Syntactic Prediction and Lexical Surface Frequency Effects in Sentence Processing

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Abstract

This paper presents three experiments which examine the effect of lexical surface frequency on sentence processing and the interaction between surface frequency and syntactic prediction. The first two experiments make use of the self-paced reading paradigm to show that processing time differences due to surface frequency (e.g., the frequency of *cats* not including occurrences of *cat*), which have previously been demonstrated in isolated word tasks like lexical decision, also give rise to reaction time differences in sentence processing tasks, in this case for singular and plural English nouns. The second experiment investigates whether a prediction for the number morpheme triggered by the number-marked determiners *this* and *these* might counter the surface frequency effect; however, the small size of the surface frequency effect and baseline differences in reaction times to *this* and *these* made the results unclear. Results from a third experiment using lexical decision suggest that the difference in the size of the surface frequency effects between the lexical decision experiments and the self-paced-reading experiments are likely due to differences in task demands. Our results have methodological implications for psycholinguistic experiments that manipulate morphology as a means of examining other questions of interest.

Introduction

We have strong empirical and theoretical reasons to think that predictive mechanisms play a key role in how we perceive the world. Within language processing, some recent work has been argued to demonstrate predictive mechanisms operating over semantic (Federmeier & Kutas, 1999; deLong, Urbach & Kutas, 2005) and syntactic (Staub & Clifton, 2006; Lau, Stroud, Phillips & Plesch, 2006) representations. Somewhat less work has looked at how predictive mechanisms might affect the processing of morphologically complex words (e.g. Vainio, Hyönä, & Pajunen 2003; Lukatela, Moraca, Stojnov, Savic, Katz, & Turvey, 1982), and the work that has been done has not seriously addressed what we think would be one of the most interesting consequences: researchers may now have an entirely new avenue for testing theories of lexical access and representation.

In this paper we use the possibility of predictive morphological processing as a new tool for addressing long-standing debates about the mental representation of inflected forms. Controversy exists over whether inflected forms like the English plural are accessed through a decompositional mechanism (e.g., Taft, 1979), a whole-word form mechanism (e.g. Burani, Salmaso & Caramazza, 1984), or a dual-route mechanism (e.g. Schreuder & Baayen, 1995). Here we examine the processing of English plurals in neutral contexts (*the old soldiers*) and in contexts which predict the plural form (*these old soldiers*). We suggest that existing theories of lexical representations may make different predictions about the effect of this context on lexical processing. In essence, under decompositional views, predictive contexts such as *these* could speed processing significantly by providing advance knowledge of the internal composition of the upcoming form, while under whole-word views in which all form variants are listed, predictive contexts will only have the modest effect of excluding a subset of possible competitors (e.g., all the singular forms listed).

1 Background

1.1 Previous studies of morphologically complex lexical access A great deal of work in cognitive psychology has focused on the access and representation of word forms composed of more than one morpheme, for example, 'birds' ([bird] + [pl]) . The representational question central to this area is: Are there levels of long-term mental representation at which multi-morpheme word forms are stored not as bundles of morphemes per se but as undifferentiated whole forms—and if so, what are they? The processing question central to this area is: Are multi-morpheme words accessed by means of their constituent morphemes—and if so, in what way and to what extent? One line of thought begins from the position that it would be wasteful to store complex word forms that are largely predictable from a small number of rules governing their relation to simplex morphemes. The other line of thought is often associated with exemplar-based theories of learning and representation (concepts are just clustered collections of all perceptual experiences), and this side points out that if the brain's storage capacity is large enough not to place a serious constraint on the type of lexical representations used, then the 'waste' would be in actually computing morphological relationships online rather than just storing all the forms individually for direct access. The first line of thought is often known as the 'decompositional' perspective and the second as the 'whole-word' perspective.

Many authors trying to address this debate have used frequency as an indicator of what is stored. Two frequencies central to this area of research are *root frequency* (also sometimes known as *base frequency*) and *surface frequency*. Root frequency is the number of times that a given *morpheme* appears. For example, the root frequency of 'bird' would include occurrences of 'birds' as well as 'bird'. Surface frequency is the number of times that a given *word* appears. The surface frequency of 'bird' would *not* include occurrences of 'birds'; the word 'birds' would have its own surface frequency, which equally would not include occurrences of 'bird'. It is easy to see that the concepts of root and surface frequency can be mapped rather directly onto predictions of the decompositional and whole-word theories, respectively. Decompositional theories argue that individual morphemes are used to access complex words; thus, they predict in the general case that increased root frequency of constituent morphemes would speed processing of the complex forms in which they occur, independent of the surface frequency of the form. Whole-word theories argue that complex words are accessed as wholes; thus, they predict in the general case that increased surface frequency of whole word forms would speed processing of complex forms, independent of the base frequency of their constituent morphemes.

In fact, from the very beginning of this area of research, effects of both root and surface frequency have consistently been found (although not always in the same studies). Effects of root frequency have been shown in lexical decision tasks since Taft's seminal (1979) study (e.g. Burani, Salmoso & Caramazza, 1984, Niswander, Pollatsek & Rayner, 2000; New, Brysbaert, Segui, Ferrand, & Rastle, 2004). Many studies have also demonstrated effects of surface frequency on inflected forms (e.g. Burani, Salmoso & Caramazza, 1984; Bertram, Laine, Baayen, Schreuder & Hyona, 2000; Niswander, Pollatsek & Rayner, 2000; New, Brysbaert, Segui, Ferrand, & Rastle, 2004; Baayen, Dijkstra & Schreuder, 1997; Sereno & Jongman, 1997). The fact that both root and surface frequency effects exist, then, is not really controversial. It is at the interpretation of these effects where the debate is played out.

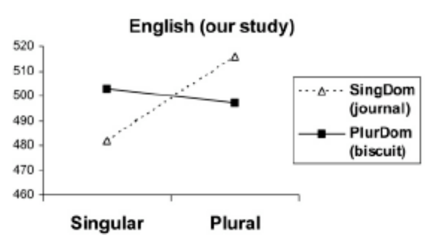
Although root frequency effects are often presented as evidence for a decompositional approach, from the whole-word perspective the existence of root effects has sometimes been explained as a type of 'priming' between surface word forms due to phonological and semantic similarity (e.g. 'bird', 'birds'), without the need to appeal to decompositional mechanisms (Burani, Salmoso, & Caramazza, 1984). More recently, it has been suggested that both root and surface frequency effects can be understood in a framework in which the existence of other similar forms affects processing difficulty through changing the amount of 'information' conveyed by a given form (Hay & Baayen, 2005; Del Prado Martin, Kostic, & Baayen, 2004). These explanations generally make use of a notion of similarity that is not specifically morphological identity in order to motivate the effect of root frequency on complex word form processing.

On the decompositional side, Taft (2004) has recently suggested that surface frequency effects can actually be attributed to difficulties at one part of the decompositional process, the semantic combination stage; he argues that less frequent complex forms are less frequent because the combinations they form are less plausible, and this plausibility difference causes a slowdown in the semantic composition stage (e.g. *suns*). Still others suggest a subtle, decompositional-style twist on the whole-word view: Frequency effects are still computed over the wordform level, but the frequencies are associated with combinations of single-morpheme wordforms. In other words, the operation of recognizing the parts of a morphologically complex wordform can be affected by the strength of association between the morphemes that compose it (Robert Fiorentino, p.c.). Decompositional explanations for surface frequency effects generally either try to make the level at which surface frequencies are stored irrelevant to the initial access stage (e.g. the semantic computation level), or they suggest that surface frequencies are actually frequencies of combination, not wordforms.

Finally, a very influential group of models known as *dual-route* models bypass the either/or question altogether and propose that both roots and whole wordforms are stored, and that both whole-word and decompositional methods of access are always attempted in a 'race' of sorts which terminates immediately when the first of the two routes succeeds; this allows the possibility of faster access on average than either route when taken alone (e.g. Schreuder & Baayen, 1995; Baayen, Dijkstra & Schreuder, 1997).

In this study we focus on effects of surface frequency with respect to inflectional morphology in English. The most recent and comprehensive lexical decision study to look at these types of effects is that of New et al. (2004). As seen in Figure 1, they show that while words that appear more often in the singular (singular-dominant) show a cost when presented in the plural form, words that appear more often in the plural (plural-dominant) do not, and even show a slight tendency towards the plural being faster. This asymmetrical pattern replicates earlier findings of Sereno and Jongman (1997). As materials in both studies were balanced for root frequency, these findings show that surface frequency does seem to affect lexical processing for English nouns that can bear singular and plural morphology. Our study will examine how context interacts with this basic pattern.

Figure 1. New et al. (2004) Experiment 3



1.2 Previous work on morphology processing in sentential context As described above, much of the debate over the role of decomposition in lexical access of morphologically complex words has focused on results from isolated word tasks like lexical decision. Such experiments have massively increased our understanding of lexical representation, however, they also have serious shortcomings. The main concern is that it is not clear how or to what extent grammatical inflections are processed in a task like lexical decision. For most lexical decision experiments, processing the inflections is not necessary for success in the task; determining whether the string is a word or a non-word can be done by simply focusing on the root part of the word (and in English, where inflections are generally suffixal, this can be approximated by 'the left portion' of the word). More importantly, one of the major motivations for the decompositional approach to access of inflected words is the predictability of the crucial semantic and grammatical information added by the affix, which must be accessed in order to compute things like number and tense agreement within a sentence. However, in a lexical decision task there is no need to process the inflection as an independent unit of grammar and meaning, since no intra-sentential context exists. Thus, it is conceivable that the type of access mechanism that is most successful in a lexical decision task is not the same mechanism that is used to process words within sentences (the normal case). However, a few studies have recognized this limitation and examined the processing of morphologically complex words in sentential context.

Although not looking at the surface/root frequency issue specifically, a study by Randall and Marslen-Wilson (1998) importantly showed that lexical effects appeared in sentence reading tasks. They presented three self-paced reading experiments in which they manipulated lexical factors like frequency and morphological complexity that are known to impact lexical decision times. In Experiment 1, they controlled overall contextual predictability and showed effects of surface frequency and complexity on the first spillover region (longer reading times for less frequent and complex words than for more frequent and simple words) with no interaction. Experiment 3 showed that regularly inflected past-tense verbs in sentences showed a slowdown in the spillover region relative to irregular verbs. The set of experiments as a whole suggests that lexical factors do yield reliable effects on self-paced-reading times; however, due to the fact that these comparisons were necessarily made across different items, and several key parameters of the items that are known to affect lexical decision times were not reported (e.g. root frequency, affix frequency, word length, number of syllables), these results must be taken as preliminary. Other than our own, this study is the only one we know of that looked at morphological processing in sentences in English using self-paced reading.

Niswander, Pollatsek, and Rayner (2000) used eye-tracking to measure fixation durations for suffixed English wordforms (both inflectional and derivational). Focusing on their inflectional results, they found a robust surface frequency effect in both inflected nouns and inflected verbs, as well as a significant root frequency effect in inflected nouns (the interpretation of the verb results was complicated by category ambiguity in that condition). Bertram, Hyönä, and Laine (2000) found similar results for Finnish inflectional nouns using a combination of eyetracking and self-paced reading, although they found that the root frequency effect tended to be delayed (significant differences on the spillover word only) while the surface frequency effect showed up in the earliest eyetracking measures. These studies thus support the findings of the lexical decision experiments in a more ecologically valid context (although see Hyönä, Vainio, & Laine, 2002, for one example in which a morphological effect shows up in word tasks but not sentence tasks).

1.3 Previous work on contextual prediction Given these latter results showing that morphological frequency effects can be obtained within sentence contexts, we can now begin to explore potential interactions between sentential context and morphology, as we focus on in this paper. Previous work on syntactic contextual effects in lexical access has looked at both smaller contexts (Lukatela et al, 1982) as well as whole sentences (Niswander et al, 2000; Hyönä et al, 2002; Bertram et al, 2000).

In a series of papers, Lukatela and colleagues used a continuous lexical decision methodology, similar to a priming paradigm, in which preceding items could be interpreted as being in a syntactic relation to following items (e.g. adjective-noun, pronoun-verb, preposition-noun). In this, they take advantage of the morphological richness of Serbo-Croatian, in which, for example, adjectives are overtly marked with case, gender, and number information that matches the associated noun. Summing up broadly across these studies, what they tend to find is that when preceded by grammatically consistent words, lexical decisions to targets were faster than to targets preceded by grammatically inconsistent words (Lukatela et al., 1982; Lukatela, Kostic, Feldman, & Turvey, 1983; Gurjanov, Lukatela, Lukatela, Savic, & Turvey, 1985; Gurjanov, Lukatela, Moskovljevic, Savic, & Turvey, 1985; Lukatela, Kostic, Todorovic, Carello, & Turvey, 1987).

We can imagine several possible explanations for these results. One explanation, which Lukatela and colleagues suggest in some of the papers, is that slowdowns are caused by a grammatical error-checking mechanism that is triggered/initiated by inconsistent word sequences. However, Lukatela et al. (1982) showed that lexical decisions to verbs were actually faster after an appropriate pronoun than after a 'neutral' pseudoword baseline, and this is harder to capture with an error-checking mechanism. A second kind of explanation could be simple morphological priming; e.g., processing a word with first-person morphology primes the processing of a following word with first-person morphology. One piece of evidence in favor of this explanation is Lukatela et al.'s (1982) third experiment, in which they looked at verb-pronoun sequences rather than pronoun-verb sequences. Since verbs in sentences in Serbo-Croatian agree with the preceding subject rather than with the following object, verb-pronoun sequences should not require agreement matching or checking. However, Lukatela and colleagues still found a small but significant facilitatory effect of morphological match. The third explanation for this pattern of results is a predictive mechanism: Perhaps when an adjective or pronoun or preposition is encountered, even in a lexical decision task, some kind of morphological prediction for the upcoming material is activated. In this case we might expect facilitation when the prediction is realized and difficulty when it is not. This explanation fits with the observations of both facilitatory and inhibitory effects, but not as well with the verb-pronoun results.

More recently, Bölte and Connine (2004) looked at similar effects of gender-marked determiners on lexical decisions to subsequent nouns in German, in the auditory domain. They showed that lexical decisions were facilitated when nouns were preceded by consistent determiners relative to a noise baseline. They also showed that lexical decisions did not seem to be slowed down when nouns were preceded by inconsistent determiners, relative to this baseline.

One difficulty that arises in interpreting these experiments is that it is not clear exactly what participants are doing in the task—the task is presented as a strict lexical decision task that happens to have certain patterns of presentation (e.g. adjective-noun-adjective-noun..)—so it is not clear to what extent the mechanisms being used are the same as those used in normal sentence processing. A few studies have looked at contextual effects in more typical sentence processing tasks. In Experiment 2 of the Randall and Marslen-Wilson (1998) study discussed above the authors did manipulate the degree of semantic/syntactic-category constraint on the critical word position, but the only significant effect was a three-way interaction with type of affix (prefix/suffix) and productivity (productive/unproductive) which did not obviously follow from the predictions of any existing theory (sentences with productively suffixed words and unproductively prefixed words showed no contextual effect, but strong contextual constraints had a facilitatory effect on sentences with productively prefixed and unproductively suffixed words). More successfully,Vainio, Hyönä, and Pajunen (2003) used eye-tracking to show that the presence of a predictive modifier seemed to speed processing (as measured by second-pass reading times) for case-agreeing nouns relative to an unpredictive modifier. But while these two findings are suggestive, more work clearly needs to be done to more thoroughly examine the strength and reliability of contextual influence on morphological processing in sentences.

1.4 The current study Here we explore the idea that the number-marking system in English is a case in which the combinatorial process of syntactic interpretation at the sentence level can shed light on the lexical storage scheme being used. The determiner *the* is ambiguous with respect to number (*the apple/the apples*), so a noun phrase beginning *the big*... provides no indication towards the number-marking on the upcoming noun head. In contrast, the demonstrative determiner has a singular and plural form, *this* and *these*, so a noun phrase beginning *these big*... provides incontrovertible evidence that the upcoming head will be marked plural. If the number-marking on the determiner is used as some form of context to help constrain the lexical recognition process, the interaction of this predictive effect with effects of root and surface frequency may put constraints on models of lexical storage and lexical retrieval.

The intuition behind our manipulation is this: if word forms are processed as wholes, without being decomposed, then being able to predict some of the subparts—e.g. the affixes—of the word in advance won't provide any advantage to the access process. Only if the context allows prediction of the exact wordform as a whole should the reader realize any advantage in processing. Another way of putting this is that, on a whole word form view of the lexicon, a plural determiner only constrains the upcoming input in the sense that it rules out the thousands of singular forms, while still maintaining as active possibilities the thousands of plural forms. Thus, we might not expect this constraint to result in much benefit to processing. On the other hand, on a decompositional view, the plural determiner allows the processor to know in advance how the upcoming word will need to be broken up: exactly the step that is theorized to be more costly for complex forms with low surface frequency. A second important difference between the predictions of the two views is that, without any extra assumptions, the advantage of a predictive determiner should be equal for singulars and plurals in a whole wordform model, because either will have the same effect of ruling out half of the stored noun forms[1]. In the decompositional model, the step that causes slowdown in the low surface frequency complex case—the operation of decomposition—does not even occur in the non-complex singular cases, so the effect of a predictive determiner should only be beneficial in the plural case.

2 Experiment 1

In the first experiment we tested the effect of singular/plural surface frequency within a self-paced reading paradigm. We used sentences of the form *The N V that* ***the Adj *N* spillover*** ..., in which there was time from the onset of the determiner through the adjective to anticipate the upcoming noun head, but in which there were no prior cues to the number of the upcoming noun.

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1 Although this prediction could be tempered by the possibility of floor effects.

2.1 Materials The 23 singular-dominant (*sg-dom)* and 23 plural dominant (*pl-dom*) target words used in this experiment were those used in Experiment 3 of New et al. (2004), which was a lexical decision task manipulating singular and plural surface frequency. An additional 23 equal-frequency (*eq-freq*) words were created to match with the other lists across certain parameters. The three word lists were balanced for total (root) frequency according to the Cobuild Bank of English corpus (320 million words): sg-dom mean= 34 words per million, SD = 29; pl-dom mean=35 w.p.m., SD=27; eq-freq mean=37 w.p.m., SD = 35. Nouns from the singular dominant list appeared much more often in the singular form than the plural (mean=76% of occurrences in the singular); nouns from the plural dominant list showed the reverse pattern (mean=74% of occurrences in the plural). Nouns from the equi-dominant list appeared in both forms equally (mean=51% of occurrences in the singular). The 69 target nouns with their corresponding statistics are listed in Appendix A. 23 pairs of sentences were created for each dominance condition; the two versions differed only in whether they contained a singular or a plural noun. The sentences are listed in Appendix B. Each of the sentences took the form *The-N-V-that-the-ADJ-TARGET-AUXVerb…* . The adjective was included in order to provide time for a prediction based on the determiner to be instantiated in the second experiment. Two lists were created; only one version of each sentence appeared in each list. In addition, 237 filler sentences of different structures were included in each list. Yes/no comprehension questions were written for all target and filler sentences, with correct responses balanced across conditions.

2.2 Participants 38 members of the University of Maryland community participated in the experiment in return for financial compensation. All participants were native speakers of American English.

2.3 Procedure Sentences were presented on a desktop PC using the Linger software (Doug Rohde, MIT) in a self-paced word-by-word moving window paradigm (Just, Carpenter, & Woolley, 1982). A comprehension question appeared after each sentence. Participants were instructed to read at a natural pace and answer the questions as accurately as possible. Six practice items were presented before the beginning of the experiment.

2.4 Results Mean accuracy for comprehension questions across subjects was 93.8% (SD = 2.6%); mean RT per word across subjects was 348.2 ms (SD = 73.2 ms). Mean accuracy and RT for all participants was within 2 SD of the mean, therefore all participants were included in the analysis. After one RT > 5 s had been excluded, responses further than 2.5 SD from the mean RT for each region were excluded from further analysis. This affected about 2% of the data from these 5 regions. Reading times within sentences for which the comprehension question was answered incorrectly were excluded.

The mean RTs computed across subjects for all conditions in the five regions of interest are presented in Table 1. Figures 2 and 3 show the pattern of reading times for the singular-dominant and plural-dominant pairs, respectively.

We computed a 3 x 2 repeated-measures ANOVA using dominance and number as factors, for the five regions from the beginning of the embedded clause (e.g. *that the beautiful soldier was…*). The results are presented in Table 2. The only significant effect before the critical region 4 was a significant interaction between number and dominance in region 2 by subjects, but since there were no differences between the singular and plural conditions until region 4, we assume that this effect must have been spurious. Paired comparisons over each dominance pair also showed no significant effect of number.

In region 4, the noun region, we saw a significant main effect of dominance ($F_1(1,35) = 3.4$, $p < .05$), but the interaction of dominance and number was not significant ($F_1\ (1,35) = 1.5$). There was a numerical tendency for the sg-dom conditions to be more different than the others, but planned comparisons showed no significant differences for any pair at region 4 (ps > .1). However, in region 5, the spillover region, we also saw a marginally significant main effect of dominance, and here the interaction between number and dominance was also marginally significant. Planned comparisons showed a marginally significant difference between singular and plural RTs for the singular dominant condition such that RTs in the plural condition were slower ($t_1(37) = 1.95$, p =.06), while the plural dominant and equal dominant conditions showed no significant differences.

Table 1. Mean reading times for each region with standard deviations.

		…that	*the*	*old*	*prophet(s)*	*could…*
singular-dominant						
	sg	317 (68)	299 (57)	318 (74)	335 (88)	333 (71)
	pl	320 (67)	311 (62)	315 (77)	350 (104)	345 (66)
plural-dominant						
	sg	314 (62)	306 (61)	324 (79)	349 (83)	346 (78)
	pl	315 (54)	301 (61)	320 (74)	349 (96)	343 (74)
equal-frequency						
	sg	320 (63)	303 (56)	320 (80)	336 (83)	336 (70)
	pl	318 (62)	299 (53)	308 (66)	330 (77)	330 (67)

Figure 2. Mean RTs with standard errors, singular-dominant conditions.

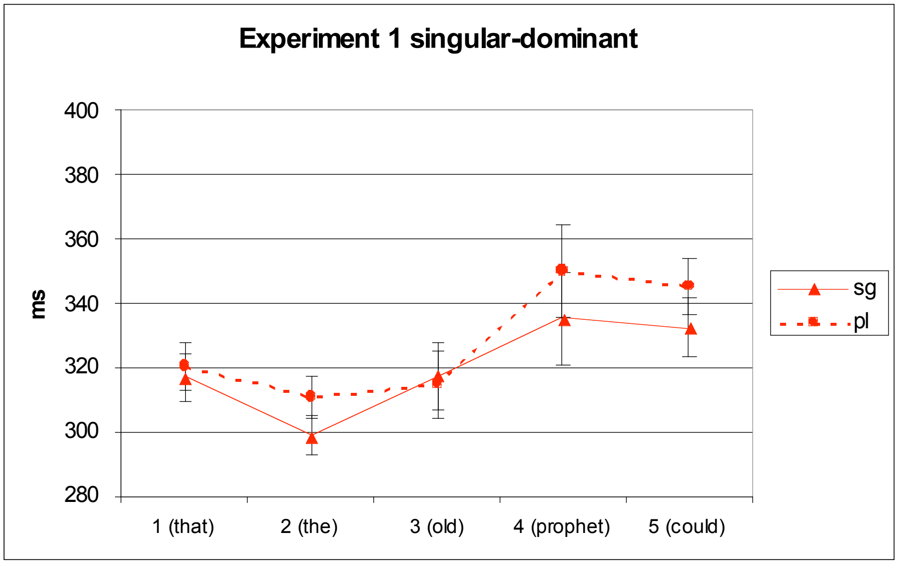


Figure 3. Mean RTs with standard errors, plural-dominant conditions.

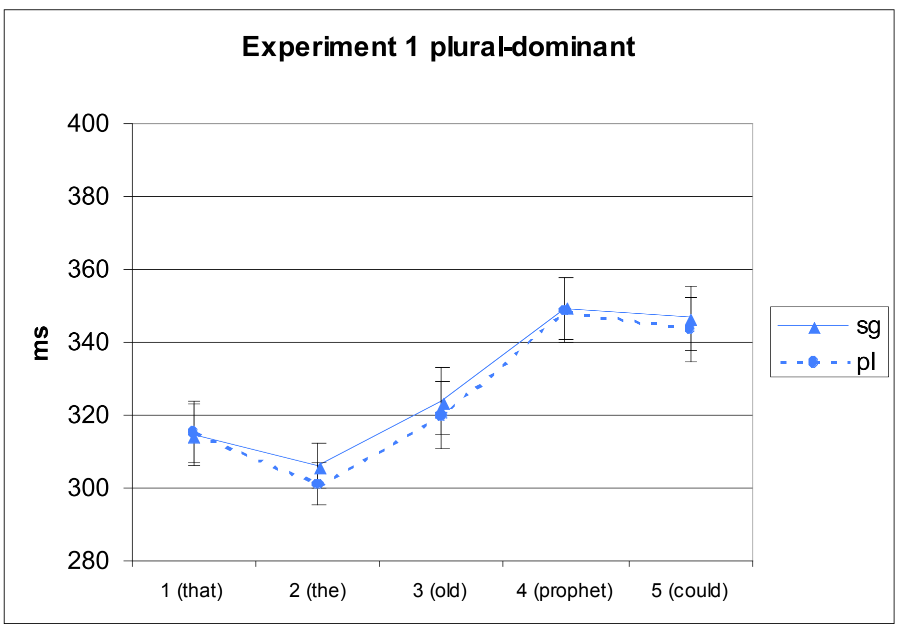


Table 2. Experiment 1 ANOVA Table

3x2 ANOVA	*By participants*				
	df	**MSE**	**F1 value**	**p**	**95% CI**
Region 1					
number	1,35	315	0.0	**0.83**	8.3
dominance	1,35	674	0.7	**0.52**	12.1
number x dominance	1,35	598	1.3	**0.27**	11.4
Region 2					
number	1,35	498	0.0	**0.92**	6.0
dominance	1,35	779	0.3	**0.71**	7.5
number x dominance	1,35	508	3.3	**0.04**	6.1
Region 3					
number	1,35	976	1.9	**0.17**	8.4
dominance	1,35	1024	1.5	**0.23**	8.7
number x dominance	1,35	815	0.8	**0.47**	0.5
Region 4					
number	1,35	802	0.6	**0.43**	7.7
dominance	1,35	1576	3.4	**0.04**	10.7
number x dominance	1,35	1768	1.5	**0.23**	11.4
Region 5					
number	1,35	1466	0.0	**0.94**	10.3
dominance	1,35	1690	2.7	**0.07**	11.1
number x dominance	1,35	1391	2.8	**0.07**	10.1

2.5 Discussion In sum, in Experiment 1 we showed that we could replicate the singular-dominant vs plural-dominant effect from the lexical decision literature in a self-paced-reading paradigm: words that more often appear in the singular showed longer reaction times for the plural form in the word+1 spillover region, while words that more often appear in the plural showed no reaction time differences between singular and plural forms. This asymmetrical pattern is consistent with either a decompositional approach that assumes that compositional relations can be primed, or a (partially) whole-word form approach like that of Baayen and colleagues that assumes that presentation of a plural form primes the singular form but not vice versa.

In the next experiment, we wanted to look at the effect of prediction on this dominance effect. To do this, we manipulated the determiner of the noun phrase, contrasting *the*, congruent with both singulars and plurals, with *this/these*, which are specified for number, and thus predict the number of the upcoming noun phrase. Decompositional and whole-word form theories make different predictions about the extent of response time facilitation that the demonstrative forms can exert. Because decompositional theories posit that processing a morphologically complex word involves identifying and decomposing the two parts of the word to form the semantic and syntactic representation, these theories would assume that when number is cued well in advance of the noun, much of this processing can be done ahead of time. In contrast, whole-word theories maintain that processing a morphologically complex word involves simply retrieving its undecomposable wordform. Thus, the only work that can be done ahead of time with a number cue is to rule out in advance from the lexical search the half or so of the noun wordforms that have the wrong number value. Note also that on the whole-word view, both singular and plural forms should receive the same benefit from the advance cue, while on the decompositional view, only the plural form should receive a processing benefit, because the process that is benefited—decomposition—is not required at all for singular forms.

Therefore, the decompositional view would seem to predict that the number cue should facilitate processing of the singular-dominant plural alone, such that it approaches or matches the faster reaction times of the singular-dominant singular. The whole-word form view would seem to predict that the number cue should facilitate processing of both singular-dominant forms equally, such that the singular-dominant singular form is still read faster than the corresponding plural form. One wrinkle in this set of predictions is that they do not hold if there are extra nonlinearities in processing like ceiling and floor effects, which is almost certainly the case. We will discuss this point further in the General Discussion.

3 Pilot Experiment 2

A full test of this hypothesis requires that we cross three factors—dominance, number, and determiner predictability—in a single experiment. This would require a new, larger set of materials. As a smaller scale initial test, we piloted 19 participants on a version of the study which, like Experiment 1, crossed dominance and number, but used number-specific determiners rather than *the*. Otherwise, the materials were exactly the same as those used in Experiment 1. The results are presented in Table 3.

The pilot data suggested that the decompositional hypothesis may be correct: Whereas in Experiment 1 there was a significant difference between the singular-dominant singular and plural forms, in the number-specific determiner version, the two conditions looked identical (although some unexplained difference was visible in the equal-frequency conditions). However, because the decompositional hypothesis predicts a null effect (no difference between singular-dominant forms), it is necessary to run a full dominance × number × predictability design in order to show the two patterns in the same participants. We also wanted to better control the pre-target context in order to ensure that this context did not create a bias for a particular lexical item or lexical form. Therefore, we created a new, larger set of materials in Experiment 2 to test the question of the effect of predictability on the dominance × number effect.

Table 3. Pilot Experiment 2 - Mean reading times for each region.

	…that	*the*	*Old*	*prophet(s)*	*could…*
singular-dominant					
sg	310	302	310	329	348
pl	316	298	321	332	351
plural-dominant					
sg	312	297	331	364	352
pl	313	304	339	368	368
equal-frequency					
sg	321	299	320	332	332
pl	342	316	318	345	339

4 Experiment 2

4.1 Materials The experimental targets comprised three lists of forty sentence quadruples, one list for each type of noun target (singular-dominant: *sg-dom*, plural-dominant: *pl-dom*, and equal-frequency: *eq-freq*). Forty nouns from each class were selected from the Cobuild Bank of English corpus (320 million words). The three word lists were balanced for total (root) frequency (sg-dom mean=37.0 w.p.m., SD = 32.3; pl-dom mean=36.9 w.p.m., SD=31.3; eq-freq mean=36.3 w.p.m., SD = 35.4). Nouns from the singular dominant list appeared much more often in the singular form than the plural (mean=70.7% of occurrences in the singular); nouns from the plural dominant list showed the reverse pattern (mean=68.7% of occurrences in the plural). Nouns from the equal-frequency list appeared in both forms equally (mean=50.0% of occurrences in the singular). Category-ambiguous, homonymous, and morphologically complex nouns were avoided. With one exception, only nouns with regular plurals (-*s*) were used. The 120 target nouns with their corresponding statistics are listed in Appendix C.

The noun lists formed the basis of the target sentences (Appendix D). Next a list of 40 generic adjectives was selected. The adjectives were such that they could plausibly combine with a wide range of nouns (e.g. *new, small*), while providing relatively few predictions about the semantic characteristics of the noun to follow. These 40 adjectives were combined with the 40 nouns from each list, to form 120 noun phrases. This was done partly in order to minimize the prediction of context, but also in order to match the baseline reading times for the pre-target region across the different lists.

The 120 phrases were inserted into sentence frames of the following type: NP – V– 'that' – complement clause. The target noun phrase was placed in the subject position of the complement clause. The NP and VP of the matrix clause were chosen to make as few lexical or contextual predictions as possible. Only proper names and fairly generic nouns (e.g. *the girls*, *the community*, *everyone*) were used as main clause subjects; the predicates that can be used to introduce a complement clause also impose minimal semantic restrictions on the subject of the complement clause (e.g., *think*, *know*, *be surprised*). The words following the target noun phrase (the spill-over region) were selected to be as contentless as possible, and were mostly function words. No words that required singular or plural agreement with the target noun were used in the spill-over region. Further, 28 of the 40 spill-over words across the three lists were identical.

Each of the sentence frames appeared in four versions: ambiguous-determiner singular, ambiguous-determiner plural, number-marked-determiner singular, number-marked-determiner plural (1a-d). The ambiguous-determiner conditions appeared with the determiner *the* preceding the target noun phrase, which can precede a singular or plural noun phrase. The number-marked-determiner conditions appeared with number-marked determiners *this* or *these* preceding the target noun phrase.

(1a) Katya thinks that the accomplished author should try writing ...
(1b) Katya thinks that the accomplished authors should try writing ...
(1c) Katya thinks that this accomplished author should try writing ...
(1d) Katya thinks that these accomplished authors should try writing …

As each word type could appear in four different conditions, we created four lists arranged in a Latin Square design. 120 filler sentences of various constructions were also included in each list. Yes/no comprehension questions were written for all target and filler sentences, with correct responses balanced across conditions.

4.2 Participants 69 members of the University of Maryland community participated in the experiment in return for financial compensation. All participants were native speakers of American English.

4.3 Procedure The procedure was identical to that described in Experiment 1.

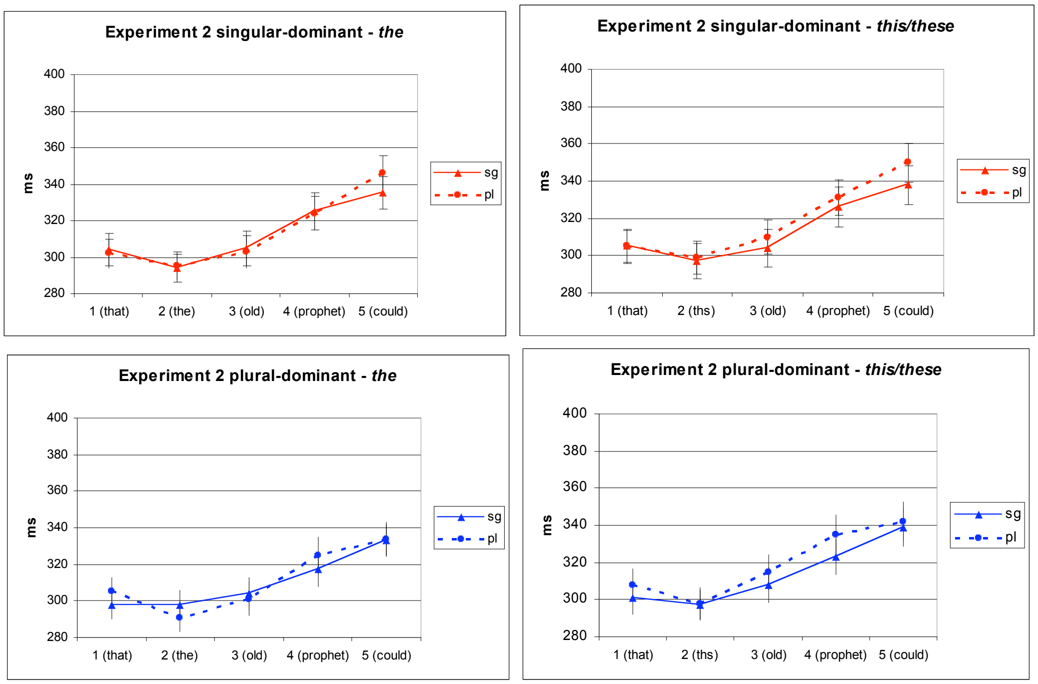
4.4 Results One participant was excluded due to low accuracy in comprehension questions (< 80%). Overall mean accuracy for comprehension questions was 97%. Mean response times for the critical regions for the remaining 68 participants are presented in Table 4. Figure 2 presents singular-dominant and plural-dominant comparisons.

Because the differences we predicted were fairly small, and because the responses of interest were thus predicted to be fairly close to the overall mean RT for reading words (in contrast to anomaly experiments) the outlier cutoff value became an important issue. Here we considered two possible outlier processing methods, a 2.5 SD cutoff (equal to ~800 ms), and the inverse means (Ratcliff 1993). Ratcliff (1993) showed that, of various outlier exclusion methods, the inverse mean transformation was the most robust in terms of statistical power over a variety of synthesized datasets. Our experiment represents a good situation for use of the inverse means, because we assume that the relative costs of seeing different forms of different surface frequency would have a small, somewhat linear effect on RT. In this case, however, we found little difference in our results between the two methods, so the figures and statistics presented here use the 2.5 SD cutoff.

Table 4. Experiment 2 mean response times in critical regions for 68 participants.

	…that	*the*	*old*	*prophet(s)*	*could…*
singular-dominant					
the					
sg	304	294	305	325	335
pl	302	295	303	324	346
this/these					
sg	305	297	304	326	338
pl	305	299	310	331	350
plural-dominant					
the					
sg	298	298	304	317	333
pl	305	291	301	325	334
this/these					
sg	301	297	308	323	339
pl	308	298	315	335	342
equal-frequency					
the					
sg	306	297	307	324	339
pl	311	290	299	324	348
this/these					
sg	306	292	303	324	329
pl	303	299	311	333	346

Figure 4. Experiment 2 mean response times in critical regions for 68 participants, non-predicted and predicted.



We computed a 3 × 2 × 2 ANOVA, with word type (sg-dom, pl-dom, eq-freq), prediction (*the* vs *this/these*) and number (singular vs plural) as factors. The results are presented in Table 5. In the pre-noun regions, the only significant effects were found in the main effect of prediction and/or the interaction between number and prediction in regions 2 and 3. These effects seemed to be driven by the occurrence of 'these', which seemed to result in a slowdown relative to the other conditions.

In region 4 (noun region), there remained a marginal main effect of prediction ($F_1(1,61)=3.5$, $p < .07$) and a significant main effect of number ($F_1(1,61)=6.5$, $p < .05$), which seemed to result from longer reading times in the plural conditions. No interactions were significant. Items analyses were computed separately for each group of items (sg-dom, pl-dom, and eq-freq). The equal dominant items showed no main effects of number or dominance. The plural dominant items showed a main effect of number ($F_2(1,37)=5.2$, $p < .05$) due to slower reading times for the plural forms, with no significant interaction. The singular dominant items showed no main effects, but a significant interaction, ($F_2(1,37)=4.7$, $p < .05$). Planned comparisons were run on each sing-pl pair (e.g., sgdom-*the*-sg vs sgdom-*the*-pl, sgdom-*this*-sg vs sgdom-*these*-pl, etc.). The only significant difference was between the pldom-*this*-sg and the pldom-*these*-pl pair, ($t_1(67)=1.99$, p = .05).

In region 5 (spillover region), there was a significant main effect of number ($F_1(1,61)=13.5$, $p < .05$), a marginal interaction between word-type and prediction ($F_1(1,61)=2.8$, $p =.06$), and a marginal interaction between dominance and number ($F_1(1,61)=2.4$, $p = .1$). By item analyses were run separately for each group of items (sgdom, pldom, and eqdom). These analyses showed main effects of number for the equal dominant items ($F_2(1,37)=5.8$, $p < .05$) and the singular dominant items ($F_2(1,37)=4.5$, $p < .05$), but not the plural dominant items ($F_2(1,37)=.3$, p >.1); no group showed a significant effect of prediction. Planned comparisons by subjects showed marginally significant differences between the non-predicted singular and plural forms for the equal dominant ($t_1(67)=1.9$, $p =$ .07) and singular dominant words ($t_1(67)=1.8$, $p = .07$) only (but not by items; *p*s > .1), and significant differences between the predictive singular and plural forms for the equal dominant ($t_1(67)=3.2$, $p < .01$) and singular dominant words ($t_1(67)=2.3$, $p < .03$) only, both in the subjects and items analyses. The plural dominant words showed no differences for the singular and plural forms.

4.5 Discussion As in Experiment 1, both singular dominant and equal dominant words engendered small but fairly reliable slowdowns in the spillover region when presented in the plural as compared to the singular, while plural dominant words tended not to show such an effect. There was a significant effect of number in the pl-dom items in region 4, the noun region, but this seemed most likely to have been driven by a slowdown for the *these Ns* condition which had baseline problems (as discussed further below). Thus, we seem to see surface frequency effects similar to those previously found in the lexical decision literature (eliminated slowdown for frequent surface forms, e.g. the plural-dominant plural condition).

Interestingly, the equal dominant items seemed to show the same slowdown as the singular dominant items, which may have implications for how the surface frequency effect is modeled. Some previous work using Baayen's race model (e.g. Lehtonen, Wande, Niska, Niemi, Laine, 2006) suggests that such facilitatory effects of surface frequency should only be seen for words whose total frequency is large. We used items with a range of total frequencies, so it is possible that only those items with high total frequencies contributed to the facilitation for the plural form in the pl-dom cases. Preliminary correlation analyses between word frequency and size of the surface frequency effect did not support this hypothesis, although it may be that our stimulus set was too small to detect such a relationship.

Table 5. Experiment 2 ANOVA Table., by participants

	df	MSE	F1 value	p	95% CI
Region 1 - that					
Number	1,61	742	1.6	**0.20**	12.7
prediction	1,61	737	0.0	**0.90**	12.6
dominance	1,61	1042	1.1	**0.32**	15.0
number x dominance	1,61	670	1.6	**0.20**	12.0
number x prediction	1,61	580	0.4	**0.53**	11.2
prediction x dominance	1,61	946	1.0	**0.39**	14.3
number x prediction x dominance	1,61	953	0.4	**0.66**	14.3
Region 2 - the					
Number	1,61	548	0.2	**0.67**	10.9
prediction	1,61	1176	1.5	**0.23**	15.9
dominance	1,61	680	0.3	**0.72**	12.1
number x dominance	1,61	594	0.6	**0.58**	11.3
number x prediction	1,61	780	4.4	**0.04**	13.0
prediction x dominance	1,61	827	0.0	**0.97**	13.4
number x prediction x dominance	1,61	737	1.1	**0.33**	12.6
Region 3 - adj					
Number	1,61	830	0.5	**0.48**	13.4
prediction	1,61	1094	5.7	**0.02**	15.4
dominance	1,61	955	0.3	**0.73**	14.4
Number x dominance	1,61	1028	0.1	**0.89**	14.9
Number x prediction	1,61	1214	5.6	**0.02**	16.2
prediction x dominance	1,61	921	0.9	**0.41**	14.1
Number x prediction x dominance	1,61	1142	0.2	**0.86**	15.7
Region 4 - noun					
Number	1,61	5985	6.5	**0.01**	36.0
prediction	1,61	1613	3.5	**0.07**	18.7
dominance	1,61	1021	0.2	**0.84**	14.9
Number x dominance	1,61	1173	1.1	**0.35**	15.9
Number x prediction	1,61	1184	1.5	**0.23**	16.0
prediction x dominance	1,61	1290	0.2	**0.82**	16.7
Number x prediction x dominance	1,61	1163	0.1	**0.92**	15.9
Region 5 – aux verb					
Number	1,61	1135	13.5	**0.00**	15.7
prediction	1,61	1342	0.3	**0.57**	17.0
dominance	1,61	1040	1.5	**0.22**	15.0
Number x dominance	1,61	988	2.4	**0.10**	14.6
Number x prediction	1,61	1033	0.5	**0.49**	14.9
prediction x dominance	1,61	1104	2.8	**0.06**	15.4
Number x prediction x dominance	1,61	1005	0.1	**0.89**	14.7

We also manipulated prediction of the singular and plural forms by including conditions with number-marked determiners (*this-these*), contrasting with number neutral *the*. We hypothesized that the cost of processing the plural forms might be reduced when such a prediction was available; this was supported by pilot data based on the Experiment 1 materials. We did not see effects of prediction here. Unfortunately, we cannot take these results as conclusive evidence against the possibility of a predictive-plural interactive effect, because of potential baseline confounds; in the pre-noun region there was significant slowdown for the predicted plural conditions relative to the predicted singular conditions. Since the adjective in this pre-noun region was the same for all conditions and was not number-biased in any obvious way, this slowdown seems likely to be a result of a baseline difference in the processing time needed for *this* vs *these*. There are several potential reasons for such a baseline difference, including frequency (*this* is ~4 times more frequent) and the cost of creating the different discourse models associated with *this* vs *these*. Regardless of the reason, the practical implication for us is that using *this* and *these* to drive morphological prediction is non-ideal in the self-paced-reading paradigm.

The differences that we found between the singular and plural conditions in Experiment 2 were small, on the order of 10-15 ms, even though the contexts were better controlled than in Experiment 1; this is smaller than the 20-30 ms effects found in previous lexical decision studies. Responses may be less time-locked to the timing of processing stages in self-paced-reading than in lexical decision because there is more pressure to respond as quickly as possible in the lexical decision task. However, another possibility is that our particular items differed in some way from those used in the lexical decision experiments. To test this possibility we decided to run a new lexical decision experiment using the critical nouns from Experiment 2. If we replicated the pattern found in other singular-plural dominance studies of English, we could then assume that the difference in effect size in Experiment 2 was due to task demands and not to the materials.

5 Experiment 3

5.1 Materials We examined two factors in the experiment: number (plural vs singular) and dominance of form (frequency of occurrence in the plural or singular). Word type lists were balanced for root-frequency. Three lists of 40 words each were created that varied in the surface frequency of the word forms. These words were the same as those used in Experiment 3. The singular-dominant group had 40 words that were more frequent in the singular form. The plural-dominant list consisted of 40 words that are more frequent in the plural form. The equal-frequency list consisted of 40 words that were equally frequent in both forms. Please refer to the Methods section of Experiment 3 and Appendix C for stimulus frequencies and statistics.

We divided the three groups of word pairs (singular-plural) into two lists, such that half of the subjects saw the singular version of each item and the other half the plural version. List A consisted of 60 singular target items, 60 plural target items, and 120 non-words. List B was exactly the same, except that the 60 words that were singular in List A were now plural and the 60 words that were plural in List A were now singular. All word categories had approximately the same mean length (singular-dominant: 6.4 characters, plural-dominant: 6.525. equal-frequency: 6.425) and number of syllables (singular-dominant: 2.125, plural-dominant: 2.15. equal-frequency: 1.975). Only unambiguous word forms were chosen so that the stimuli could only be interpreted as nouns and never as verbs (i.e., no words like *a rock*, *to rock*). The singular and noun combinations were orthographically transparent: the plural version was different from the singular version of a word only by the end morpheme 's' (i.e. *cat*, *cats*) and never by 'es' (i.e. *couch*, *couches*). Mass nouns (i.e. *beef*) and irregularly conjugated nouns (i.e. *mouse*, *mice*) were not used. The non-words used in the lexical decision task were matched to the target stimuli such all items were balanced for length (6.40 – 6.53 characters) and syllables (2.125 -1.975). Half of the non-words ended in 's' to balance the plural target items.

5.2 Procedure The materials were composed of 6 practice items, followed by 120 critical nouns and 120 filler non-words presented in pseudorandom order by the DMDX program (Jonathan Forster, U. of Arizona). Two lists, each containing the same 120 filler words and the control nouns in either the plural or the singular condition were alternated. Thus 20 subjects saw each list. The experiment took around 30 minutes, with three break screens included.

5.3 Participants 40 students from UMCP, took part in the experiment. Each participant was paid five dollars for a half hour session. All participants were native English speakers and had normal or corrected-to-normal vision.

5.4 Results Responses greater than 2.5 standard deviations from the mean were excluded from further analysis. The overall mean reaction time across all conditions for lexical items was 610 ms. Mean reaction times for the 40 participants by condition are presented in Table 5.

We computed a 3 x 2 ANOVA (Table 6) and found a significant main effect of dominance, and a marginally significant main effect of number, but the interaction was not significant. Paired comparisons within each of the three dominance pairs showed a marginally significant effect of number in the singular-dominant conditions (t_1(39)= 1.77, p = .08), but no effect of number in either the plural-dominant or equal-frequency conditions (ts < 1.3).

Table 5. Mean reaction times for 40 participants. Standard deviations are presented in parentheses.

singular-dominant	
Sg	592 (93)
Pl	607 (85)
plural-dominant	
Sg	624 (93)
Pl	623 (96)
Equal-frequency	
Sg	600 (95)
Pl	610 (95)

Table 6. 3 x 2 ANOVA for Experiment 3.

	Df	**MSE**	**F1 value**	**P**	**95% CI**
Dominance	1,39	794	16.3	**0.01**	12.7
Number	2,78	1468	2.8	**0.10**	17.3
number x dominance	2,78	670	0.9	**0.42**	11.7

Our pattern of results is consistent with the results of New et al. (2004); they observed a significant effect of number in singular-dominant pairs but not in plural-dominant pairs. However, our effect was only marginally significant, and it was numerically much smaller than New et al.'s (15 ms vs. 34 ms). What might be the source of this discrepancy? One notable difference in the results of the two studies is the overall reaction time to words; in New et al.'s study, the mean RT was 500 ms, while in our study, the mean RT was over 100 ms greater, 610 ms. Perhaps the slower reaction times, being less time-locked to the critical processes, obscured a real difference between conditions. We examined this possibility by selectively excluding the slowest 25% of participants (n=10, RTs > 665 ms). Mean reaction times for the 30 remaining subjects are presented in Table 7.

As shown, the reduced data set did show a slightly larger difference between the singular and plural versions of the singular dominant pair (20 ms) but not for the plural or equal dominant pairs. When measured with a paired comparison, the difference was significant for singular-dominant (t_1(29) = 2.2, p <.05) but not the other two pairs (ts < 1.5). This supports the idea that slower participants were contributing more variability. However, with 30 subjects included, the mean RT across all conditions was still far above that seen by New et al. (2004) in their lexical decision study (574 ms vs 500 ms). Therefore, we also conducted an analysis in which we excluded enough subjects to more closely approximate their mean. In this analysis we included only the fastest 50% of subjects (n=20) with combined mean of 538 ms. This data is presented in Table 8.

Table 7. Mean reaction times for 30 participants, with 10 participants excluded with the longest mean reaction times across the six conditions.

singular-dominant	
sg	556 (77)
pl	576 (70)
plural-dominant	
sg	591 (76)
pl	582 (59)
equal-frequency	
sg	562 (71)
pl	575 (76)

Table 8. Mean reaction times for the 20 fastest participants.

singular-dominant	
sg	512 (43)
pl	545 (62)
plural-dominant	
sg	553 (54)
pl	556 (55)
equal-frequency	
sg	520 (43)
pl	539 (66)

As shown, the data set that more closely matched the New et al (2004) mean RT also more closely matched the size of their effect. With $n = 20$ and overall mean RT = 538 ms, we saw a difference of 33 ms between the singular and plural singular dominant forms. As in New et al's data, the RTs for the plural dominant conditions were almost exactly the same. With this subset of participants the equal dominant conditions also seemed to show a weak number effect, but the reliability of this effect was less clear as it was smaller than the singular-dominant difference. Paired comparisons over this data set showed the difference for singular dominant pair to be significant ($t_1(19)= 3.3$, $p < .01$) and the difference for the equal dominant pair to be marginally significant ($t_1(19)= 1.8$, $p = .095$).

Although these analyses exclude a substantial number of participants, what is striking is that the lack of a difference between the plural-dominant pair seems to be preserved with any subset, whereas the size of the difference between the singular-dominant pair seems to be inversely related to the mean reaction time of the dataset. Of course, a more controlled replication study would be needed to confirm this pattern, but these analyses provide preliminary support for the idea that the effect size was smaller in our experiment than in New et al.'s due to less sensitivity to lexical effects in the slower reaction times, rather than differences in the materials.

5.5 Discussion In a lexical decision experiment using the same lexical items as in the sentence reading task in Experiment 2, we found a marginally significant effect of number in singular dominant words and not in plural dominant or equal dominant. When slower participants were excluded, bringing the average RT closer to that seen in previous experiments, the effect of number in singular-dominant conditions was significant. This data suggests that the small size of the effect in Experiment 2 was not due to materials but rather to some aspect of the task, but which aspect is the relevant one is not clear. We address this issue further in the General Discussion.

6 General Discussion

In Experiment 1, we showed that reaction times in a self-paced reading task for singular and plural nouns were influenced by both number and number-dominance. However, in Experiment 2 when we attempted to use this effect to test the effect of syntactic prediction on morphological processing—our theoretical question of interest—we failed to find an effect. We hypothesize that this was due to two factors, the relatively small size of the effect, and baseline differences in reading times for *this* and *these*. Therefore, we are unable to make any claims about the theoretical question of interest in this paper. Nevertheless, we think that the methodological conclusions of our study are of interest.

In Experiment 3, we showed that once corrected for individual differences in RTs, the effect size of the morphological factors for the same nouns in a lexical decision task, was just as large as that shown previously in the lexical decision literature. This suggests that the smaller effect size seen in Experiments 1 and 2 might have been a consequence of differences in the task. This is supported by the previous literature; although some have successfully found root and lexical frequency effects in sentences (e.g. eyetracking, ~20-30 ms effects, Niswander et al., 2000), others have found different types of morphological effects in isolated vs sentence contexts (Bertram, Hyönä & Laine, 2000, eyetracking and self-paced reading), and some have found morphological effects in isolated words, but *not* when the same words are placed in sentences (Hyönä, Vainio, and Laine, 2002, eyetracking). The Hyönä et al. study is particularly interesting, because in their third experiment they combined the lexical decision and sentence reading methodologies in an end-of-sentence lexical decision task, and again failed to find the effect seen in the isolated case. One possible task difference that may be relevant is time constraint—lexical decision responses are usually encouraged to be as fast as possible, imposing a time constraint, while in reading tasks speed is less emphasized, and perhaps this makes it harder to see the differences. In the Hyönä et al study, lexical decisions at the end of the sentence were longer overall than lexical decisions for isolated words, and in our lexical decision task we find that lexical differences are clearer when looking at faster decision RTs. Another possible difference that Hyönä et al suggest is that context might facilitate lexical processing such that lexical differences in RT are neutralized. Regardless of the actual reason why the lexical effects in sentences seem to be less robust, our study, combined with the previous literature, suggests at least that we cannot make the simple assumption that an effect in the isolated word methodology should show the same strength in sentence paradigms.

Although our effects were small, they were reliable, and as such they still pose a potential problem for sentence-processing studies that use morphological differences as part of their manipulation. This is important for areas of psycholinguistics in which number or other morphology is manipulated (for example the literature on agreement processing) particularly because the effects appear most strongly in the spillover region. In other studies currently being run on our lab on agreement processing, we consistently find small but reliable effects of noun number before the critical region is encountered, and in surveying the literature, we have also seen evidence for such number effects in previous results. We suggest that either the cost of morphological processing begin to be explicitly modeled as part of sentence processing results, or that items be carefully chosen such that baseline differences do not exist (e.g. plural-dominant words).

If the effect size problem for sentence tasks can be somehow avoided—perhaps through lexical decision in sentences with a stricter time constraint—the interaction of syntactic prediction with lexical processing could be re-examined with materials that would avoid our second problem, the baseline difference between our predictors *this/these*. Other possibilities would be languages with richer modifier morphology systems (e.g. classifier systems), or other types of predictors in English (e.g. numerals); the key point is to ensure that the predictors do not differ in frequency such that their differences spill over into the region of interest.

7 Conclusion

In two self-paced-reading experiments, we showed an interaction between noun number (singular/plural) and surface frequency (singular-dominant/plural-dominant/equal-frequency) such that singular-dominant items showed a number effect—slower RTs for plural forms than singulars—while plural-dominant items showed no number effect, with root frequency held constant. This replicates previous studies in isolated lexical decision showing surface frequency effects for noun number in English. In the second experiment we were unable to find effects of syntactic prediction of number by determiner (*this/these*) due to the small effect size of the number difference and due to baseline problems. In a third isolated lexical decision experiment we found a substantially larger number effect, suggesting that the small effect size in the sentence experiments was due to the task and not the materials. We suggest that other tasks and better-matched syntactic predictors will be needed to test the theoretical question of interest, the interaction between prediction and surface frequency in lexical processing. Finally, the small but reliable lexical effects we find in self-paced reading still can consistently influence reading times and should be taken into consideration by reading studies that use morphological variants as part of their design.

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References

Baayen, R. H., Dijkstra, T., & Schreuder, R. (1997). Singulars and Plurals in Dutch: Evidence for a Parallel Dual-Route Model. *Journal of Memory and Language, 37*, 94-117.

Bertram, R., Hyona, J. & Laine, M. (2000). Word morphology in context: Effects of base and surface frequency. *Language and Cognitive Processes, 15,* 367-388.

Bölte, J., & Connine, C.M. (2004). Grammatical gender in spoken word recognition in German, *Perception & Psychophysics*, *66*(6), 1018-1032.

Burani, C. Salmaso, D., and Caramazza, A. (1984). Morphological structure and lexical access. *Visible Language, 18,* 342-352.

DeLong, K., Urbach, T., & Kutas, M. (2005). Probabilistic word pre-activation during language comprehension inferred from electrical brain activity. *Nature Neuroscience, 8*(8), 1117-1121.

Del Prado Martin, F.M., Kostic, A., & Baayen, R.H. (2004). Putting the bits together: an information theoretical perspective on morphological processing. *Cognition, 94,* 1-18

Federmeier, K. D. & Kutas, M. (1999). A Rose by Any Other Name: Long-term Memory Structure and Sentence Processing, *Journal of Memory and Language*, *41*, 469-495.

Gurjanov, M., Lukatela, G., Lukatela, K., Savic, M. & Turvey, M. T. (1985). Grammatical priming of inflected nouns by the gender of possessive adjectives. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11, 692-701.

Gurjanov, M., Lukatela, G., Moskovljevic, J., Savic, M., & Turvey, M. T. (1985). Grammatical priming of inflected nouns by inflected adjectives. *Cognition*, 19, 55-71.

Hay, J and Baayen, H. (2005). Shifting paradigms: gradient structure in morphology. *Trends in Cognitive Sciences, 9(7): 342-348*.

Hyönä, J., Vainio, S., & Laine, M. (2002). A morphological effect obtains for isolated words but not for words in sentence context. *European Journal of Cognitive Psychology, 14*(4), 417-433.

Lau, E. F., Stroud, C., Plesch, S., & Phillips, C. (2006). The role of prediction in rapid syntactic analysis. *Brain & Language, 98*, 74-88.

Lehtonen, M., Wande, E., Niska, H., Niemi, J. & Laine, M. (2006). Recognition of inflected words in a morphologically limited language: frequency effects in monolinguals and bilinguals. *Journal of Psycholinguistic Research, 35,* 121-146.

Lukatela, G., Moraca, J., Stojnov, D., Savic, M., Katz, L., & Turvey, M. T. (1982). Grammatical priming effects between pronouns and inflected verb forms. *Psychological Research (Psychologische Forschung*), 44, 297-311.

Lukatela, G., Kostic, A., Feldman, L. B., & Turvey, M. T. (1983). Grammatical priming of inflected nouns. *Memory & Cognition*, 11, 59-63.

Lukatela, G., Kostic, A., Todorovic, D., Carello, C., & Turvey, M.T. (1987). Type and number of violations and their grammatical congruency effect in lexical decision. *Psychological Research*, 49, 37-43.

Moscoso del Prado Martín, F., Kostic, A., & Baayen, R.H. (2004). Putting the bits together: An information-theoretical perspective on morphological processing. *Cognition* 94(1), 1-18.

New, B., Brysbaert, M., Segui, J., Ferrand, L., & Rastle, K. (2004). The processing of singular and plural nouns in French and English. *Journal of Memory and Language*, 51, 568-585.

Niswander, E., Pollatsek, A., & Rayner, K. (2000). The processing of derived and inflected suffixed words during reading. *Language and Cognitive Processes, 15*(4/5), 389-420.

Randall, B., & Marslen-Wilson, W.D. (1998). The relationship between lexical and syntactic processing. In M.A. Gernbacher & S.J. Derry (Eds.), *Proceedings of the Twentieth Annual Conference of the Cognitive Science Society,* Mahwah, NJ: Lawrence Erlbaum Associates Inc.

Ratcliff, R. (1993). Methods for dealing with reaction time outliers. *Psychological Bulletin*, *114*, 510-532.

Schreuder, R., & Baayen, R. H. (1995). Modelling morphological processing. In L.B. Feldman (Ed.), *Morphological Aspects of Language Processing* (pp. 131-154). Hillsdale, New Jersey: Lawrence Erlbaum.

Sereno, J.A. & Jongman, A. (1997). Processing of English inflectional morphology. *Memory & Cognition, 25,* 425-437.

Staub, A., & Clifton, C., Jr. (2006). Syntactic prediction in language comprehension: Evidence from *either…or. Journal of Experimental Psychology: Learning, Memory, and Cognition*, *32*, 425-436.

Taft (1999). Lexical processing of functionally constrained words. *Journal of Memory and Language, 29*:2, 245-257.

Taft, M. (1979). Recognition of affixed words and the word frequency effect. *Memory & Cognition, 7*(4), 263-272.

Taft, M. (2004). Morphological decomposition and the reverse base frequency effect. *The Quarterly Journal of Experimental Psychology, 57A*(4), 745-765.

Vainio, Hyona, & Pajunen (2003). Facilitatory and inhibitory effects of grammatical agreement: Evidence from readers' eye fixation patterns. *Brain and Language, 85*, 197-202.

Appendix A: Experiment 1 equal-frequency target word statistics

		sg	pl
1	BONE	23.2	22
2	CONSULTANT	16.2	15.5
3	COW	13.2	11.9
4	DEPOSIT	17.1	17.2
5	TOMATO	7.4	7.2
6	DISH	14.3	13.6
7	DOLPHIN	7.7	8.3
8	MALE	21.3	21.9
9	GOAT	5.97	5.55
10	GENE	22.4	20.7
11	MINERAL	12	11.6
12	MOTIVE	9.9	10
13	VARIATION	26.9	25.2
14	METHOD	89.7	88.5
15	MUSCLE	19.5	17.4
16	NATION	43.2	41.1
17	NERVE	11.6	11.4
18	NEEDLE	12.2	10.6
19	PIG	11.7	12.4
20	PILL	5.74	5.58
21	POLE	13.2	12.5
22	SANDWICH	8.9	8.6
23	SEED	15.4	16.2

Appendix B: Experiment 1 items

1. The powerful wizard hoped that the awful beast(s) would be easily defeated.
2. The priest knew that his core belief(s) could not be shaken by any force.
3. The tourist decided that the classical cathedral(s) was/were the best part of Europe's architecture.
4. Some of the health advocates were afraid that the downtown clinic(s) would have to close because of the funding situation.
5. The young prince was sure that the evil dragon(s) was/were hiding in the forest.
6. The U.N. officials feared that the long-lasting famine(s) had caused irrevocable damage to the region.
7. Mr. Bailey requested that the baseball hat(s) no longer be worn in the school building.
8. Nancy noticed that the biology journal(s) was/were missing from their usual shelf in the library.
9. The police captain announced that the rookie lieutenant(s) should report for duty immediately.
10. The groundskeeper could see that the war monument(s) had suffered serious damage from the storm.
11. The bumbling CIA agent was confident that the fake moustache(s) would serve as an adequate disguise.
12. The Greek king believed that the old prophet(s) could give him important clues to future events.
13. The colonel was afraid that the large regiment(s) would run out of food too quickly.
14. Mandy's mother decided that the healthy salad(s) should not be removed from her diet.
15. Amy thought that her talented sister(s) would be hired right away after they finished school.
16. Jean was ecstatic that the tiny studio(s) had been expanded into a gigantic loft.
17. The customers knew that the small sum(s) would look bigger after the addition of a shipping charge.
18. The warrior feared that the old sword(s) would be impossible to sharpen again.
19. The headmistress was sure that the emerging talent(s) would soon come into full bloom.
20. The organizers decided that the difficult task(s) could not be avoided without destroying the spirit of the event.
21. The artist agreed that the rough texture(s) had been essential in her earlier sculptures.
22. The anthropologist regretted that the local tribe(s) had refused to communicate with him.
23. Many families were afraid that the deep valley(s) would flood due to the incessant rain.
24. The land developer knew that the newly-purchased acre(s) would be a perfect place to put another high-rise.
25. The high school class learned that the snake's ancestor(s) had been (a) long, skinny, saltwater fish.
26. The pastry chef decided that the cranberry biscuit(s) would go well with a lemon tapioca sauce.
27. Jennifer was relieved that the theater critic(s) had given her new play a positive review.
28. The karate master warned that the young disciple(s) would fail if she/they didn't train both mind and body.
29. The child's father said that the hard-earned dollar(s) would be placed in the piggy bank for safe keeping.
30. Keith was sure that the baseball glove(s) would be a good gift for the children at the shelter.
31. Marilyn was afraid that the broken heel(s) would make it impossible for her to walk home.
32. Mrs. Taylor forgot that the secret ingredient(s) was/were supposed to be stored in the locked cabinet.
33. The school aide noticed that the girl's lip(s) was/were cut and swollen after the fight.
34. The scientist discovered that the water molecule(s) was/were behaving completely differently in the presence of sulfur.
35. Janice suspected that the next-door neighbor(s) was/were up to something after she heard strange clanking sounds late at night.
36. The physician was confident that the inflamed nostril(s) was/were just a symptom of a minor cold.
37. Jane decided that the old sandal(s) should be thrown out after the mud fight.
38. Fred realized that the clown shoe(s) should be much bigger than his normal foot size.

39. Terrence's mom was annoyed that the maroon sock(s) had been lost in the wash.
40. The attendant was glad that the wounded soldier(s) would soon be well enough to leave the hospital.
41. The analyst doubted that the dubious statistic(s) would be taken seriously by others.
42. The pharmacist said that the bothersome symptom9s) could be alleviated by over-the-counter medicines.
43. James regretted that the white tablet(s) had fallen under the cabinet where the pets might find it.
44. The attorney realized that the clever tactic(s) would guarantee that he win the case.
45. The mechanic knew that the appropriate tool(s) would be hard to find in the small village.
46. The police said that the lethal weapon(s) had been confiscated as evidence for the trial.
47. Dr. Francis predicted that the broken bone(s) would heal quickly.
48. Mark and Bill were unaware that the management consultant(s) had recommended that they be fired.
49. Molly found it interesting that the television segment(s) was/were so frequently interrupted by commercials.
50. Andrea hoped that the bank deposit(s) had been made in time to keep the check from bouncing.
51. Jake commented that the ripe tomato(s) would be perfect for his special spaghetti sauce.
52. The White House cook was sure that the southern dish(es) would be well-received by the family.
53. All the trainers were aware that the playful dolphin(s) could turn vicious if threatened.
54. The horse breeder was afraid that the young male(s) was/were too frisky to be left alone for the weekend.
55. The farmhands decided that the old goat(s) should be given a smaller pasture to graze in.
56. The biologists speculated that the newly-discovered gene(s) might hold the key to understanding schizophrenia.
57. The business owner argued that the valuable mineral(s) was/were worth tearing up the national park for.
58. Valerie was shocked that the real motive(s) behind the company's charitable donation was/were so mercenary.
59. Madeline felt that the variation(s) in the fabric was what made it so beautiful.
60. Caroline was surprised that the method(s) for calculating the gross national product was/were so simple.
61. The weightlifter noticed that his arm muscle(s) was/were trembling under the strain of the chain.
62. The nonprofit agency requested that the industrial nation(s) reduce its/their greenhouse emissions by 2007.
63. The instructor said that the frog's nerve(s) could transmit signals even after separation from the body.
64. The seamstress found that the large needle(s) was/were best for working with denim.
65. The livestock veterinarian recommended that the diseased pig(s) be gently put to sleep.
66. The nutritionist recommended that the vitamin pill(s) be taken with a full glass of water.
67. The archaeologists discovered that the wooden pole(s) had been part of an ancient sacrificial ritual.
68. Matt decided that the tuna sandwich(es) had been left out too long for anyone to eat.
69. Thomas was afraid that the poisonous seed(s) would look appealing to young children.

Appendix C: Experiment 2 and 3 items

Singular dominant items

Word	length	syllables	Total/mil	Ratio
magnet	6	2	5.9	0.71
lobster	7	2	5.4	0.76
aisle	5	1	6.2	0.68
pyramid	7	3	6.6	0.71
sweater	7	2	7.5	0.70
puppet	6	2	6.6	0.65
comet	5	2	7.4	0.71
diagram	7	3	8.1	0.70
hurricane	9	3	7.3	0.77
wagon	5	2	9.6	0.68
bucket	6	2	10.3	0.69
vaccine	7	2	12.5	0.73
monster	7	2	16.7	0.74
casino	6	3	16.3	0.77
laser	5	2	16.3	0.80
paragraph	9	3	18.1	0.70
elephant	8	3	15.9	0.64
basket	6	2	18.2	0.69
surgeon	7	2	21.5	0.63
guitar	6	2	32.1	0.80
priest	6	1	36.8	0.65
myth	4	1	28.2	0.69
apple	5	2	33.1	0.73
lever	5	2	5.4	0.72
pilot	5	2	50.7	0.65
key	3	1	45.4	0.71
planet	6	2	36.9	0.76
apartment	9	2	36.7	0.76
mistake	7	2	58.9	0.64
engine	6	2	61.2	0.72
camera	6	3	63.4	0.67
accident	8	3	73.4	0.77
cat	3	1	51.2	0.63
author	6	2	76.4	0.74
restaurant	10	3	80.8	0.66
mountain	8	2	85.2	0.65
magazine	8	3	88.9	0.74
island	6	2	107.2	0.79
dream	5	1	105.4	0.62
executive	9	3	107.6	0.72
	6.4	**2.125**	**37.03015**	**0.71**

Plural dominant items

Word	length	syllables	Total/mil	Ratio
chore	5	1	5.2	0.36
ant	3	1	6.0	0.35
bandit	6	2	6.2	0.28
alien	5	3	6.3	0.30
mammal	6	2	6.7	0.25
rumor	5	2	6.8	0.25
thug	4	1	7.0	0.27
pesticide	9	3	8.2	0.33
appliance	9	3	8.6	0.32
shrub	5	1	9.7	0.29
mechanic	8	3	11.6	0.37
organism	8	4	12.1	0.36
inmate	6	2	15.7	0.20
glove	5	1	16.2	0.33
insect	6	2	16.7	0.38
molecule	8	3	17.5	0.37
herb	4	1	19.1	0.33
particle	8	3	19.3	0.31
toy	3	1	23.1	0.35
athlete	7	2	27.4	0.38
ingredient	10	4	28.4	0.24
tactic	6	2	28.5	0.24
diplomat	8	3	33.0	0.34
anecdote	8	3	5.5	0.38
vegetable	9	3	44.2	0.36
shoe	4	1	48.6	0.26
opponent	8	3	49.2	0.36
consequence	11	3	49.6	0.32
hostage	7	2	50.7	0.39
neighbor	8	2	62.9	0.36
item	4	2	63.0	0.34
critic	6	2	67.5	0.28
refugee	7	3	67.6	0.28
employee	8	3	76.2	0.28
colleague	9	2	77.9	0.26
expert	6	2	80.9	0.34
bird	4	1	88.9	0.40
skill	5	1	93.6	0.28
soldier	7	2	103.5	0.25
weapon	6	2	106.6	0.21
	6.53	**2.18**	**36.9**	**0.31**

Equal-frequency items

Word	length	syllables	Ratio	total/ mil
skeleton	8	3	0.55	5.85
assassin	8	3	0.53	6.50
orange	6	2	0.51	7.95
umpire	6	2	0.52	9.18
goat	4	1	0.51	10.37
receipt	7	2	0.51	10.45
dinosaur	8	3	0.49	11.05
knight	6	1	0.49	11.25
shark	5	1	0.54	11.32
carrot	6	2	0.49	12.36
monkey	6	2	0.54	12.48
specimen	8	3	0.53	12.81
candle	6	2	0.49	13.06
feather	7	2	0.48	13.48
burglar	7	2	0.54	6.77
peasant	7	2	0.47	16.26
exam	4	2	0.52	17.44
whale	5	1	0.54	14.27
tiger	5	2	0.51	19.82
obstacle	8	3	0.46	20.01
onion	5	2	0.54	20.10
creature	8	2	0.46	26.26
bullet	6	2	0.50	26.82
oyster	6	2	0.45	9.11
curtain	7	2	0.50	27.77
chief	5	1	0.46	32.64
barrier	7	3	0.52	33.32
instrument	10	3	0.47	39.00
missile	7	2	0.47	43.33
lesson	6	2	0.48	53.54
hill	4	1	0.55	53.70
guest	5	1	0.45	63.85
technique	9	2	0.49	70.55
vehicle	7	3	0.54	75.71
agent	5	2	0.54	84.21
lawyer	6	2	0.48	86.90
candidate	9	2	0.55	91.95
affair	6	2	0.49	114.20
tree	4	1	0.47	127.36
animal	6	2	0.47	131.48
	6.375	**2**	**0.50**	**36.36**

Appendix D

1. Katya thinks that the/this/these accomplished author(s) should try writing science fiction next.
2. Ms. Anderson is sure that the/this/these awful dream(s) about being kidnapped was/were inspired by the scary show they watched.
3. I want to remind everyone that the/this/these beautiful comet(s) won't appear again in our lifetime.
4. Mr. Bailey told them that the/this/these boring paragraph(s) really need(s) to be changed.
5. Kyle is afraid that the/this/these busy aisle(s) could become a deathtrap if there was ever a fire in the store.
6. Dave knows that the/this/these cheap guitar(s) won't have the best sound, but he said they're good for travel.
7. Joe and Mark are convinced that the/this/these common camera(s) can't be trusted for nighttime shots.
8. The community is worried that the/this/these crippled priest(s) might have trouble making the trip to Rome.
9. We realized that the/this/these damaged engine(s) could be fixed using the parts we found in the junkyard.
10. They're warning everyone that the/this/these dangerous laser(s) should be taken off the market.
11. We're not sure how it's possible that the/this/these delicate basket(s) could have been woven by children.
12. We were amazed that the/this/these enormous pyramid(s) could have been built by human hands.
13. Tonya has been assuming that the/this/these enthusiastic executive(s) from Microsoft was/were in town for the conference.
14. The girls have decided that the/this/these exotic island(s) must hide a treasure.
15. Rachel knows that the/this/these expensive sweater(s) will probably go on sale in a few weeks.
16. Steven says that the/this/these famous casino(s) actually employs over half the region.
17. We were amazed that the/this/these gigantic lobster(s) could have lived in the bay for so many years without being caught.
18. Amy told me that the/this/these huge apple(s) would be presented to the best teacher in the school.
19. John explained that the/this/these illegal vaccine(s) could cause birth defects and so had been banned in the U.S.
20. John explained that the/this/these illegal vaccine(s) could cause birth defects and so had been banned in the U.S.
21. Ellen thinks that the/this/these important restaurant(s) will be accepted to the National Restaurant Association this year.
22. Cathy found that the/this/these influential magazine(s) always present(s) issues in a misleading way.
23. I'm really glad that the/this/these kind surgeon(s) will operate on my dog for free.
24. Sean decided that the/this/these large bucket(s) should be used to carry soil to the garden.
25. Micki knows that the/this/these little puppet(s) in the cupboard is/are going to be her younger sister's birthday present.
26. The workers worry that the/this/these massive lever(s) would be difficult to lift in time, if there were ever an accident.
27. The couple is disappointed that the/this/these new apartment(s) actually has/have less storage space than their old one.
28. Tyler is afraid that the/this/these powerful magnet(s) won't be powerful enough for his atomic accelerator.

29. I resented that the/this/these rare mistake(s) on the math test made me lose so many points.
30. The manager was afraid that the/this/these small wagon(s) wouldn't be able to hold all the sheep.
31. The tenant requested that the/this/these strange cat(s) be allowed to sit on the stairs of the building.
32. No one is surprised that the/this/these talented pilot(s) can fly for so long without taking a break.
33. The painter was pleased that the/this/these tall mountain(s) could be seen even on foggy days.
34. Diane told us that the/this/these terrible myth(s) about the Cyclops was/were never taken literally by the ancient Greeks.
35. The professor says that the/this/these tiny planet(s) won't survive the collision with the meteor.
36. The villagers were relieved that the/this/these unexpected hurricane(s) didn't destroy any houses.
37. The instructor thinks that the/this/these unpleasant accident(s) can be regarded as a motivation for developing better canoeing skills.
38. I was surprised that the/this/these useful key(s) had/have been sitting on Yumi's desk in plain sight, where anyone could grab it/them.
39. Chris observed that the/this/these useless diagram(s) on the poster incorporated more than five separate errors.
40. Jimmy regrets that the/this/these young elephant(s) at the zoo rarely come(s) out of the shelter to play where everyone could see it/them.
41. Nancy and Sarah were disappointed that the/this/these accomplished soldier(s) wouldn't talk about him/their experience.
42. Everyone was surprised that the/this/these awful rumor(s) about the mayor spread so quickly.
43. Heather couldn't believe that the/this/these beautiful glove(s) on the ground had been forgotten by someone.
44. Everyone agrees that the/this/these boring anecdote(s) should be excluded from the official account of the interview.
45. The men are surprised that the/this/these busy diplomat(s) still has/have time to meet with them about the fundraiser.
46. Tara realized that the/this/these cheap toy(s) from the dollar store would make a good prize for the kids in the program.
47. Stacey finds that the/this/these common tactic(s) of rewarding kids for good grades often backfires on parents.
48. David told us that the/this/these crippled refugee(s) will never be able to return to her/their native land.
49. Brad says that the/this/these damaged weapon(s) should be destroyed before someone gets hurt.
50. We quickly realized that the/this/these dangerous inmate(s) always need(s) to be kept separate from the other prisoners.
51. Clare forgot that the/this/these delicate organism(s) can't survive at temperatures of less than 45 degrees.
52. Matt and I can't believe that the/this/these enormous shoe(s) in the lost and found actually belong(s) to anyone we know.
53. Mrs. Callahan is recommending that the/this/these enthusiastic employee(s) be nominated for an award.
54. Maria convinced us that the/this/these exotic herb(s) would be wonderful in the stew we are cooking.
55. Natalie is afraid that the/this/these expensive item(s) will break her holiday budget, even though it/they would be the perfect gift(s).

56. I'm almost certain that the/this/these famous expert(s) can answer all the questions we have about ancient Egypt.
57. The boys announced to their classmates that the/this/these gigantic alien(s) from Mars was/were about to attack.
58. Maya and Kesha were convinced that the/this/these horrible insect(s) actually enjoyed tormenting them at night.
59. Everyone was shocked that the/this/these huge thug(s) from the mob got off scot-free at the end of the trial.
60. The community was angry that the/this/these illegal pesticide(s) had been so overused by farmers.
61. James was surprised that the/this/these important ingredient(s) really had no effect on the taste of the dish.
62. Brandon noticed that the/this/these influential critic(s) didn't have any idea what to say about such obscure art forms.
63. Greg is grateful that the/this/these kind neighbor(s) always offer(s) to baby-sit his daughter when he has an emergency.
64. The jury agreed that the/this/these large vegetable(s) at table number five should win the annual vegetable competition.
65. The girls were amazed that the/this/these little bird(s) could sing so loudly.
66. Angela expected that the/this/these massive particle(s) would not evaporate as quickly as the other particles in the solution.
67. Brad found out that the/this/these new colleague(s) could work with several different programming languages.
68. I suspect that the/this/these powerful opponent(s) of the government won't win support in urban areas.
69. Doctors are excited that the/this/these rare molecule(s) could have such interesting medicinal qualities.
70. The gardener has decided that the/this/these small shrub(s) must be trimmed the same way as the bigger shrubs.
71. Jim observed that the/this/these strange mammal(s) usually sleep(s) for most of the day, waking up for meals and mating.
72. Sharon knows that the/this/these talented athlete(s) must practice for many hours every day to be fit for the Olympics.
73. I'm hoping that the/this/these tall mechanic(s) will be able to fix all the problems in my car.
74. Harold thinks that the/this/these terrible bandit(s) in the movie doesn't/don't seem like (a) believable character(s).
75. Larissa was sure that the/this/these tiny ant(s) wouldn't be able to escape from the jar, but she was wrong.
76. Jimmy resents that the/this/these unexpected chore(s) for his mom made him late to the movies.
77. Lisa hopes that the/this/these unpleasant consequence(s) of smoking will discourage her children from doing it themselves .
78. Juanita was annoyed to hear that the/this/these useful appliance(s) might not be available for purchase in the U.S.
79. Makeshi pointed out that the/this/these useless skill(s) could at least come in handy if she ever joined the circus.
80. We agreed that the/this/these young hostage(s) should have time to heal from the trauma before anyone questions him/them.
81. We were pleased that the/this/these accomplished candidate(s) really took the time to do some research on our area.
82. Mrs. Larson thinks that the/this/these awful skeleton(s) should not be part of an elementary school classroom.

83. I was disappointed that the/this/these beautiful candle(s) couldn't actually be lit and was/were only decorative.
84. Lyn discovered that the/this/these boring specimen(s) actually held the clue to the weird data she'd been finding.
85. Mark is assuming that the/this/these busy chief(s) won't really have time to check over the travel arrangements.
86. I'm surprised that the/this/these cheap instrument(s) from overseas is/are still on the market.
87. Jaiva realized that the/this/these common obstacle(s) to success in business could be overcome with determination.
88. Carl believes that the/this/these crippled animal(s) should be put to sleep to end its/their pain.
89. Everyone is afraid that the/this/these damaged missile(s) will detonate before there's time to evacuate.
90. Everyone is hoping that the/this/these dangerous vehicle(s) will be banned by the government.
91. Lisa is speculating that the/this/these delicate feather(s) might have come from a hummingbird.
92. Brian told us that the/this/these enormous goat(s) had occasionally frightened some of the local children.
93. Tim and Rebecca said that the/this/these enthusiastic guest(s) can't stop gushing about the sights.
94. Tricia was unaware that the/this/these exotic creature(s) could change colors to match the environment.
95. Phil finds it interesting that the/this/these expensive lawyer(s) usually make(s) his assistants do all the real work.
96. We were unaware that the/this/these famous knight(s) might have been (an) ancestor(s) of ours.
97. No one could believe that the/this/these gigantic carrot(s) could have been grown organically, without the use of any artificial chemicals.
98. Deena heard that the/this/these horrible shark(s) didn't give any signs of warning before the attack.
99. Mrs. Burgess decided that the/this/these huge onion(s) would be perfect for the omelet she was making for dinner.
100. The community has requested that the/this/these illegal technique(s) be allowed to be used in extraordinary situations.
101. We realized that the/this/these important affair(s) might be covered up by the government if we didn't act quickly.
102. I think that the/this/these influential agent(s) will be able to get us the correct information on this secret operation.
103. Luis was astonished that the/this/these kind peasant(s) would be willing to give up so much of his bread to feed others.
104. Zara just noticed that the/this/these large oyster(s) from Martha's plate is/were about to fall straight into the dog's mouth.
105. Barry is telling everyone that the/this/these little monkey(s) in the zoo once belonged to him.
106. Tyrone explained that the/this/these massive hill(s) always has/have more varieties of wildlife than the rest of the city.
107. Elena insists that the/this/these new curtain(s) be dyed orange so that it matches with the couch.
108. The guide confessed that the/this/these powerful tiger(s) often come(s) close to jumping its/their fence.
109. The boy is thrilled that the/this/these rare whale(s) in the water is/are so close to his ship.
110. The man explained that the/this/these small receipt(s) must be saved in case the purchase is returned.

111. Research has shown that the/this/these strange dinosaur(s) had a very strong maternal instinct.
112. The newspapers reported that the/this/these talented burglar(s) rarely got caught by the Police.
113. Felisha realized that the/this/these tall umpire(s) can see every detail of the game because of his/their height.
114. The press believes that the/this/these terrible assassin(s) could have been caught and punished many years ago.
115. I still can't believe that the/this/these tiny bullet(s) can cause so much damage to such a massive animal.
116. Darrell is upset that the/this/these unexpected exam(s) in the middle of the semester could ruin his chances of earning a 4.0 GPA.
117. The authorities were sure that the/this/these unpleasant parasite(s) wouldn't be a problem to get rid of.
118. Sanjay is worried that the/this/these useful lesson(s) still won't be enough to prepare him for snowboarding by himself.
119. Colin realized that the/this/these useless barrier(s) could be put to better use as a makeshift soccer goal.
120. Mrs. McGraugh assumed that the/this/these young tree(s) should be watered like the rest of the plants in the garden.