rancid mayonnaise, ran to the bathroom and threw up. Her **stomach** caused her	Baseline High	Caroline ordered at the cash register and took her purchase to the car. Her **stomach** growled as

		some discomfort afterwards.		she smelled the food she bought.
	LowP	Julie ate some rancid mayonnaise, ran to the bathroom and threw up. Her **nausea** caused her discomfort for hours.	Baseline Low	Pam quickly ate a sandwich with mayonnaise, and rushed to her class. Her **nausea** made it difficult to concentrate on the lecture.
53	HighP	The wooden sailing ship cruised through the ice-cold sea, struck the iceberg with a tremendous crunch, and went under the water. The **passengers** managed to get into safety rafts.	Baseline High	The family went on a vacation to the Bahamas and the children were joyfully playing with each other. The **passengers** smiled as they watched the young children having fun.
	LowP	The wooden sailing ship cruised through the ice-cold sea, struck the iceberg with a	Baseline Low Filler	The wooden sailing ship cruised through the ice-cold sea, and the passengers put on extra

		tremendous crunch, and went under the water. The **disaster** managed to make national news.		layers of clothing to keep warm. The **accident** last year made them all cautious.
54	HighP	Brad fumbled through the dark until he located the box of matches and struck one. The **flame** illuminated the room and he could see again.	Baseline High	Seth was sitting on the beach that night waiting for his girlfriend to return with their food. The **flame** from the lighter caught on the firewood.
	LowP	Brad fumbled through the dark until he located the box of matches and struck one. The **candle** illuminated the room and he could see again.	Baseline Low	Brad fumbled through the dark cave until he located the one other person with him. The **candle** had gone out so they sat huddled in the dark.
55	HighP	On the midterm, Jerry found out that he had gotten the lowest grade in the class and had	BasleineHigh Filler	After a grueling twelve hour shift at his part-time job, Daniel had to meet with his

		failed. The **teacher** was very disappointed in his performance.		supervisor. The **principal** was very proud of Daniel's hard work.
	LowP	On the midterm, Jerry found out that he had gotten the lowest grade in the class and had failed. The **sorrow** was very difficult for him to endure.	Baseline Low	On the midterm, Jerry found out that he had gotten the highest grade in the class and had passed. The **sorrow** he felt earlier was forgotten.
56	HighP	It was Nicole's birthday and she eagerly picked up the biggest present and unwrapped it. The **gift** was something she had been asking for since last year.	Baseline High	Becca parked her car near the curb and walked toward her sister's house carrying something heavy. The **gift** for her only sibling had cost a lot of money.
	LowP	It was Nicole's birthday and she eagerly picked up the biggest present and unwrapped it. The	Baseline Low	It was Nicole's favorite season and she woke up excited and ready for the day. The **bow** on the

		bow was bright pink and she laid it on the floor before revealing the gift.		Christmas present from her mother was huge.
57	HighP	The male robin climbed out of the nest, spread his wings, and took off. He **flew** for hours before landing in a new area.	Baseline High	The yellow bird was eagerly eating out of his owner's hand. He **flew** away quickly as his owner stood up.
	LowP	The male robin climbed out of the nest, spread his wings, and took off. He **searched** for hours for food before returning to his nest.	Baseline Low	The head of the household walked to the office to turn on the television. He **searched** the entire room until he found the remote.
58	HighP	In the final seconds of the game, the football floated into the hands of the receiver in the end zone and the team scored six points. The **crowd** of people yelled excitedly.	Baseline High	In the final minutes of the battle, Thor hit his opponent with a spinning kick, defeating him and severing their alliance of five years. The **crowd** cheered at this victory.

	LowP	In the final seconds of the game, the football floated into the hands of the receiver in the end zone and the team scored six points. The **cheers** of joy were loud.	Baseline Low	In the final seconds of the recess, the children collectively ran towards the ball which floated into the depth of the muddy puddle near the fence. The **cheers** could be heard from the school.
59	HighP	The linguistics professor had not eaten anything for several days and stood in the front of the large class where she became increasingly dizzy and collapsed. Her **students** finally called someone after several minutes.	Baseline High	The banker had not eaten anything for many hours and stood in front of the long line where she became increasingly dizzy and collapsed. Her **students** from the university called an ambulance.
	LowP	The linguistics professor had not eaten anything for several days and	Baseline Low	The physics professor had not taught anything for several days and

		stood in the front of the large class where she became increasingly dizzy and collapsed. Her **fainting** finally prompted her to go to a hospital.		stood in front of the class where she began her lecture on the new topic. Her **fainting** from nervousness was unexpected.
60	HighP	Near the end of his first marathon, the fatigued jogger barely finished the race and then fell to the ground. His **legs** could no longer hold him up as he collapsed.	Baseline High	Near the end of the hallway in the apartment, the small mouse barely escaped from the ferocious tabby cat. The **legs** of the cat were too short to jump onto the counter.
	LowP	Near the end of his first marathon, the fatigued jogger barely finished the race and then fell to the ground. His **aching** could no longer be ignored and he rested.	Baseline Low	Near the end of his first marathon, the excited jogger smoothly finished the race and ran across the finish line. His **aching** had not started until the race was

				over.
61	HighP	The director and the cameraman were preparing to shoot close-ups of the actress on the edge of the roof on the 14th story building, when suddenly the actress fell and was killed. Her **body** remained on the scene for hours.	Baseline High	The actors were preparing for their next action scene on the balcony of the tallest building when the director informed them filming was over for the day. The **body** they had found on set lead to an investigation.
	LowP	The director and the cameraman were preparing to shoot close-ups of the actress on the edge of the roof on the 14th story building, when suddenly the actress fell and was killed. Her **corpse** remained on the scene	Baseline Low	The director and the cameraman were preparing to shoot close-ups of the lead actress on the bench in the church on the corner of 14th street, when suddenly the power went out. Her **corpse** was found when the

		for hours.		power returned.
62	HighP	Jason needed to have his appendix removed immediately and was rushed to the hospital for the operation. The **doctor** was very good and he had a quick recovery.	Baseline High	Liam needed to have his home checked immediately and called in professionals to fix his problem. The **doctor** said his illness could be due to something in his home.
	LowP	Jason needed to have his appendix removed immediately and was rushed to the hospital for the operation. The **procedure** was very quick and he had an easy recovery.	Baseline Low	Cooper needed to retake his test immediately and was sent to the cafeteria for a quiet space. The **procedure** he had earlier that week left his ears sensitive.
63	HighP	Peter did not have the money for the fancy sports car, so he went to the bank to borrow some	Baseline High	Noah loved to paint and create art, but did not have the proper materials to create the

		money. The **loan** had to be paid back within 5 years.		painting . The **loan** he received from his parents was not enough to cover the cost.
	LowP	Peter did not have the money for the fancy sports car, so he went to the bank to borrow some money. The **lender** had him agree to pay it back within 5 years.	Baseline Low	Adrian only had enough time to take a quick shower so he went to the locker room to get a towel. The **lender** he was meeting with would not wait long.
64	HighP	When Tom was sound asleep his cat that had collected fleas sneaked into his bed and the fleas irritated his skin. The **bites** annoyed Tom and he put his cat in another room.	Baseline High	Ethan was so exhausted from his long day of work that he got lost on his walk home. The *bites* from the mosquitos near the unfamiliar swamp left him feeling itchy.
	LowP	When Tom was sound asleep his cat that had collected fleas sneaked	Baseline Low	Leon was sound asleep next to his cat until he suddenly bolted upright

		into his bed and the fleas irritated his skin. The **result** annoyed Tom and he put his cat in another room.		and was unable to resume his slumber. The **result** left him tired in the morning and unable to work efficiently.
65	HighP	Jimmy was playing a game that involved throwing rocks at targets, when he hit a car door and damaged it. The **owner** was very upset when he noticed the damage and made him pay for the repairs.	Baseline High	Logan was playing a song on a guitar that involved strong plucking when he accidentally broke the strings. The **owner** was very upset and made him pay for the broken instrument by working in his store.
	LowP	Jimmy was playing a game that involved throwing rocks at targets, when he hit a car door and damaged it. The **window** was also shattered and he had to	Baseline Low	Tristan was playing a game that involved throwing rocks into the river, when he heard an animal in the bushes. The **window** of the car he was in would not

		pay for the damages.		close as he tried to block the animal.
66	HighP	Mary, who had become a real junk food addict, went to McDonalds and ordered a large patty. The **burger** did not taste very good and she threw it out.	Baseline High	Emma, who was a recent college graduate, went to her first interview in the city. The **burger** she ordered before the interview made her feel queasy.
	LowP	Mary, who had become a real junk food addict, went to McDonalds and ordered a large patty. The **meal** did not taste very good and she threw it out.	Baseline Low	Sydney, who had become a junk food addict, went to the candy store and bought a lollipop. The **meal** she ate earlier did not keep her desire for candy away.
67	HighP	Without having found any gas station in the Nevada desert, Frank drove his Buick until it ran out of gas and came	Baseline High	Luke didn't find the set of keys and had to sleep outdoors because he could not get into his house. The **car** he slept

		to a halt. The **car** was left sitting in the sun.		in was very uncomfortable and he awoke with a crick in his neck.
	LowP	Without having found any gas station in the Nevada desert, Frank drove his Buick until it ran out of gas and came to a halt. The **tank** was empty and he began walking.	Baseline Low	Without having found an inn in the Nevada desert, Declan drove his Buick until he found a house owned by a woman with many animals. The **tank** of his car was completely empty when he arrived.
68	HighP	The telephone had already rung five times before Rob reached over and picked it up. The **caller** did not like having to wait and began speaking too rapidly for him to understand.	Baseline High	Evan was frustrated at his supervisor when he heard about the scandal in the office. The **caller** had tipped off the police about the illegal activity and the business was under investigation.

	LowP	The telephone had already rung five times before Rob reached over and picked it up. The **voicemail** did not sound kind, as Rob had not picked up quickly enough.	Baseline Low	The postman had already knocked five times before Will got up and opened the door. The **voicemail** he'd received earlier in the day told him to be wary of the man.
69	HighP	The den was much sunnier than he liked, so the decorator walked over and shut them. The **blinds** did a good job of blocking out the sun.	Baseline High	The loft was much dimmer than she liked, so the designer walked over and turned on the lamp. The **blinds** could not be opened to let sunlight in.
	LowP	The den was much sunnier than he liked, so the decorator walked over and shut them. The **shutters** did a good job of blocking out the sun.	Baseline Low	The den was much hotter than he liked, so the man walked out of the room. The **shutters** kept the room insulated and too humid.
70	HighP	The milk had been left	Baseline	The book had been

		out in the hot kitchen for a week before anyone realized it was rancid. The **smell** was the first indication the milk had gone sour.	High	sitting in the family library for months before the husband realized it was on the shelf. The **smell** from the dust was strong.
	LowP	The milk had been left out in the hot kitchen for a week before anyone realized it was rancid. The **odor** was the first indication the milk had gone sour.	Baseline Low	The milk had been bought earlier that week and was going to be used to create a large meal. The **odor** was unexpected as they opened the carton.
71	HighP	The star athlete stretched his muscles and assumed a ready position at the line, heard the starter gun fire and took off. The **race** was quick and he won by a landslide.	Baseline High Filler	The volunteer stretched his back and checked-in all of the participants, directed them to their stations, and ended his shift. The **event** had lasted all night and he was ready to go home.

	LowP	The star athlete stretched his muscles and assumed a ready position at the line, heard the starter gun fire and took off. The **track** was smooth as he ran towards the finish line.	Baseline Low	The star actor stretched his muscles, assumed a laid back position in front of the camera, and heard the director's signal. The **track** was smooth as the actor began to run.
72	HighP	Angela had lost her car keys until she checked her nightstand. She **found** them and ran for the door because she was going to be late.	Baseline High	April loves animals and she is always helping any creature in need. She **found** a small kitten in her yard just last week and took it in.
	LowP	Angela had lost her car keys until she checked her nightstand. She **grabbed** them and ran for the door because she was going to be late.	Baseline Low	Angela picked up her car keys and headed towards the garage. She **grabbed** her umbrella from the hook and got into her new car.
73	HighP	During the race, Michael accelerated his Ferrari	Baseline High	During the break, Caleb moved from aisle to

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		before the turn, and continued gaining on his competitor before finally leaving him behind. He **won** the race and was happy.		aisle trying to entertain the guests before they left the auditorium. He **won** their laughter and was delighted.
	LowP	During the race, Michael accelerated his Ferrari before the turn, and continued gaining on his competitor before finally leaving him behind. He **passed** the remaining cars and won.	Baseline Low	Before the competition, Leon continued listening to music and mentally prepared for his event against the best competitor in the league. He **passed** his opponent in the race.
74	HighP	The teacher was preparing the cake for the party, so she put it in the oven to cook it. She **baked** the cake for the guest of honor.	Baseline High	Samantha was not a social person, so she often stayed at home watching television and working on her hobby. She **baked** a loaf of bread for the week while watching a movie.

	LowP	The teacher was preparing the cake for the party, so she put it in the oven to cook it. She **heated** the cake for the guest of honor.	Baseline Low	The teacher was preparing a surprise for her class, so she spent extra time on the details for the event. She **heated** the food and waited for the students to arrive.
75	HighP	After standing through the three-hour debate, the tired speaker walked over to his chair and plopped down into it. He **sat** down onto the seat with a sigh.	Baseline High	After surveying the scene, the energetic announcer walked to the stage and made a strong declaration. He **sat** on a chair with a huff and began his monologue.
	LowP	After standing through the three-hour debate, the tired speaker walked over to his chair and plopped down into it. He **sank** down into the seat with a sigh.	Baseline Low	After watching the three-hour movie, the guest speaker walked over to the podium and began his speech. He **sank** onto the stool after half an hour of talking.

76	HighP	Mark was out walking in the park and was completely unprepared for the sudden downpour which drenched him. His **clothes**, no longer dry, clung to him as he walked home.	Baseline High	In the afternoon, Caleb wanted to go to the market, so he waited on the roadside for the bus. His **clothes** were stained with sweat, but he didn't mind.
	LowP	Mark was out walking in the park and was completely unprepared for the sudden downpour which drenched him. His **soaked,** no longer dry clothes clung to him as he walked home.	Baseline Low	Carson was running towards his house because he remembered he left the stove on in the kitchen. The **soaked** carpet indicated the sprinklers went off and put out the fire.
77	HighP	While waiting for the water to fill her bathtub, Jan accidentally fell asleep on her bed for several hours and water poured over the edge of	Baseline High	Kiera went on vacation for two weeks to spend some time alone and to enjoy a change of scenery, removing herself from a stressful

		the tub. The **flood** would damage the floor.		environment. The **flood** earlier that week had ruined her home.
	LowP	While waiting for the water to fill her bathtub, Jan accidentally fell asleep on her bed for several hours and water poured over the edge of the tub. The **spill** would damage the floor.	Baseline Low	While waiting for the deliveryman to come, Jane accidentally fell asleep on her bed for several hours and woke-up with a start when the doorbell rang. The **spill** from this morning went ignored as she answered the door.
78	HighP	Having just finished reciting their wedding vows, Kristi and Tom were positively glowing as they smooched. The **couple** then walked down the aisle smiling.	Baseline High	After reciting the poem about his life, Carter received a standing ovation from the audience. The **couple** in the audience was in tears.
	LowP	Having just finished reciting their wedding	Baseline Low	Having just finished the concert, Kristi and Elliot

		vows, Kristi and Tom were positively glowing as they smooched. The **embrace** then ended as they walked down the aisle.		were positively glowing from the applause. The **embrace** they shared spoke volumes of their love.
79	HighP	While repairing the rip in her blouse, Jessica slipped with the needle and stuck her finger. The **blood** had dried by the time she found a band aid.	Baseline High	While serving a new dish to the customer, Amelia slipped and the plate fell to the floor. The **blood** from the cut she got had to be cleaned.
	LowP	While repairing the rip in her blouse, Jessica slipped with the needle and stuck her finger. The **prick** had only hurt a little bit.	Baseline Low	While tending to her garden, Piper looked up as her daughter held her hand out towards her. The **prick** from the rosebush had caused a small injury.
80	HighP	Jason had almost fallen asleep in the canoe,	Baseline High	Oliver had found a quiet spot near the vacation

		when he finally felt a pull on the line and realized he had snagged a fish. He **reeled** the fish in, making the whole day worthwhile.		house in the woods and sat down to gather items for his meal. He **reeled** in the fish he caught and began to prepare it.
	LowP	Jason had almost fallen asleep in the canoe, when he finally felt a pull on the line and realized he had snagged a fish. He **took** the fish home, making the whole day worthwhile.	Baseline Low	Cole had almost fallen asleep in the canoe, when he finally noticed it was raining and began rowing towards the riverbank. He **took** his poncho out and shivered in the cold.
81	HighP	Donald was walking very quickly and didn't notice how uneven the sidewalk was until he stumbled accidentally. The **fall** was embarrassing because there was a cute girl	Baseline High	Dylan was sprinting down the street when he noticed a little girl sitting on the sidewalk, crying. The **fall** she experienced made her sad.

		watching.		
	LowP	Donald was walking very quickly and didn't notice how uneven the sidewalk was until he stumbled accidentally. The **slip** was embarrassing because there was a cute girl watching.	Baseline Low	Donald was walking on the sidewalk towards his girlfriend's house when he noticed something on the ground. The **slip** he had was unexpected as he fell.
82	HighP	The cowboy shot the gangster at high noon and then dug a large enough hole to put him in the ground. The **grave** he placed him in was shallow an unmarked.	Baseline High	The policeman arrested the gangster at dawn, placed him in a holding cell, and searched for the victim. The **grave** he found the victim in caused him severe distress.
	LowP	The cowboy shot the gangster at high noon and then dug a large	Baseline Low	The cowboy shot the gangster at high noon and then announced to

		enough hole to put him in the ground. The **dirt** he covered him with was loose and easy to lift.		the bystanders that he would always take care of any threat. The **dirt** he covered in the gangster with rose in a mound.
83	HighP	Erica gave the milk to the cashier, took out her wallet and purchased it. She **paid** an extra dollar for the larger carton.	Baseline High	Hannah patted her pockets and found what she was looking for. She **paid** for the item she picked up and left the store.
	LowP	Erica gave the milk to the cashier, took out her wallet and purchased it. She **bought** an extra pack of gum as well.	Baseline Low	Mara gave the milk to her sister, and poured a bowl of cereal. She **bought** a new box every week for her younger sibling.
84	HighP	Emily was very hungry, so she got out the chicken and threw some vegetables in a pan and	Baseline High	Hailey was very tired, so when she got home, she turned music on and took a quick nap. She

	LowP	started making dinner. She **cooked** chicken as well.		**cooked** dinner shortly after she woke up.
		Emily was very hungry, so she got out the chicken and threw some vegetables in a pan and started making dinner. She **sautéed** chicken as well.	Baseline Low	Chloe really wanted tea, so she went to the kitchen and turned on the kettle to boil hot water. She **sautéed** vegetables on the other burner.

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