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Impact of Informative Context's Meaning Consistency During Incidental Vocabulary Acquisition

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Abstract

The authors examined the influence of context meaning consistency on incidental vocabulary acquisition during reading. *Context meaning consistency* refers to informational context that reflected the same meaning (i.e., consistent) or different meanings (i.e., inconsistent) across two self-paced reading sessions for a given item (both sessions on the same day). The first sentence of each sentence-pair item contained informational context, and the second sentence contained a target word (novel target or known control). Acquisition was assessed via surprise memory tests given right after the reading sessions (immediate) and again approximately a week later (delayed). Inconsistent context was generally associated with inflated reading times and less recall than consistent context, and retention was particularly low when the first encounter with the novel target was during the second reading session. Self-paced reading times were also particularly inflated in the second reading session for items in which readers encountered the novel word version of the target for the first time (i.e., known control encountered during the first reading session instead). Acquisition was facilitated most for novel targets that were presented during both reading sessions in consistent meaning context, but suffered the most in the case of consistent context and the novel target initially encountered in the second session. When presented with different meanings for the same novel target across self-paced reading sessions (inconsistent context condition), the intended meaning for the initial presentation was more likely to remain in memory.

Vocabulary growth in students (from elementary school through college) benefits from direct instruction in school, but by adulthood, direct instruction has typically ceased. However, vocabulary knowledge continues to grow throughout adulthood (e.g., Brusnighan, Morris, Folk, & Lowell, 2014; Eskenazi, Swischuk, Folk, & Abraham, 2018; Landauer & Dumais, 1997; Long & Shaw, 2000). Thus, there must be some other source of vocabulary learning. There is evidence to suggest that incidental vocabulary acquisition during reading often occurs for adult readers, allowing them to infer the meanings of unknown words from the surrounding contextual information (e.g., Chaffin, Morris, & Seely, 2001; Joseph, Wonnacott, Forbes, & Nation, 2014; Lowell & Morris, 2017; Pagán & Nation, 2019; Williams & Morris, 2004). However, aspects of incidental vocabulary learning that require

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further investigation remain. In particular, how does the consistency (or lack thereof) of the informative context affect the acquisition process and/or product? In the current study, we addressed this question.

Explicit Versus Incidental Learning

Explicit vocabulary instruction can take on many different forms, from teaching dictionary definitions to students to instruction that is much more integrated across the curriculum. This could include connecting words to their use in books or in one's own life and/or enhancing this with more detailed semantic analysis of words in written/spoken context. Thus, the range of explicit instruction approaches that teachers have at their disposal is substantial, with use of definitions representing a small portion of that toolbox. For the purpose of the current study, our focus was on examining how acquisition occurs outside of the time when such explicit instruction would take place and examining the mechanisms that underlie incidental acquisition.

There have been many investigations of explicit vocabulary instruction regarding the construction of effective instructional contexts and their subsequent outcomes for memory (e.g., Gardner, 2004, 2007; Lawrence, Capotosto, Branum-Martin, White, & Snow, 2012; Lesaux, Kieffer, Kelley, & Harris, 2014; McKeown, 1985; Nagy, Anderson, & Herman, 1987; Nagy & Herman, 1984, 1987; Nagy, Herman, & Anderson, 1985; Nash & Snowling, 2006); however, a person's lexicon is so massive that it is quite unlikely that the individual has intentionally studied all the meanings of all the words that he or she knows. It is outside of that environment of explicit instruction where adults often find themselves faced with new words and have to build their meanings from context incidentally, and that process is what we sought to better understand. Landauer and Dumais (1997) highlighted the prevalence of this scenario of incidental vocabulary acquisition in reading:

> A typical American seventh grader knows the meaning of 10–15 words today that she did not know yesterday. She must have acquired most of them as a result of reading because (a) the majority of English words are used only in print, (b) she already knew well almost all the words she would have encountered in speech, and (c) she learned less than one word by direct instruction. Studies of children reading grade-school text find that about one word in every 20 paragraphs goes from wrong to right on a vocabulary test. The typical seventh grader would have read less than 50 paragraphs since yesterday, from which she should have learned less than three new words. Apparently, she mastered the meanings of many words that she did not encounter [through speech, direct instruction, or grade-school text].
>
> (p. 211)

How does the student acquire the meanings of the words that she has not explicitly studied? This might be the result of the use of contextual clues to determine the meanings of unfamiliar words. That is, incidental vocabulary acquisition likely contributes to this growth on a regular basis. Within the literature on word learning, some have suggested that acquisition occurs incrementally, such that each encounter with a word in context adds some new piece of information about it (Adlof, Frishkoff, Dandy, & Perfetti, 2016; Bolger, Balass,

Landen, & Perfetti, 2008; Fukkink, Blok, & de Glopper, 2001; Jenkins, Stein, & Wysocki, 1984; Nagy et al., 1985, 1987). Each word a reader comes across activates that letter string, if present, and other similar or related letter strings in the lexicon. The more frequently a reader activates a certain word, the stronger it becomes within the reader's knowledge base, eventually taking residence as an established word (Bolger et al., 2008; McKeown, 1985; Myers & O'Brien, 1998; Reichle & Perfetti, 2003).

Contextual Use in Incidental Vocabulary Acquisition

According to Fischer (1994), the context in which words are found is vital for acquiring an acceptable understanding of a word's connotation. Fischer showed that participants were more likely to appropriately use new vocabulary learned in context than with definitions alone. Further, Chaffin and colleagues (2001) recorded eye movements while reading in an incidental acquisition setting and showed that readers tended to look at the contextual information surrounding a novel word more so than the same context surrounding a known word, including regressive and rereading eye movement behavior. Chaffin et al. pointed toward those findings as evidence that a major source of adult vocabulary acquisition is reading, often acquiring new vocabulary incidentally without an explicit goal of learning new words.

There is some evidence in the literature to suggest that a reader's first exposure to an unknown word in context is enough to provide some form of word learning (e.g., Brusnighan & Folk, 2012; Brusnighan et al., 2014; Lowell & Morris, 2014; Williams & Morris, 2004), especially when the context highly constrains the number of possible concepts that the word could represent (e.g., Bolger et al., 2008; Borovsky, Kutas, & Elman, 2010; Lowell & Morris, 2017). For example, Lowell and Morris (2017) monitored participants' eye movements as they read sentences in which novel or control words were embedded in strong or moderately strong constraining contexts. After the reading session, participants took a surprise vocabulary test. When the participants read the novel words in moderately strong contexts, they spent more time on the target and rereading the context before moving past the novel word as compared with the strongly constraining context.

Joseph and colleagues (2014) presented novel words in context over several days. Participants had many exposures to each novel word, but the researchers manipulated whether the participants saw the words early in the learning phase (day 1) or later (day 2). Joseph et al. found that reading times for the novel words decreased with each additional encounter of them and that participants remembered the novel words better when they were presented earlier in the learning context (see also Joseph & Nation, 2018) as compared with later. In addition, Bolger and colleagues (2008) argued that it is particularly beneficial to learn new words within a range of varied contexts, resulting in a more abstract understanding of their meanings, when compared with a single repeated context or a single definition that does not provide any of the words' nuances. Pagán and Nation (2019) provided evidence of the benefit of exposures to unfamiliar words in varied context but within an incidental acquisition paradigm, instead of explicit instruction. Eskenazi and colleagues (2018) also found that multiple exposures to novel words increased word learning, even when the words were in uninformative contexts. That is, as long as the readers

encountered the novel words in informative contexts in the first three encounters, additional encounters with the words supported learning, even when the context was not informative, as long as the participants were highly skilled spellers. The findings of these studies suggest that readers continued to add more and more information upon each encounter of novel words as they developed the words' meanings incidentally.

Word learning is typically measured by the knowledge that a person exhibits on subsequent vocabulary tests (Seipel, 2011), which can vary in form from one study to another, including sentence decision tasks (e.g., Jenkins et al., 1984), forced-choice or multiple-choice memory tests (e.g., Brusnighan & Folk, 2012; Brusnighan et al., 2014; Lowell & Morris, 2017; Nagy et al., 1985; Williams & Morris, 2004), postreading interviews (e.g., Nagy et al., 1985), and generation/correct usage tasks (e.g., Bolger et al., 2008). Regardless of the approach, each of those studies provided evidence of statistically significant word learning within one or two exposures in context. Thus, including rich and constraining contextual information in the sentences presented to participants should allow them to acquire some aspect of an unknown word's meaning during their first encounter with it. The question remains as to what would happen to that word learning if readers were to encounter that same unknown word again but surrounded by a comparably strong context that referred to a very different meaning than the first encounter's context information.

The Current Study

In the current study, we attempted to address how incidental acquisition might be influenced by varied contexts for unknown words that either converge on the same meaning (i.e., consistent context) or support an entirely different meaning (i.e., inconsistent context-a situation that is similar to a reader developing multiple meanings for a word, polysemy). That is, as the reader encounters the new word for the second time, what type of impact does the context consistency have on those earliest iterations of the incidental acquisition process? Note that this context manipulation differs from what has been done in the literature on incidental acquisition to this point in terms of varied contexts, in that in those studies, an inconsistent context condition was not included. Rather, the varying of context in those studies maintained the same intended target concept (e.g., Eskenazi et al., 2018; Pagán & Nation, 2019). Our experimental design also allowed us to obtain some information regarding the extent to which the number of exposures (i.e., one vs. two) to a novel word in context would affect learning. We examined both reading time and vocabulary learning immediately after the reading session and then again after a one-week delay. We hypothesized that participants would have longer reading times when the meaning of the target was changed from one encounter to the next, relative to the two encounters converging on the same meaning. Similarly, we hypothesized that learning would be best when the two encounters converged rather than differed.

Method

Participants

Sixty-four members of the University of South Carolina Union (USC Union) community participated in the current study.[1] USC Union is a small regional campus of the University

of South Carolina (USC), in the Southeastern United States, as one of USC's Palmetto College campuses. All participants were native English speakers and were compensated for their time with extra credit in a chosen course, when applicable. In a minority of cases, the participant was a student who volunteered despite not having an instructor who was offering extra credit, or was a member of the university staff (not associated with the lab) who was volunteering to help the researchers obtain more data. The sample ranged in age from 17 to 63 years old (mean [*M*] = 28) and was primarily female (44 females, 20 males). The range in age was indicative of the student population for the campus, as there are many nontraditional students enrolled in this small, regional, rural campus. Similarly, the large proportion of female participants is not uncommon for psychology experiments in general.

Materials

Self-Paced Reading Stimuli—Self-paced reading stimuli consisted of 40 experimental sentence pairs and 24 filler sentence pairs. Each experimental sentence pair contained an informative context region in the first sentence and a target word region in the second sentence. The following is an example of the possible versions of one of those experimental items (see the Appendix for the full listing of experimental items; see Figures 1–3 for visual displays of the self-paced reading procedure and conditions):

Meaning A	**Meaning B**
Elizabeth was frightened by how severe this [**sore throat; nasal congestion**] had become.	Elizabeth was frightened by how severe this [**hazardous weather; freezing rain**] had become.
The awful [cold/*klon*] was becoming worse throughout the week.	The awful [cold/*klon*] was becoming worse throughout the week.

The region of bold text in the sample item above is the informative context region, which was intended to provide the readers with information about the intended meaning of the second sentence's target word. Thus, in the first reading session, the participant would have seen one of the versions of meaning A. Then. in the second reading session, the participant would have either seen the other version of meaning A (i.e., consistent context condition) or one of the meaning B versions of that context region (i.e., inconsistent context condition). The extent to which the different versions of informative context constrained the possible meanings of the target word was previously assessed online via an independent sample of USC Columbia students (n = 160), recruited using the Psychology Department's human subjects' participant pool in exchange for course credit. The results of that data collection confirmed that the level of constraint across versions of informative context was comparably strong (p > .10), representing mean levels of constraint ranging from .76 to .80.

The underlined and italicized words in the sample item represent the target word region of the experimental sentence pairs. The underlined word is the known control, and the italicized word is the novel target. Due to the nature of the consistent/inconsistent context manipulation, the known controls were all homographic homophones so the same word

[1]An additional independent sample of participants from USC Columbia participated in the norming components of the current study, which is discussed further in the Materials subsection.

could be used in both cases while being able to fit sensibly into either meaning's sentence-pair frame. Based on word association data for the known controls obtained from an independent sample of USC Columbia students ($n = 97$) via the participant pool, either of the two meanings for the known controls used in our study were equally likely ($p > .10$). The word form frequency[2] of the known controls ranged from 1 per million to 604 per million ($M = 53$ per million, standard deviation [SD] = 101 per million).

We created the novel targets such that they each consisted of the same number of letters as their corresponding known control, were pronounceable (i.e., followed the orthographic rules of the English language), and were at least two letters different from any existing English word. In addition, the novel targets were matched with the known controls on orthographic frequency.[3] This was critical because unlike the known controls, the novel targets by definition have a word frequency of zero. However, the novel targets, just like the known controls, consist of legal combinations of letters that occur with a certain frequency in English. This allows the known and novel words, then, to at least be matched in terms of a general perceptual frequency.

Recognition and Multiple-Choice

Surprise Memory Test[4]: This test consisted of the 40 novel targets, each with three response options. Due to the target word manipulation within the self-paced reading stimuli, there was a portion of novel target words that each participant did not see. Thus, those novel targets that they did not see, based on the counterbalancing condition to which they were randomly assigned, served as fillers among the 40 novel target stimuli on this posttest. The following is an example:

klon _____

- unhealthy condition
- uncomfortable climate
- new pet

Participants were instructed to enter *yes* in the blank if they remembered seeing the word during the self-paced reading sessions or *no* if they did not. Participants were also asked to select one of the three response options that they thought best matched the word's meaning. One response option was a synonym for meaning A, one was a synonym for meaning B, and one was unrelated to both possible meanings of the novel target. The order of the response options was randomized across items. Note that in some cases, participants had been presented with the novel target in both self-paced reading sessions, but the novel

[2]We based this on word form frequency within the CELEX database, accessed via Medler and Binder's (2005) online orthographic database, MCWord. To control for a large range in word form frequency, this value was incorporated into the appropriate statistical analyses as a continuous covariate. Statistically significant effects of the variables of interest reported in this article were above and beyond any influence of word frequency.

[3]We based this on summed (average) unigram, bigram, and trigram frequencies from Medler and Binder's (2005) online orthographic database, McWord. Novel targets ($M = 277{,}757$ per million, $SD = 50{,}676$ per million) and known controls ($M = 278{,}880$ per million, $SD = 53{,}266$ per million) did not differ statistically significantly ($p = .77$) on this measure.

[4]Cued recall versions of the surprise memory test were also administered. In the interest of space, and given that the bulk of the statistically significant findings came from the other tasks in this experiment, those cued recall data are not detailed here but are available upon request.

target was accompanied by a different intended meaning in each case. To account for that discrepancy as they completed this posttest, participants were encouraged to select the meaning that came to mind first if they were not certain of which one to choose.

Author Recognition Test: The Author Recognition Test was originally developed by Stanovich and West (1989) as a predictor of word-processing ability. That is, they argued that there is a connection between an individual's orthographic processing skills and his or her level of print exposure. The survey was updated in 2008 by Acheson, Wells, and MacDonald, and we used this version in the current study as a quick assessment of reading habits that could be used as a covariate in the statistical analyses. The survey consists of 130 names, and the instructions indicate that some of the names are authors of books, and other names are not. The participants' task was to place a check mark next to any name that they knew was an author. Scores are calculated as the number of correct identifications minus incorrect identifications.

Procedure

When participants arrived, they were told that they would be completing a set of comprehension tasks on this first visit to the lab and that they would be asked to return for a follow-up visit to the lab approximately a week later. The first task was a self-paced reading task (session 1) on the computer (via E-Prime 2.0 Professional; Psychology Software Tools, 2013) that contained sentence pairs, some of which were followed by comprehension questions. During this task, participants initially saw a blank screen. Their first press of the space bar triggered the first sentence of the sentence pair to be displayed on the screen (initial reading epoch for sentence 1). Their second press of the space bar triggered the first sentence to disappear and the second sentence of the sentence pair to be displayed (initial reading epoch for sentence 2). Next, a third press of the space bar triggered the second sentence to disappear and the first sentence to reappear (rereading epoch for sentence 1). Finally, a fourth press of the space bar triggered the first sentence of the pair to disappear again and the second sentence to reappear (rereading epoch for sentence 2). Participants did not have any way of backtracking through this sequence or skipping any of the initial reading or rereading epochs for either sentence of the sentence pair. Half of the experimental items contained a novel target word, and the other half contained a known control instead in the target word region (see Figure 1).

Each participant completed a practice round prior to the experimental portion of the task. During the self-paced reading session, half of the filler items were followed by yes/no reading comprehension questions (18.7% of items) to ensure that readers were attending to what they were reading. All conditions were counterbalanced across items and participants and randomized within each self-paced reading session. As soon as they finished with session 1, participants then completed a digit span task that served as a distractor task prior to another self-paced reading task (session 2). Given the wide range of ages across participants, the digit span performance also served as a means of controlling for individual differences in working memory by including those scores as a covariate in the regression models.

Session 2 was identical in format and procedure to session 1 but not identical in content of the experimental items. That is, all of the same sentence frames were displayed during session 2 as had been displayed during session 1. Within those frames, however, the context region and the target word region were manipulated (see Figures 2 and 3). During session 2, the same target (known or novel) was repeated within the sentence frame from session 1 for half of the 40 experimental items, but that target was changed from session 1 for the other half of those items. The context region was also changed for session 2 such that it contained the alternate version of the same meaning information (i.e., consistent condition) or contained information for the different possible meaning of the target (i.e., inconsistent condition). Thus, for the 20 experimental items in which the target was repeated from the first session, the participant either saw the other context that was consistent with the previous encounter (10 trials: five novel, five known), or they saw the context that was inconsistent with the meaning presented in the first encounter (10 trials: five novel, five known). For the other 20 experimental items in which the target was not repeated from the first session, the participant either saw the other version of the context that represented the same (consistent) meaning from what had been contained in the sentence frame previously (10 trials: five novel, five known), or they saw the version of the context that represented a different (inconsistent) meaning from what had been contained in the sentence frame previously (10 trials: five novel, five known).

Reading comprehension performance was consistently high across participants (M = 96% for session 1 and 92% for session 2). After completing session 2, participants took the surprise memory tests, including the recognition and multiple-choice surprise memory test, in which they indicated whether they remembered seeing each novel word at any point during the self-paced reading sessions, and then selected one of three multiple-choice options that best represented the meaning of the novel word.

Approximately one week (M = 5.69 days) after their initial visit to the lab, participants returned for their follow-up visit. Upon their arrival, participants were given the same surprise memory tests that they had taken during their initial lab visit. Finally, participants were asked to provide some brief information on their own reading habits (Acheson et al., 2008; Stanovich & West, 1989) and then were debriefed before leaving the lab.

Results

Self-Paced Reading Data

The design of the self-paced reading portion of the study provided two reading times for each sentence of the pairs of reading stimuli. As participants progressed through an item, an initial reading time was recorded between the time that the first sentence appeared on the screen until the press of the space bar, then an initial reading time for the second sentence, then a rereading time for the first sentence, and finally a rereading time for the second sentence. We ran linear mixed-effects regression models for each of the four types of reading times (i.e., sentence 1 initial, sentence 2 initial, sentence 1 rereading, sentence 2 rereading), using R statistical software (version 3.5.1; R Development Core Team, 2018) with subjects and items included in each model as random effects. We used Markov chain Monte Carlo sampling to obtain p-values based on the t-statistics for the parameter estimates of the fixed

effects (e.g., Jaeger, 2008; for a description of the model, see Baayen, 2007). The appeal of using this type of regression model to analyze the sizable data set at hand (i.e., 2,500+ data points) was partly due to the ability to incorporate by-subject and by-item influences into the same analysis, while also controlling for other potential extraneous influences as covariates in the model.

The fixed effects in all of the models for the reading time measures from the first self-paced reading session (session 1, the initial lab visit) included target word condition (novel or known), trial epoch (sentence 1 initial, sentence 2 initial, sentence 1 rereading, or sentence 2 rereading), and their interactions. The fixed effects in all of the models for the reading time measures from the second self-paced reading session (session 2, still during the initial lab visit) included target word condition (novel in both sessions, novel in session 1 but known in session 2, novel in session 2 but known in session 1, or known in both sessions), trial epoch (sentence 1 initial, sentence 2 initial, sentence 1 rereading, or sentence 2 rereading), consistency of the intended meaning of the target concept (context region referring to the same meaning across both reading sessions [consistent] or context region referring to different meanings between reading sessions [inconsistent]), and their interactions.

We also ran follow-up paired comparisons between conditions of interest in cases of a statistically significant effect of target word condition (for session 2) or a statistically significant interaction, which included corrections for multiple comparisons. Finally, given the benefit of linear mixed-effects models to accommodate multiple predictors, we included additional covariates in the models, including the participant's age, score on the digit span distractor task, and score on the Author Recognition Test. All findings reported in this article were above and beyond any influence of these covariates. As mentioned in the Method section, two other covariates were word frequency and orthographic frequency. Despite the discrepancy in word frequency between known and novel words, the inclusion/exclusion of this covariate did not alter the pattern of results reported regarding the primary variables of interest, nor did the orthographic frequency covariate on which the novel and known targets were matched.

Session 1 Self-Paced Reading Data—During the first self-paced reading session (during the initial lab visit), the only statistically significant differences in reading times were on sentence 2 of the experimental sentence pairs, demonstrating the typical novel word effect (see Figure 4). For initial presentation of sentence 2 ($\beta = 200.53$, standard error [*SE*] = 28.51, $p < .001$) and for the rereading presentation of sentence 2 ($\beta = 143.17$, $SE = 46.07$, $p < .01$), participants read longer when the sentence contained a novel target word versus a known control.

Session 2 Self-Paced Reading Data—The second self-paced reading session (during the initial lab visit) presented readers with context information that pointed them toward either the same intended meaning for the target word as the first session (consistent context) or a completely different meaning (inconsistent context), for a given sentence-pair frame. Note that this manipulation of the context information created four different scenarios for the readers in the second self-paced reading session, relative to the same sentence-pair frame that they had seen during the first self-paced reading session: (1) same intended

meaning reflected in the context and same type of target word (i.e., novel/known) in the next sentence; (2) same intended meaning reflected in the context and different type of target word in the next sentence; (3) different intended meaning reflected in the context and same type of target word; and (4) different intended meaning reflected in the context and different type of target word. Generally, reading times were inflated on sentence 2 of the sentence pair if it was the participant's first encounter with the novel target word (i.e., the known control had been the target in the sentence frame during the first reading session; see Figure 5). This pattern was present across context consistency conditions (i.e., same meaning reflected in context information across sessions or different meanings reflected in context information across sessions) and for initial reading and rereading presentations of sentence 2 but was more dramatic in initial reading times, as evidenced by a statistically significant interaction between target word type and epoch ($\beta = -127.92$, $SE = 50.50$, $p < .05$).

Regarding the influence of the primary variable of interest, context consistency, the rereading times in particular are where this is most noticeable, in that rereading times were inflated for inconsistent context information that pointed to a different meaning for the target word than what participants had encountered in the first session for that item. This was true of both sentence 1 rereading ($\beta = -395.02$, $SE = 120.10$, $p < .01$) and sentence 2 rereading ($\beta = -183.28$, $SE = 81.39$, $p < .05$). These times were most inflated in the condition in which it was the first appearance of the novel target word, and the context information was pointing to a completely different meaning than it had implied in the same sentence frame during the first reading session. That is, readers were essentially starting from scratch with a totally new word and meaning, with the cost of the typical novel word effect adding to their efforts to integrate the new word into the sentence.

Recognition Data

The recognition data are based on participants indicating whether they remembered having seen the novel target during any of the self-paced reading portions of the experiment. Accuracy in this case is described in terms of hits and false alarms. *Hits* refers to participants correctly indicating that they remembered seeing a novel word that they had actually been presented with during the reading sessions. *False alarms* refers to participants incorrectly indicating that they remembered seeing a novel word that they had not been presented with during either reading session. Misses and correct rejections are the inverse of those categories, but only hits and false alarms are discussed here for simplicity. That said, note that for the target word condition in which a novel target was not presented during either self-paced reading session, a hit is not possible. Likewise, a false alarm was not possible in the other three conditions, in which the novel target was presented during the first session, the second session, or both.

Recognition of the novel target was best if it had been encountered during both self-paced reading sessions (see Table 1), for both immediate recognition during the initial lab visit ($\beta = 1.15$, $SE = 0.07$, $p < .0001$) and delayed recognition during the follow-up lab visit ($\beta = 0.91$, $SE = 0.06$, $p < .0001$). Critically, recognition was poorest for novel targets that had only been presented during the second self-paced reading session, not during the first session

Meaning Accuracy Data (Multiple-Choice Results)

Meaning accuracy data are based on participants selecting one of the three possible meanings for the novel target on the memory test that best reflects the novel target's meaning. Accurate responses required that the option selected matched up with the meaning that participants had encountered in one or both of the self-paced reading sessions for that item (see Table 2). For the inconsistent context condition, for two of the response options, one option reflected reading session 1's intended meaning, and the other option reflected reading session 2's intended meaning. In contrast, for the consistent context condition, only one response option of the three was correct, because readers had encountered the same intended meaning across both reading sessions for that item.

In the inconsistent context condition, the main finding was in the performance on the immediate memory test during the initial lab visit. Correctly selecting the meaning corresponding to the context information from the first reading session was particularly likely for a novel target that had been encountered in both reading sessions ($\beta = 0.13$, $SE = 0.06$, $p < .05$). This was not the case when looking at the likelihood of selecting the intended meaning from the second reading session, suggesting that the first available meaning took precedence over the second, different meaning for a novel target that was encountered twice. In the consistent context condition, again on the immediate memory test during the initial lab visit, having been presented with the novel target in both reading sessions facilitated accuracy in selecting the correct intended meaning for the novel targets on the memory test ($\beta = -0.12$, $SE = 0.06$, $p < .05$). The second encounter with the novel target in the second reading session appears to have allowed for reinforcement of the consistent intended meaning for the new word.

Discussion

Our primary goal in the current study was to better understand the impact that changing the intended meaning of an unfamiliar word across the first two exposures can have on word processing and incidental vocabulary acquisition while reading. Based on the results reported here, context meaning consistency has an impact on the acquisition process during reading and on the nature of memory representations for novel words following those encounters in context (see Tables 3 and 4 for summary results). As with many aspects of memory, more exposures also facilitated novel word acquisition, although context consistency and whether a single exposure occurred during the first or second reading session exerted unique influences on acquisition. Over the course of the days between participants' first and second lab visits, there was some degradation of memory representations for the novel words; however, many of the same patterns remained in the memory data in terms of the impact of context consistency and of seeing the novel word once or twice.

The current study provided a number of new findings regarding the impact of context consistency on incidental acquisition. This is evident in the self-paced reading times for the second session, where context consistency across the two reading sessions became a factor. For the known controls, which were homographic homophones, having consistent meanings across the two reading sessions allowed for particularly short initial reading of the known-

control sentences. However, having a novel target appear for the first time in reading session 2 triggered particularly inflated initial reading of the novel-target sentence when the context information pointed to the same intended meaning across reading sessions (i.e., the same sentence frame during session 1 contained the known control instead of the novel target). One interpretation for the extra time in the latter case is that it is time spent on developing a stronger representation of the novel word and its meaning. An alternative interpretation is that the novel word disrupts processing and inflates the reading time due to some kind of surprisal upon encountering an unanticipated novel word, instead of encountering an expected known control that had been seen with that intended meaning in the first session (for a review of prediction theories, see Kuperberg & Jaeger, 2016). However, if participants had already been presented with a novel target in the first reading session, encountering or not encountering it in the second reading session did not cause the same kind of disruption to reading time.

The last interpretation may have more support here when considering the memory test data. For example, we found the lowest rates of novel target recognition in the consistent context condition and with the novel target only having appeared in the second reading session. However, the extra time does not appear to be all for naught, because in terms of meaning accuracy on the multiple-choice memory test, the performance is not the lowest for this condition. Thus, even though the extra initial reading time of sentence 2 in this case may have reflected some disruption in participants' reading and acquisition process, it is not necessarily the case that the extra time was completely devoid of any acquisition taking place. Follow-up analyses of the current data revealed that for recognition accuracy, inflated reading times were predictive of better performance. Although we believe that this explanation has more support given the memory data, the added precision of eye movement recording in a future study could potentially shed more light on its validity.

For the inconsistent context condition, in which readers encountered informative context that pointed to a different intended meaning for the target word in each reading session, a different story emerged. In the case of encountering a known control, initial reading times on the known-control sentence were comparable when participants encountered the same known control that they had seen in session 1 or when they had instead read a novel target in that item during session 1. This differs from the consistent context condition. That is, seeing a known control in session 2 after having seen a novel target in session 1 may have caused confusion and required disentangling those two same meanings from each other to map onto two different target words across reading sessions. However, in the inconsistent context condition, with two different intended meanings between the reading sessions, there was nothing to disentangle because participants had seen the novel target with one meaning and then the known control with a completely different meaning for the second encounter. There was no reason for participants to think that those encounters were linked. When there was a novel target in the second reading session with inconsistent context, there was inflated initial reading time on the novel-target sentence, when it was the first or second time encountering the novel target. Further, turning to rereading times for both sentences, there was more rereading for inconsistent context, especially when readers encountered the novel target for the first time in reading session 2. This additional rereading time generally did not translate into superior retention performance for the inconsistent context condition. Thus,

having to initiate incidental acquisition of a novel target during the second reading session was particularly disruptive to acquisition relative to the other scenarios.

Another interesting aspect of the data regarding the manipulation of context consistency was its impact on the nature of the acquired novel target and its meaning. For cases in which the novel target was presented in both reading sessions, recall, recognition, and meaning accuracy were generally better than only having encountered the novel target once, especially when the context was consistent. Using the context to mean the same thing in both cases served to reinforce the meaning in readers' minds. The findings reported by Bolger and colleagues (2008) are consistent with this, in that their varied contexts yielded better acquisition than presenting participants with an identical context repeatedly. These findings are also consistent with other studies that have shown that repeated exposures to novel or less familiar words helps with learning the words (Eskenazi et al., 2018; Jenkins et al., 1984; Pagán & Nation, 2019). However, when the context was inconsistent across encounters, memory performance was not nearly as strong in the present study. Even though inconsistent context may have disrupted acquisition relative to the consistent context condition, readers mostly were just as likely to invoke either of the two intended meanings for the novel target that they had encountered during the reading sessions. Critically, in terms of meaning accuracy on the multiple-choice memory test, the initial meaning of the novel target was chosen by participants more often than the meaning from the second session. This adds to the literature suggesting that it is possible for meaning to begin to be acquired, to some extent, during the initial encounter of a novel word in context (e.g., Brusnighan et al., 2014; Chaffin et al., 2001; Lowell & Morris, 2014, 2017; Williams & Morris, 2004). At the same time, it also supports the notion that additional exposure to a new word in meaning-consistent contexts serves to strengthen the mental representation (e.g., Bolger et al., 2008; Fukkink et al., 2001; Jenkins et al., 1984; Nagy et al., 1987; Pagán & Nation, 2019), while also potentially leaving the representation vulnerable to influence if the new word is subsequently encountered with more drastically different meaning information.

Finally, the ability of readers to pick up on the nuances of informative context in the process of incidental vocabulary acquisition is a skill that is partly cultivated through reading experience. One of the components of the current study's procedure that was not directly related to the main hypotheses was the Author Recognition Test (Acheson et al., 2008; Stanovich & West, 1989) that participants completed at the end of the study. The test is a quick and easy self-report measure of reading habits, wherein participants place a check mark next to any name on the list that they believe to be an author. The more an individual reads, he or she will be likely to accurately recognize more authors among the names of authors and nonauthors. Given the powerful nature of the linear mixed-effects models used to analyze the data in the current study, the Author Recognition Test scores were entered in as a covariate. That covariate was a statistically significant predictor in the model for recognition performance on the immediate memory test ($\beta = 0.02$, $SE = 0.009$, $p < .05$) because the higher the test score, the higher the proportion of recognized novel targets (see Figure 6). This suggests that more time spent reading, which is what would help one recognize more authors, would provide more opportunities to naturally engage in incidental acquisition of unfamiliar words. Then, when it came time to apply that skill in the current study, those readers benefited from the ability to acquire novel words. More practice in

inferring unknown words' meanings from context begets more skill at using context to make those kinds of inferences. Pulido (2007) reported findings consistent with this for second-language incidental acquisition as well. In that case, participants learning Spanish were more likely to incidentally acquire new words while reading if they engaged in more elaborative rehearsal of novel words during reading, particularly for more proficient readers.

Limitations

One of the limitations of this study concerns the methodology used. We used a self-paced reading paradigm in which one sentence at a time was presented to participants. A more naturalistic approach would have been to collect eye movement data while participants read the passages containing the target words. An eye movement approach would have allowed all the passages to be present at once, and participants would have had the ability to move across the passages in any way that they deemed most appropriate to read for comprehension. Although that approach is more naturalistic and would have provided a wealth of information, we were able to obtain similar results with the self-paced method as other researchers have found using eye movements. For example, the classic novel-word effect (e.g., Chaffin et al., 2001) can be seen in the first session of self-paced reading times, with readers spending more time on reading and rereading novel-target sentences than known-control sentences. This serves as a replication of other paradigms in which that pattern has been connected to novel-word acquisition (e.g., Brusnighan et al., 2014; Lowell & Morris, 2014, 2017; Williams & Morris, 2004), indicating that incidental acquisition was taking place and allowing for further interpretation of the reading time and memory data.

Additionally, our version of self-paced reading provided readers with access to the entire first sentence of each pair and the entire second sentence of each pair on the screen, respectively. We opted for this presentation over a word-by-word or phrase-by-phrase version of self-paced reading within each sentence because we argue that having the whole sentence on the screen at once is closer to a natural encounter with that text. That said, there have been many reading experiments in previous studies that have used some version of a moving window within the self-paced reading paradigm and have reported findings that line up nicely with more naturalistic reading findings as well. In designing empirical studies of reading, to attain optimal control over variables of interest and minimize extraneous influence, an element of artificiality within the lab setting is inevitable. For example, even in the case of eye movement monitoring with the entire sentence pair or passage on the screen at once, the eye-tracking equipment itself may present an aspect of artificiality in the reading process. In the absence of that specialized equipment, the self-paced reading paradigm in the current study was the same as how the participants would read information on their own computers in terms of the physical setup of the space. Also, for some novel words, readers encountered them twice during the course of our experiment, which builds on some of the foundational studies of incidental acquisition in reading in which only one encounter with the target word was included. Thus, we believe that our results were not too compromised by using this self-paced reading paradigm.

Implications

As we mentioned earlier, individuals learn many words from mere exposures to them during reading. Much of this reading for students (from elementary school through college) happens while they are reading texts and other assignments for their classes. Thus, in textbooks, the authors/publishers may be aware of words that are likely to be unknown to the readers. A growing body of research now suggests that the contextual support and number of exposures that writers provide for these words will impact how well the words are learned. In addition, if the words are found in enough varied contexts, the depth of knowledge of these words can be impacted as well. That is, Bolger and colleagues (2008) argued that experiencing words in a range of varied contexts results in readers developing a more abstract, nuanced understanding of their meanings. Given time constraints in the classroom for those who are provided with explicit vocabulary instruction, especially adults who are learning English as a second language, encouraging more supplemental reading outside of the classroom to increase exposures to key terms in context could be useful. For many adults, explicit vocabulary instruction is not part of their routine, so their vocabulary growth would particularly benefit from increasing their exposures to unfamiliar words via more time with varied reading materials.

Summary

Consistently providing the same meaning for a new word over the course of repeated exposures, using different wording in the context each time, seems to provide a particularly strong foundation for developing a representation for the new word in our lexicon. We acquire some aspect of a new word’s form and meaning upon our initial encounter with the word in context, but additional exposures constantly update our mental representation with new nuances to even just a single meaning of the word. If the information varies too widely, even crossing over into a completely different meaning for the word, it may slow the acquisition process and require more encounters with the new word before it is fully incorporated. Thus, with the nature of the mental representations of newly encountered words being vulnerable at first and constantly evolving as we get more and more information from the world around us, it is likely optimal to fully acquire the nuances of a single meaning for a new word before presenting alternative meanings, if possible. Generally speaking, the more opportunities that we give students to engage in this process of incidental acquisition during reading, the more successful they will be in the future.

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APPENDIX: Experimental Items for the Self-Paced Reading Stimuli

Different versions of context for each meaning are in boldface. Known-control words are underlined, and novel-target words are in italics.

Item	Meaning A sentence pair	Meaning B sentence pair
1	Rachel spent hours [shopping for jewelry; trying on bracelets] with her new coworkers. The next day, everyone agreed that her [charm; *loich*] brightened up the place.	Rachel spent hours [smiling and chatting; enchanting and laughing] with her new coworkers. The next day, everyone agreed that her [charm; *loich*] brightened up the place.
2	Todd decided to take the [road less traveled; bumpy dirt path] this time. He knew it was the [course; *flarse*] that he needed to take.	Todd decided to take the [advanced math class; upper level algebra] this time. He knew it was the [course; *flarse*] that he needed to take.
3	Bill knew he should take the [headache medicine; healing potion] with him to hang out with friends. The next day, he knew he had made the right choice by taking the [capsule; *suclain*].	Bill knew he should take the [game piece; time keeper] with him to hang out with friends. The next day, he knew he had made the right choice by taking the [capsule; *suclain*].
4	Sally wanted to [learn how to play it; learn the new song], so that she could follow in her mother's footsteps. She knew that the [organ; *oftil*] would be a beneficial part of her life.	Sally wanted to [receive the transplant; donate her kidney], so that she could follow in her mother's footsteps. She knew that the [organ; *oftil*] would be a beneficial part of her life.
5	Joe was excited for his [players to dominate; team to win] that afternoon. He was confident that he had the right [pitcher; *cormeth*] for the job.	Joe was excited for his [ice-cold beverage; homemade moonshine] that afternoon. He was confident that he had the right [pitcher; *cormeth*] for the job.
6	Sam's future depended on whether or not he chose the right [brand of beer; flavor comination]. He was sure of his decision to pick the [draft; *tivin*] that was different from the rest.	Sam's future depended on whether or not he chose the right [piece of writing; sample of writing]. He was sure of his decision to pick the [draft; *tivin*] that was different from the rest.
7	The venue had just enough [structural support; gymnastics equipment] for the event. There was one [beam; *cebb*] in particular that was crucial to the performance.	The venue had just enough [rays of sunshine; natural light] for the event. There was one [beam; *cebb*] in particular that was crucial to the performance.
8	There were a lot of [men's underwear; undergarments for men] in the back. All of the [boxers; *gavice*] were carried out to the front.	There were a lot of [professional fighters; men throwing punches] in the back. All of the [boxers; *gavice*] were carried out to the front.
9	Everyone agreed that the [musician's pieces; string quartet] held well together last night. It was clear that [band; *futh*] did a great job of keeping it together.	Everyone agreed that the [household items; hair style] held well together last night. It was clear that [band; *futh*] did a great job of keeping it together.
10	After a long day, everyone enjoyed watching the [winged rodents; creepy creatures] fly overhead. It was so dark outside that I could barely see the [bat; *zos*] in the yard.	After a long day, everyone enjoyed watching the [round objects; worn baseballs] fly overhead. It was so dark outside that I could barely see the [bat; *zos*] in the yard.
11	Each year a speech is delivered from [a sound system; expensive equipment], which is beginning to fail. The duality of the [speakers; *isolects*] was becoming worse every year.	Each year a speech is delivered from [a radio personality; an ordinary person], which is beginning to fail. The duality of the [speakers; *isolects*] was becoming worse every year.
12	The highlight of the weekend was all of the [entertaining storytelling; scary ghost stories]. Howard felt that the [legend; *acture*] had helped him get through the day's events.	The highlight of the weekend was all of the [treasure hunts; scavenger hunts]. Howard felt that the [legend; *acture*] had helped him get through the day's events.
13	John knocked against the [baby cow; young animal] when he fell down. That same [calf; *swic*] was still weak from a fall last night.	John knocked against the [leg bone; sore muscle] when he fell down. That same [calf; *swic*] was still weak from a fall last night.
14	Susan had to go shopping for several new items, including [protective eyewear; fashionable spectacles], yesterday. She was so excited about the new [glasses; *lissits*] she got!	Susan had to go shopping for several new items, including [juice cups; beer mugs], yesterday. She was so excited about the new [glasses; *lissits*] she got!

Item	Meaning A sentence pair	Meaning B sentence pair
15	Everyone was bored until the [tennis player's big serve; pro athlete's winning ace]. The sound of the [racket; *systle*] could be heard by all.	Everyone was bored until the [bees escaped the cages; clown threw the pie]. The sound of the [racket; *systle*] could be heard by all.
16	When Jane was doing her homework she was stopped by the [absence of ink; dried up ballpoint]. It was obvious that the [pen; *ces*] was not working!	When Jane was doing her homework she was stopped by the [animals escaping outside; stampede of cows]. It was obvious that the [pen; *ces*] was not working!
17	Everyone particularly enjoyed [splashing water; belly flopping] when they had the chance. It was clear that the [pool; *lysa*] was the most fun!	Everyone particularly enjoyed [sinking shots; playing 9-ball] when they had the chance. It was clear that the [pool; *lysa*] was the most fun!
18	Jack was always the one to bring [hollow point bullets; ammunition clips] for everyone. He checked his [barrel; *comile*] before leaving for the event.	Jack was always the one to bring [high-gravity beer; aged bourbon] for everyone. He checked his [barrel; *comile*] before leaving for the event.
19	Claire had been working on getting the [infield grass; baseball field] just right. She couldn't wait to see how the finished [diamond; *cropion*] looked!	Claire had been working on getting the [shiny ring; expensive jewelry] just right. She couldn't wait to see how the finished [diamond; *cropion*] looked!
20	Charlie was ready to get started on the [tailored outfit; corporate clothing] for next week. He was excited to get his first real [suit; *inom*] of his own!	Charlie was ready to get started on the [injury claim; court case] for next week. He was excited to get his first real [suit; *inom*] of his own!
21	One of Sandy's favorite hobbies was [typing love notes; composing poetic messages] on days like this. She had created the most beautiful [letter; *thorer*] yet!	One of Sandy's favorite hobbies was [practicing ink calligraphy; writing cursive characters] on days like this. She had created the most beautiful [letter; *thorer*] yet!
22	Tom worried every morning that he might [chop a finger; detach a toe] at work. However, after a long day's work, it all worked out and all the [digits; *hurker*] were in the right place.	Tom worried every morning that he might [miscalculate a number; delete a figure] at work. However, after a long day's work, it all worked out and all the [digits; *hurker*] were in the right place.
23	Jason watched as the [oak tree; leafy redwood] was crushed. One of the [limbs; *migal*] was too weak to last very long.	Jason watched as the [animal's body; athlete's leg] was crushed. One of the [limbs; *migal*] was too weak to last very long.
24	Adam still relied on the same [plumbing fixture; copper drainage] since he was twenty years old. The old man was surprised that the [pipe; *usho*] was still working after all these years.	Adam still relied on the same [tobacco puffer; smoking device] since he was twenty years old. The old man was surprised that the [pipe; *usho*] was still working after all these years.
25	The children were losing interest in the [love to read; encyclopedia topic] all the sudden. Their mother adjusted to the highest [volume; *viddor*] to recapture their attention.	The children were losing interest in the [radio broadcast; evening news] all the sudden. Their mother adjusted to the highest [volume; *viddor*] to recapture their attention.
26	Lucy's teacher gave her the [reading homework; English assignment] to make things easier the next day. She went through the [passage; *flantal*] with ease.	Lucy's teacher gave her the [hallway directions; landmarked route] to make things easier the next day. She went through the [passage; *flantal*] with ease.
27	Ella received a new [wooden antique; storage container] that was quite larger than she remembered. She was afraid that this new [chest; *yeade*] stuck out too far.	Ella received a new [cosmetic enhancement; breast augmentation] that was quite larger than she remembered. She was afraid that this new [chest; *yeade*] stuck out too far.
28	The group focused on figuring out where the [ground cracked; earth separated]. It was important to identify the [fault; *wolir*] accurately.	The group focused on figuring out where the [blame fell; communication failed]. It was important to identify the [fault; *wolir*] accurately.
29	Jill had tried multiple [body soaps; facial cleansers], but this one was the best yet! This new type of [bar; *oyn*] made for a different experience than before.	Jill had tried multiple [watering holes; seedy saloons], but this one was the best yet! This new type of [bar; *oyn*] made for a different experience than before.
30	Jake decided to go [salsa dancing; get drinks] after a long day.	Jake decided to go [play golf; practice putting] after a long day.

Item	Meaning A sentence pair	Meaning B sentence pair
	He was relieved to have a [club; *dwup*] nearby at all times.	He was relieved to have a [club; *dwup*] nearby at all times.
31	It was up to Janet to make sure everything was [chronologically organized; alphabetically arranged] throughout the day. She always took her time [filing; *vaveng*] to make sure she did it correctly.	It was up to Janet to make sure everything was [neatly trimmed; smoothly polished] throughout the day. She always took her time [filing; *vaveng*] to make sure she did it correctly.
32	Elizabeth was frightened by how severe this [sore throat; nasal congestion] had become. The awful [cold/*klon*] was becoming worse throughout the week.	Elizabeth was frightened by how severe this [hazardous weather; freezing rain] had become. The awful [cold/*klon*] was becoming worse throughout the week.
33	Rick spilt the [healthy cereal; granola mix] all over the place this morning. Nothing looked very clean with [grains; *aldins*] scattered everywhere.	Rick spilt the [seasoning salt; beach sand] all over the place this morning. Nothing looked very clean with [grains; *aldins*] scattered everywhere.
34	Ashley was so excited about the [fancy dance; prince's party] that was just announced. All the kids talked about the [ball; *yonu*] for days.	Ashley was so excited about the [children's toy; sports memorabilia] that was just announced. All the kids talked about the [ball; *yonu*] for days.
35	Amy's large and [powerful arsenal; dangerous weaponry] was quite impressive. When the others asked her about them, she said that it was her right to have [arms; *wiem*] like these.	Amy's large and [muscular limb; powerful appendage] was quite impressive. When the others asked her about them, she said that it was her right to have [arms; *wiem*] like these.
36	As time went by, the [hunted animals; wild deer] became more unpredictable. Eventually the [game; *ermi*] seemed like it might get away from them.	As time went by, the [fierce competitors; opposing players] became more unpredictable. Eventually the [game; *ermi*] seemed like it might get away from them.
37	Martha loved to check on all the [illumination sources; colored lights] on a regular basis. The pink [bulb; *pamu*] was quite beautiful.	Martha loved to check on all the [beautiful flowers; gorgeous tulips] on a regular basis. The pink [bulb; *pamu*] was quite beautiful.
38	After working all day, the [scrumptious food; gourmet dinner] was all Lee could think about. Despite all the work, the [meal; *woto*] was worth it.	After working all day, the [yellow corn; golden maize] was all Lee could think about. Despite all the work, the [meal; *woto*] was worth it.
39	Heather became lost in her [cosmetic enhancements; beautiful face] and how much she had changed. Those moments spent with her [reflection; *rotopolynn*] were quite valuable.	Heather became lost in her [deep thoughts; innovative ideas] and how much she had changed. Those moments spent with her [reflection; *rotopolynn*] were quite valuable.
40	Pam was frightened when she noticed the [elusive rodent; dirty creature] there. The tiny [mole; *esco*] was in plain sight.	Pam was frightened when she noticed the [round blemish; dark spot] there. The tiny [mole; *esco*] was in plain sight.

Biography

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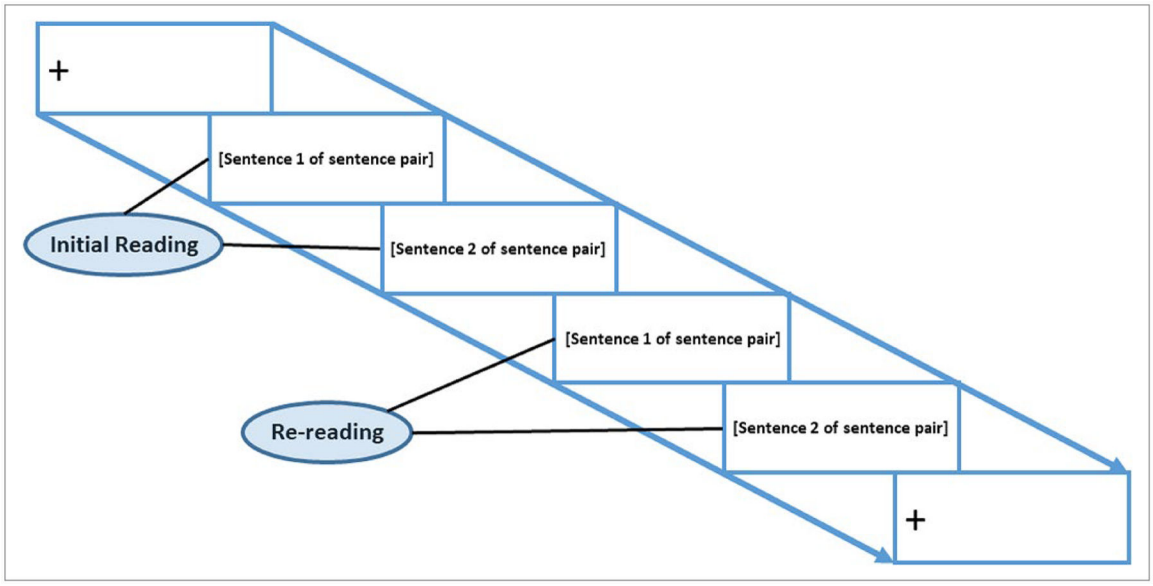

FIGURE 1.

Self-Paced Reading Procedure

Note. Flow chart depicting Self-Paced Reading Procedure, based on the sequence of information readers were presented with on the screen after each press of the SPACE bar.

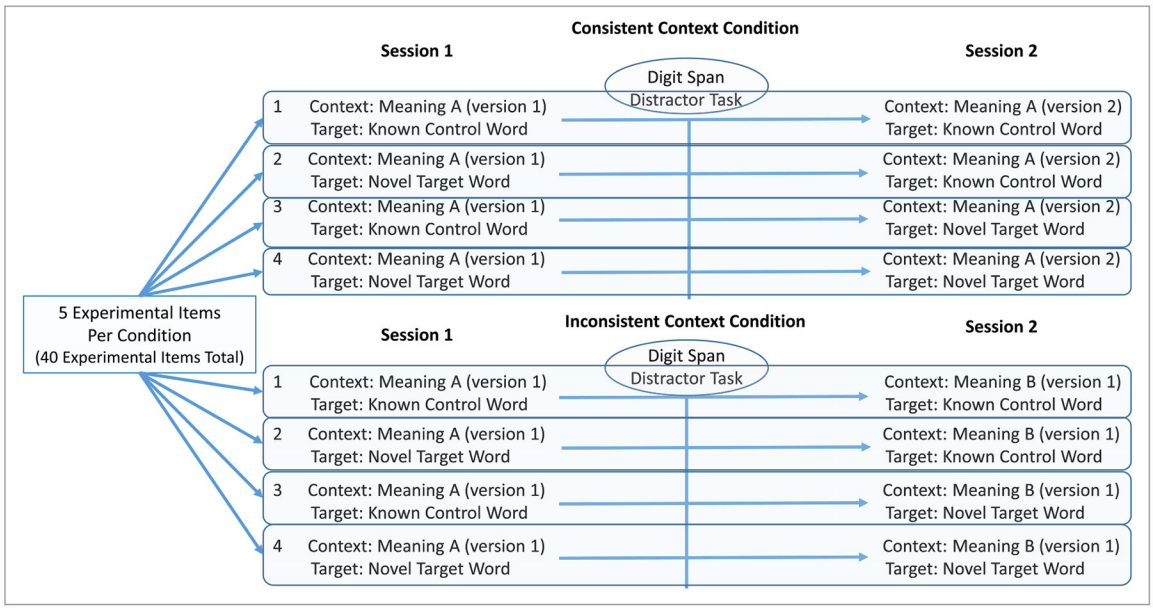

FIGURE 2.

Design of the Self-Paced Reading Stimuli Conditions across Reading Sessions

Note. Diagram of the Self-Paced Reading stimuli conditions across the two reading sessions.

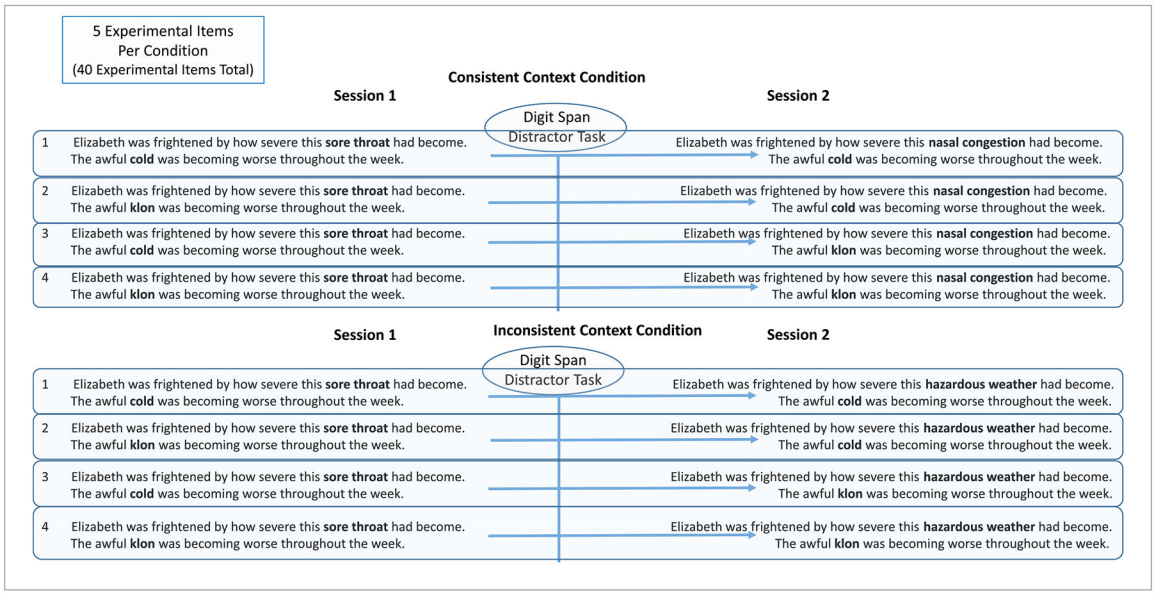

FIGURE 3.

Sample Item Versions Across Self-Paced Reading Conditions/Sessions

Note. Diagram of the Self-Paced Reading sample item across conditions and sessions.

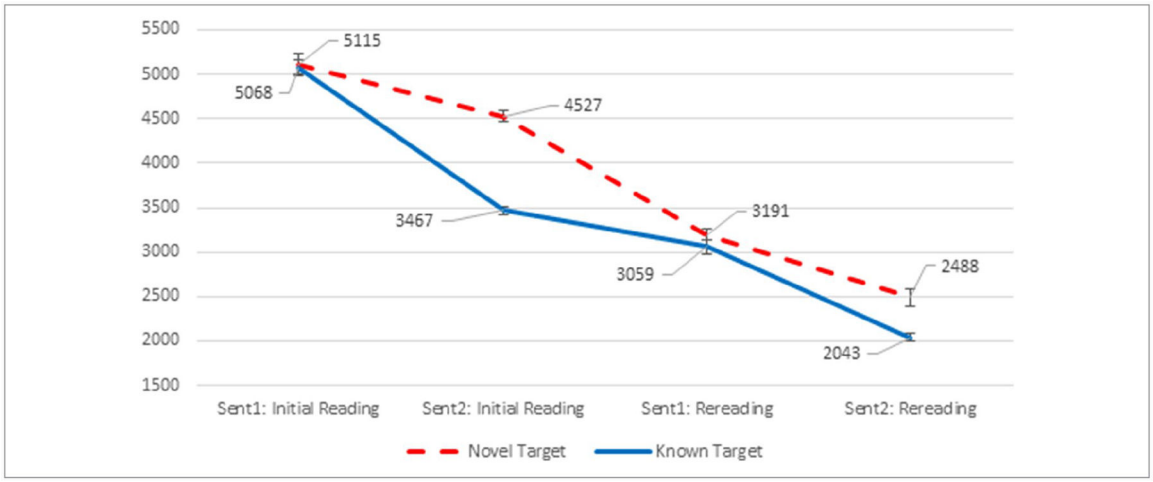

FIGURE 4.

Session 1 Self-Paced Reading Times (msec) by Epoch

Note. Self-paced reading time means from reading session 1, in milliseconds, for items with novel target words versus items with known controls, by reading epoch. Standard error bars included.

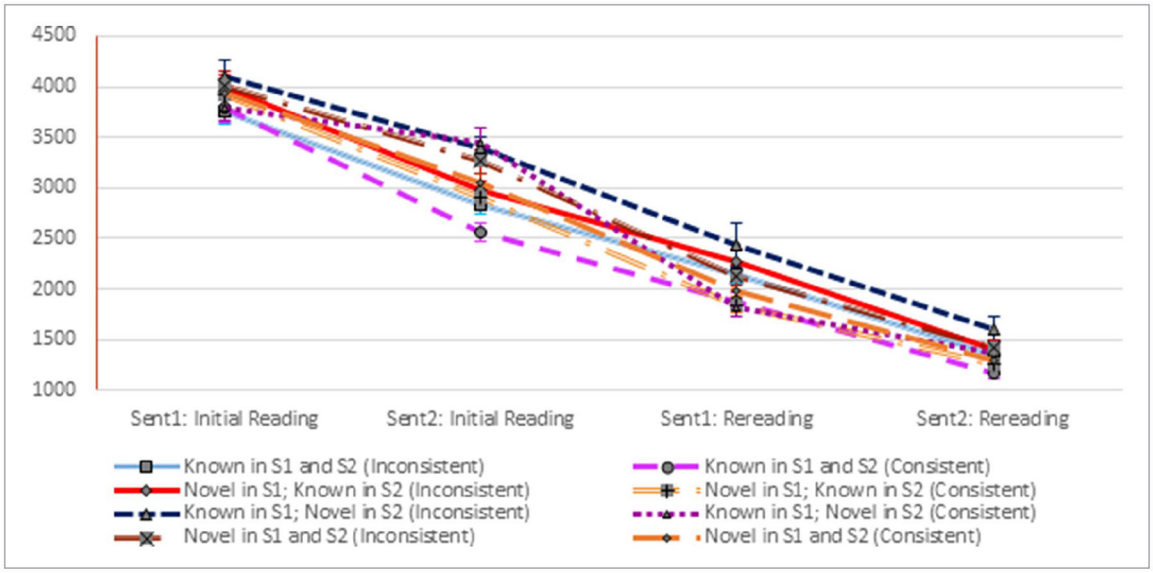

FIGURE 5.

Session 2 Self-Paced Reading Times (msec) by Epoch

Note. Self-paced reading time means from reading session 2, in milliseconds, for consistent and inconsistent context items with novel target words or known controls in neither, one, or both reading sessions; by reading epoch. Standard error bars included.

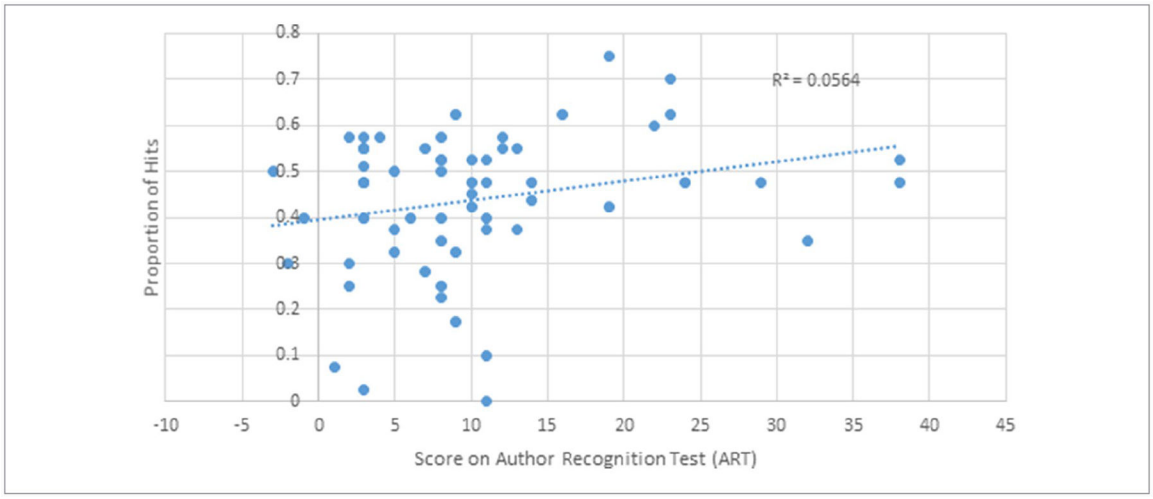

FIGURE 6.

Novel Word Recognition on Immediate Test

Note. Recognition performance (i.e., remembering the novel target from the self-paced reading session) on the Immediate Test (Day 1) as a function of scores on the Author Recognition Test (ART).

TABLE 1

Recognition Means (in Percentages), Collapsed Across Consistent/Inconsistent Context

	Immediate test		Delayed test	
Target word condition	**Hits**	**False alarms**	**Hits**	**False alarms**
Known control in session 1 and session 2		21 (2)		21 (2)
Novel in session 1 and known in session 2	55 (2)		52 (2)	
Known in session 1 and novel in session 2	46 (2)		46 (2)	
Novel target in session 1 and session 2	74 (2)		60 (2)	

Note. Standard errors are in parentheses.

TABLE 2

Multiple-Choice Accuracy Means (Percentage Correct)

	Immediate test			Delayed test		
	Inconsistent context			Inconsistent context		
Target word condition	Meaning from session 1	Meaning from session 2	Consistent context	Meaning from session 1	Meaning from session 2	Consistent context
Known control in session 1 and session 2	29 (3)	35 (3)	35 (3)	31 (3)	38 (3)	37 (3)
Novel in session 1 and known in session 2	32 (3)	37 (3)	41 (3)	35 (3)	36 (3)	37 (3)
Known in session 1 and novel in session 2	32 (3)	35 (3)	43 (3)	29 (3)	38 (3)	41 (3)
Novel target in session 1 and session 2	38 (3)	35 (3)	50 (3)	34 (3)	37 (3)	44 (3)

Note. Consistent context = same meanings across sessions. Standard errors are in parentheses.

TABLE 3

Summary Results of the Linear Mixed-Effects Models for the Self-Paced Reading Data

Measure	Fixed effect	β	Standard error	*t*	*p*
Session 1 self-paced reading					
Sentence 1 of the sentence pair: First presentation of the sentence	Target word type	−6.56	62.74	−0.10	.916
Sentence 2 of the sentence pair: First presentation of the sentence	Target word type	200.53	28.51	7.03	<.001
Sentence 1 of the sentence pair: Second presentation of the sentence	Target word type	−18.74	39.25	−0.47	.633
Sentence 2 of the sentence pair: Second presentation of the sentence	Target word type	143.17	46.07	3.10	<.01
Session 2 self-paced reading					
Sentence 1 of the sentence pair: First presentation of the sentence	Target word type	91.83	51.23	1.79	.073
	Context consistency	−17.59	135.55	−0.13	.896
	Interaction: Target Word Type × Context Consistency	−55.29	72.45	−0.76	.445
Sentence 2 of the sentence pair: First presentation of the sentence	Target word type	170.68	36.37	4.69	<.0001
	Context consistency	−160.63	96.24	−1.66	.095
	Interaction: Target Word Type × Context Consistency	26.77	51.44	0.52	.602
Sentence 1 of the sentence pair: Second presentation of the sentence	Target word type	10.59	45.39	0.23	.815
	Context consistency	−395.02	120.10	−3.28	<.01
	Interaction: Target Word Type × Context Consistency	18.82	64.19	0.29	.769
Sentence 2 of the sentence pair: Second presentation of the sentence	Target word type	39.53	30.75	1.28	.198
	Context consistency	−183.28	81.39	−2.25	.024
	Interaction: Target Word Type × Context Consistency	8.86	43.50	0.20	.838

TABLE 4

Summary Results of the Linear Mixed-Effects Models for the Recognition and Meaning Accuracy Data

Measure	Fixed effect	β	Standard error	*z*	*p*
Recognition					
Immediate test (hit rate)	Target word type	1.15	0.07	16.46	<.0001
	Context consistency	−0.01	0.18	−0.05	.957
	Interaction: Target Word Type × Context Consistency	0.03	0.09	0.32	.748
Delayed test (hit rate)	Target word type	0.91	0.06	13.91	<.0001
	Context consistency	−0.02	0.18	−0.14	.887
	Interaction: Target Word Type × Context Consistency	0.07	0.09	0.80	.418
Meaning accuracy					
Immediate test: Based on meaning from session 1 (inconsistent context)	Target word type	0.13	0.06	2.40	.016
Immediate test: Based on meaning from session 2 (inconsistent context)	Target word type	−0.02	0.06	−0.27	.784
Immediate test: Based on meaning from either session (consistent context)	Target word type	0.12	0.06	2.14	.032
Delayed test: Based on meaning from session 1 (inconsistent context)	Target word type	0.02	0.05	0.33	.735
Delayed test: Based on meaning from session 2 (inconsistent context)	Target word type	−0.01	0.05	−0.20	.840
Delayed test: Based on meaning from either session (consistent context)	Target word type	0.002	440.32	0.00	1

Note. For recognition results, the fixed effect of target word type referred to the four possible conditions for each of the novel targets shown: whether the novel target had not appeared at all during the two self-paced reading sessions, whether it had appeared in just the first or second session, or whether it had appeared in both sessions. For the meaning accuracy results, the context consistency conditions are parsed out in this table due to the fact that accuracy meant something different in each of the different context conditions.