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Semantic preview benefit in English: Individual differences in the extraction and use of
parafoveal semantic information

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Abstract

While there is robust evidence that skilled readers of English extract and use orthographic and phonological information from the parafovea to facilitate word identification, semantic preview benefits are more elusive. We sought to establish whether individual differences in the extraction and/or use of parafoveal semantic information could account for this discrepancy. Ninety-nine adult readers were assessed on measures of reading and spelling ability and read sentences while their eye movements were recorded. The gaze-contingent boundary paradigm was used to manipulate the availability of relevant semantic and orthographic information in the parafovea. On average, readers showed a benefit from previews high in semantic feature overlap with the target. However reading and spelling ability yielded opposite effects on semantic preview benefit. High reading ability was associated with a semantic preview benefit that was equivalent to an identical preview on first-pass reading. High spelling ability was associated with a reduced semantic preview benefit despite an overall higher rate of skipping. These results suggest that differences in the magnitude of semantic preview benefits in English reflect constraints on extracting semantic information from the parafovea and competition between the orthographic features of the preview and target.

Keywords

Reading, eye movements, individual differences, lexical quality, semantic preview benefit

Word count

7859 (excluding Abstract, References, and Footnotes)

It is well established that skilled readers initiate the processing of an upcoming word before it is directly fixated. Most investigations of parafoveal processing during sentence reading have used the *gaze-contingent boundary paradigm* (Rayner, 1975), in which a target word in the parafovea is replaced by a *preview* stimulus until the reader's eyes cross an invisible boundary located at the end of the immediately preceding word. Since the reader never fixates the preview stimulus, any benefit in *target* fixation duration following a related preview relative to an unrelated preview is reasoned to be due to parafoveal processing of the preview stimulus. By manipulating the form of the relationship between the preview and the target, conclusions can be drawn about the nature of the information processed in the parafovea (see Schotter, Angele, & Rayner, 2012, for a review).

Typically, a significant *preview benefit* is interpreted as evidence of two things: that the reader *extracted* some relevant information (e.g., orthographic features) from the parafovea *and* that this information was *integrated* with the processing of the target word when it was fixated to facilitate its identification. There is robust evidence across many languages that readers extract (sublexical) orthographic and phonological information from the parafovea and integrate it with information extracted from the target to reduce the time required for target identification (Schotter et al., 2012).

The evidence for parafoveal *semantic preview benefit*, which is the focus of the present study, is more ambiguous. Recent evidence of semantic preview benefit in Chinese (e.g., Tsai, Kliegl, & Yan, 2012; Yan, Richter, Shu, & Kliegl, 2009; Yan, Risse, Zhou, & Kliegl, 2012; Yan, Zhou, Shu, & Kliegl, 2012; Yang, Wang, Tong, & Rayner, 2012), Korean (Kim, Radach, & Vortius, 2012), and German (Hohenstein, Laubrock, & Kliegl, 2010; Hohenstein & Kliegl, 2014) suggests that readers can extract semantic information from parafoveal words and subsequently

integrate this information during foveal word identification. These findings contrast with the data obtained for skilled readers of English¹.

In the seminal investigation of semantic preview effects in English by Rayner, Balota, and Pollatsek (1986), and in a recent replication (Rayner, Schotter, & Drieghe, 2014), participants read sentences containing a preview of a critical target word that was identical (e.g., *north*), a semantically related word (*south*), an unrelated word (*phone*), or a visually similar nonword (*norlb*)². The results showed an orthographic preview benefit, because fixation durations following visually similar previews were shorter than in the unrelated preview condition. However, there was no semantic preview benefit: gaze duration on the target word did not differ between the semantically related and unrelated previews. But the same items produced semantic priming of naming responses to target words presented individually at fixation (Rayner et al., 1986), suggesting that the lack of preview benefit was not due to a weak manipulation of semantic relatedness. The data were therefore interpreted as evidence that readers do not process parafoveal words to the semantic level.

However, the form of semantic relationship required may depend on task requirements. As outlined above, semantic preview benefit requires both activation of semantic information from parafoveal words and integration of that information when the target word is fixated. If the extraction or use of semantic information in reading depends on spreading activation through a semantic network (e.g., Collins & Loftus, 1975) or the pre-activation of shared semantic features (e.g., Plaut & Booth, 2000), then it may only be observed when the preview and target are closely related words. Rayner et al.'s (1986, 2014) items included preview/target pairs with a variety of semantic relationships: synonyms (e.g., *boots/shoes*), antonyms (e.g., *fast/slow*), and semantic associates (e.g., *doctor/lawyer*). This broad array of relationships may benefit the

lexical retrieval processes required for isolated word naming. However, effective *integration* of semantic features activated by the preview during sentence processing may only occur for word pairs that share contextually-relevant semantic features. The broad range of semantic relationships included in earlier studies may have diluted any semantic preview benefit.

Support for this interpretation comes from a recent study by Schotter (2013) in which synonyms (e.g., *street* as a preview for *avenue*) were directly compared with semantic associates (*suburb* as a preview for *avenue*). The results showed a semantic preview benefit relative to an unrelated word from synonyms but not semantic associates, indicating that English readers *can* extract and use semantic information from parafoveal words “but only if the meaning of the word does not change between preview and target” (Schotter, 2013, p. 627). There is no obvious reason why semantic information would be more likely to be *extracted* from a synonym than a semantic associate preview because the target word has not been presented at the time the parafoveal preview word is being processed. This pattern of results therefore suggests that semantic preview benefit in English depends on how effectively the information activated by the preview is integrated with the target (and/or the sentence). Schotter, Lee, Reiderman, and Rayner (2015) extended these findings by showing that both synonyms *and* semantically associated words produced a semantic preview benefit when the sentence was moderately constraining. This suggests that semantic activation and/or integration may be facilitated by top-down expectancies derived from the sentence context.

The elusiveness of semantic preview benefit in sentence reading may also reflect a cost associated with orthographic discrepancies between semantically related preview and target words. Readers may be more likely to ‘discard’ activated semantic information when they fixate on a word that does not match the orthography of the preview word (Schotter, 2013); or suffer

interference from the orthographic/ phonological mismatch between the preview and target which counteracts any benefit from the semantic relationship. Such effects may be more marked in deep orthographies like English in which the resource demands of phonological decoding may limit the extraction or use of parafoveal information, leading to reduced semantic preview benefit relative to other languages (Laubrock & Hohenstein, 2012; Schotter, 2013).

The semantic preview effects reported in other languages may also reflect specific characteristics of their writing systems that create more optimal conditions for extracting semantic information from upcoming words (Rayner et al., 2014; Schotter, 2013). For example, Chinese is written with a dense, non-alphabetic orthography in which most words comprise only a small number of characters. Coupled with the lack of spaces between words in written Chinese, this means that upcoming words lie closer to the point of fixation. Furthermore, semantic information is often coded directly into the orthography because of the presence of semantic radicals, which may directly activate semantic information (e.g., Yan, et al., 2012). These features of the Chinese writing system potentially make the extraction of semantic information from upcoming words less demanding than in English. Although German is an alphabetic language, it has a much shallower orthography than English. Nouns are also orthographically marked by capitalization. These features may increase the speed and efficiency of foveal processing which, in turn, allows deeper parafoveal processing than typically occurs in English.

Thus, cross-language differences in semantic preview benefit may reflect language-specific factors that facilitate deep processing of upcoming words before they are fixated. This view implies that a semantic preview benefit in English is more likely to be observed under conditions that support deeper parafoveal processing. Consistent with this interpretation, the *foveal load*, or processing difficulty of the fixated word, has been shown to affect the extent of

parafoveal processing (Henderson & Ferreira, 1990). When the foveal word is high frequency, it may be processed so quickly that there are sufficient attentional resources and/or processing time available to extract deeper information from the parafovea before a saccade is executed. There may also be characteristics of the information in the parafovea that increase the depth of processing. For instance, Rayner and Schotter (2014) recently found a semantic preview benefit in English when the preview and target were capitalized nouns (e.g., *Dancer* as a preview for *Ballet*) but not when they were lowercase (*dancer* as a preview for *ballet*). They argued that capitalization makes the parafoveal word more salient which increases the attention allocated to the preview resulting in stronger pre-activation of its features. Interestingly, the effect was only significant in first-pass reading for words whose meanings did not change with capitalization. When the meaning changed between the capitalized and lowercase words (e.g., *china/China*) semantic preview benefit was restricted to the late measure of go-past duration, which includes fixations on the target as well as regressions to earlier words in the sentence, and was mainly attributable to greater interference from the unrelated preview. This supports the view that capitalization enhances extraction of information from the parafovea rather than directly facilitating target identification. This late effect suggests that semantic preview in English may impact postlexical integration processes as well as the early stages of lexical processing.

The present study investigates another factor that influences the depth of parafoveal processing. Our recent research has revealed that the extent of parafoveal processing during sentence reading is systematically modulated by the quality of skilled readers' lexical representations (Veldre & Andrews, 2014, 2015a, 2015b) suggesting that semantic preview benefit in English may critically depend on individual differences in lexical quality.

Lexical Quality and Parafoveal Processing

Lexical quality refers to the precision, redundancy, and coherence of the stored representation of a word. According to the *lexical quality hypothesis* (Perfetti, 1992, 2007) high-quality lexical representations support rapid, synchronous activation of the orthographic, phonological, and semantic information that comprise a word's identity. This coherent activation of fully-specified representations of most words affords the benefit of functionally autonomous, automatic, word identification which preserves cognitive resources for higher-level integration and comprehension processes (Andrews, 2015). Lexical quality varies *within* skilled readers as a function of item characteristics such as word frequency. There are also systematic differences between skilled readers in the average quality of the representations stored in their mental lexicons. Critically, assessing lexical quality in a sample of above-average readers requires more than a test of passage comprehension (Andrews, 2012). Readers with similar levels of reading comprehension ability may differ substantially in the quality of their lexical representations because skilled readers can compensate for imprecise word knowledge by relying more heavily on context. As Frith (1980) noted, this 'partial reading strategy' is likely to be effective in many reading tasks. However, readers with low-quality lexical representations may experience difficulty when reading more demanding texts or when the topic is unfamiliar.

As noted above, orthographic precision is central to lexical quality. Therefore, in order to tap this critical construct, our studies have employed assessments of spelling ability in addition to reading comprehension. Spelling ability has been argued to be the most appropriate index of orthographic precision because accurate spelling requires the precise knowledge of the identity and order of letters in words (Andrews, 2012; Perfetti, 1992). Individual differences in lexical quality among skilled readers have been found to modulate masked priming of isolated words

(Andrews & Lo, 2012, 2013), sentence comprehension (Andrews & Bond, 2009; Hersch & Andrews, 2012), word reading speed (Martin-Chang, Ouellette, & Madden, 2014), and eye movements during reading (Kuperman & Van Dyke, 2011).

A notable feature of the reading behavior of individuals with high-quality lexical representations appears to be an increased reliance on parafoveal processing. Veldre and Andrews (2014) found that lexical quality affects the reading perceptual span, i.e. the area from which information is extracted in a single fixation. We used the moving window paradigm (McConkie & Rayner, 1975) to manipulate the amount of orthographic information visible to readers during sentence reading. High reading comprehension and high spelling ability were both associated with a greater benefit to reading rate and saccade length at larger rightward windows, as well as greater cost from small windows. These results reveal that *lexical expertise*, defined by the combination of high reading and spelling ability, is associated with both the extraction of information at greater eccentricity from the point of fixation and heavier reliance on detailed information from the upcoming word, reflected in an increased cost when it is not available.

The association between lexical quality and close parafoveal processing in reading was confirmed using the boundary paradigm (Veldre & Andrews, 2015b). The results of this study showed that higher reading comprehension ability only predicted an increase in identity preview benefit among above-average spellers – that is, among lexical experts. This enhanced preview benefit for lexical experts in early measures depended on foveal load because the interaction was restricted to sentences in which the pre-target word was low frequency. Furthermore, the increased preview benefit on first fixation duration for lexical experts only occurred for previews that provided accurate word length information. This is consistent with the proposal that highly skilled reader/spellers use parafoveal word length in combination with orthographic information

to constrain the potential lexical candidates for an upcoming word (Inhoff, Radach, Eiter, & Juhasz, 2003; Juhasz, White, Liversedge, & Rayner, 2008). We argued that this finding implies that lexical experts are more likely to process parafoveal items to the lexical level (Veldre & Andrews, 2015b).

Consistent with this interpretation, our recent investigation of individual differences in preview benefit from one-letter-different neighbor words (e.g., *seed* as a preview for *sped*) revealed that only lexical experts showed inhibition from a higher-frequency neighbor preview in first-pass measures (Veldre & Andrews, 2015a). This result suggests that lexical processing of the high frequency preview word triggered lexical competition and thus inhibition of the target word (Andrews & Lo, 2012; Davis & Lupker, 2006). In contrast, lower proficiency readers showed facilitation in first-pass measures and a late cost in second-pass fixation likelihood, which we attributed to misidentification of the target and delayed integration difficulty.

The present study aimed to extend the findings of Veldre and Andrews (2014, 2015a, 2015b) by investigating whether semantic preview benefit also depends on skilled reading proficiency. If the absence of semantic preview benefit in English reflects a reduced likelihood of activating parafoveal semantic information in this relatively deep writing system, it would be expected that semantic preview benefits would be stronger for higher proficiency readers because these readers engage in deeper parafoveal processing (Veldre & Andrews, 2014, 2015a, 2015b). In order to maximize the likelihood of facilitation in the present study we selected preview/target word pairs that were high in *semantic feature overlap* (e.g., McRae, Cree, Seidenberg, & McNorgan, 2005). Such items have been found to yield masked semantic priming in single word semantic categorization tasks (Quinn & Kinoshita, 2008) and facilitate self-paced reading times (Roland, Yun, Koenig, & Mauener, 2012) suggesting that they have the capacity to

tap early semantic activation. Controlling for shared semantic features between words that were exactly the same length, which is a necessary requirement of the boundary paradigm, meant that some word pairs were synonyms (e.g., *supper/dinner*) but many pairs were not strictly synonymous (e.g., *brown/green*; *glue/tape*). Evidence of semantic preview benefit in the present study will therefore generalize Schotter's (2013) findings in neutral sentence contexts from specifically synonyms to words that share semantic features.

METHOD

Participants

The final sample comprised 99 undergraduate students from the University of Sydney (68 female; mean age 19.7) who received course credit as compensation³. All had normal or corrected-to-normal vision and reported English as the first language they learned to read and write.

Materials and Design

Seventy-two sentences (mean length: 11.4; range: 8-15 words) were constructed in which the parafoveal preview of a critical target word was manipulated (see Figure 1 for an example and Appendix for complete list of sentences). The target words ranged in length from 4 to 6 letters and never occurred in the first two or final two positions in the sentence. An invisible boundary was located at the end of the pre-target word (mean length: 5.3, range: 4-9 letters). Prior to the reader crossing the boundary, the target word was replaced with a preview stimulus that was either identical to the target, a semantically related word, an orthographically related nonword, or an unrelated word.

--- INSERT FIGURE 1 ABOUT HERE ---

The stimulus characteristics and norming data are presented in Table 1. The semantically related word pairs were selected from the WordNorms database (Buchanan, Holmes, Teasley, & Hutchison, 2013) because they were high in semantic feature overlap. The higher frequency word of each pair was used as the semantically related preview. The unrelated preview was matched on frequency with the semantically related preview but did not share semantic features with the target. The semantically related and unrelated previews both had, on average, 10% orthographic overlap with the target. The target, semantically related, and unrelated previews were matched on neighborhood size, mean bigram and trigram type frequency. The orthographically-related nonword preview shared the first 2-3 letters with the target (50-60% letter overlap depending on word length) and the remaining letters were visually similar to the target (ascenders were replaced with ascenders, descenders with descenders).

Norming study. Fifteen undergraduate students, who did not participate in the reading experiment, completed a cloze norming task in order to confirm that the sentence contexts were neutral. The participants were given each sentence frame up to the pre-target word and asked to write down the word they thought was most likely to come next in the sentence. The results of the cloze task revealed that the preview words were very low in contextual predictability from the sentence context (mean cloze prediction: target 2%; semantic 5%; unrelated 0%).

Following Schotter (2013), we also conducted a meaning judgment task in order to identify the extent to which the word preview changed the meaning of the sentence. A separate sample of 25 undergraduate students were given a sentence frame up until the target word and a second sentence frame with the target replaced by either the semantically related or unrelated preview and asked to judge the similarity in meaning between the two fragments on a 7-point scale. The results showed that the sentence fragments ending in the semantically related preview

were judged to be quite similar in meaning to the fragments ending with the target (5.2) while sentence fragments ending with the unrelated preview were rated as dissimilar to the target-ending sentence fragments (1.8).

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Measures of Reading and Spelling Ability

All participants completed several measures of written language proficiency.

Reading ability. Participants completed the Nelson-Denny Reading Test (Brown, Fishco, & Hanna, 1993), which includes vocabulary and passage comprehension subsections. Total raw scores were standardized to provide a measure of reading ability.

Spelling ability. Participants also completed two measures of spelling ability: spelling dictation and spelling recognition. The *spelling dictation* test consisted of a list of 20 low frequency words selected from Burt and Tate (2002). Each word, and a sentence containing the word, was read aloud by the experimenter and the participant was instructed to write down the correct spelling of the word. Dictation scores were the number of correctly spelled words.

The *spelling recognition* test comprised a list of 44 correctly spelled words intermixed with 44 incorrectly spelled items. Participants were given unlimited time in which to circle all incorrectly spelled items. Scores on the spelling recognition test were the number of correctly identified misspellings..

Standardized scores on the spelling dictation and recognition tests were highly correlated ($r = .73$) and were averaged to form a single, continuous measure of spelling ability. The standardized measures of reading and spelling ability were moderately correlated ($r = .50$).

Apparatus

An SR Research EyeLink 1000 eye tracker was used to record participants' eye movements as they read the experimental sentences which were presented in black monospaced font on a gray background. The sentences occupied a single line of a 21-in. ViewSonic CRT monitor with a refresh rate of 150Hz. Viewing was binocular but fixation position was monitored from the right eye. Participants were seated 60 cm from the monitor and a chin and forehead rest was used to minimise head movements. At this distance 2.5 characters equaled 1 degree of visual angle.

Procedure

Participants were tested individually in a single session that lasted approximately 1.5 hours. The battery of reading and spelling ability measures was administered first followed by the sentence reading task. The participants were instructed to read the sentences for meaning and that a comprehension question would follow some sentences. A three-point calibration procedure was followed by three practice trials and the 72 experimental trials presented in a randomised order. At the beginning of each trial, a fixation point appeared at the location of the first letter of the sentence. Once the participant made a stable fixation on this point, the experimenter pressed a key to display the sentence or performed a new calibration procedure if necessary. The participant pressed a key when s/he finished reading the sentence. Each participant only saw each sentence once, but all sentences appeared in all preview conditions over four counterbalanced lists. On all practice trials and approximately 25% of experimental trials, the sentence was followed by a three-option multiple-choice comprehension question that required a moderate understanding of the meaning of the sentence.⁴

RESULTS AND DISCUSSION

Fixations below 80 ms that were within one letter space of an adjacent fixation were merged with that fixation. Remaining fixations below 80ms and fixations above 1000 ms were eliminated (3.2% of total fixations). Trials were eliminated in which a participant made a blink immediately before or after fixating the target word (6.3% of trials) or the display change completed more than 10 ms into a fixation or was triggered by a saccade that landed to the left of the boundary (12.4% of trials). Target gaze durations above 1200 ms (11 trials) were also excluded. These exclusion rates did not differ between conditions [$F < 1$] and left 5784 trials available for analysis. Mean comprehension accuracy was high (94%; range 80-100%), indicating that participants were reading for meaning⁵.

Several measures of fixation duration were analyzed: single fixation duration (SFD; the fixation duration in cases when only one first-pass fixation is made on the target word), first fixation duration (FFD; the duration of the first fixation on the target word regardless of the number of first-pass fixations it receives), gaze duration (GD; the sum of all first-pass fixations on the target word), go-past duration (GPD; the sum of all fixations from the first fixation on the target word until a word to the right is fixated, i.e., this measure includes fixations on the target and any regressions to earlier words in the sentence), and total duration (TD; the sum of all fixations on the target word including regressions from later in the sentence). We also analyzed three measures of fixation probability: first-pass fixations on the target word (the probability of making a fixation on the target during first-pass reading), regressions out of the target (the probability of making a regression out of the target to a word to the left), and regressions into the target (the probability of making a regression to the target from a word to the right). Means for the four preview conditions on each of these measures are presented in Table 2.

--- INSERT TABLE 2 ABOUT HERE ---

The duration measures were analyzed by linear mixed-effects models (LMM) and fixation probability measures were analyzed with generalized LMM (GLMM) using the *lme4* package (Version 1.1-7; Bates, Maechler, Bolker, & Walker, 2014) in *R* (Version 3.2.0; R Core Team, 2015). The models included subject and item random intercepts and random slopes where possible.⁶ Three contrasts assessed preview effects by comparing (i) the unrelated vs. semantically related preview; (ii) the semantically related vs. identical preview; and (iii) the unrelated vs. orthographically related preview. This contrast coding scheme was implemented by transposing the generalized inverse of the matrix of contrast coefficients (Venables & Ripley, 2002). The LMM intercepts, therefore, represent the grand mean of each dependent measure. The two proficiency measures were included in the models as continuous, mean-centered predictors. The models also included interactions between each of the proficiency measures and the preview contrasts. A *t* or *z* statistic greater than 1.96 indicates an effect that is significant at approximately the .05 alpha level.

The (G)LMM estimates for coefficients, standard errors, and *t/z* values for the fixed effects for each dependent measure are reported in Tables 3 and 4. We first summarize the preview effects in the average data and then consider the effects of proficiency on semantic preview benefit.

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Average Preview Effects

Fixation duration measures. There was a significant benefit from a semantically related preview relative to an unrelated word on all fixation duration measures, except total duration [FFD: $t = 3.5$; SFD: $t = 3.7$; GD: $t = 3.4$; GPD: $t = 2.1$; TD: $t < 1$]. Thus, consistent with the

findings of Schotter (2013), semantic preview benefit in English can be observed when the preview and target share a high degree of semantic overlap. However, an identical preview resulted in significantly shorter fixation times than a semantically related preview on all measures [FFD: $t = 2.0$; SFD: $t = 2.0$; GD: $t = 2.5$; GPD: $t = 2.8$; TD: $t = 5.4$]. Therefore, on average, the semantically related preview provided facilitation relative to an unrelated word, but less benefit than an identical preview of the target word. However, as summarized below, these semantic preview effects were modulated by reading proficiency.

Somewhat surprisingly, the orthographically-related nonword preview provided significant benefit relative to an unrelated word only on total duration [FFD: $t < 1$; SFD: $t = 1.4$; GD: $t < 1$; GPD: $t < 1$; TD: $t = -2.7$]. It is surprising that the orthographic preview benefit was restricted to the late measure of total duration given that Rayner et al. (1986) found significant preview effects on gaze duration from a similar orthographic preview. This was the only nonword preview among the present conditions so it is possible that the non-lexical status of the orthographic preview produced some inhibition relative to the high-frequency unrelated word, counteracting the benefit from the orthographic overlap with the target in first-pass reading (e.g., Drieghe, Rayner, & Pollatsek, 2005). Furthermore, given that the orthographic preview only shared the initial 50% of the target word's letters, preview benefit was likely reduced by illegal orthographic information extracted from the second half of the preview⁷. The orthographic preview effect did not significantly interact with the individual difference measures.

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Fixation probability measures. First-pass fixation probability did not differ between the semantic preview and either the unrelated [$z = 1.3$] or identical previews [$z < 1$]. However, readers were significantly less likely to skip an orthographically-related nonword than an

unrelated word [$z = 3.1$]. Thus it appears the decision to skip the target was based solely on the extraction of lexical information from the preview and was not influenced by the integration of semantic information extracted from the preview with the sentence. This is consistent with evidence that word skipping decisions occur on the basis of a preliminary stage of word identification that is independent of contextual or syntactic fit (Abbott, Angele, Ahn, & Rayner, 2015; Angele, Laishley, Rayner, & Liversedge, 2014; Angele & Rayner, 2013; Choi & Gordon, 2013; Gordon, Plummer, & Choi, 2013).

Readers were marginally more likely to make a regression out of the target in the unrelated condition than in the semantically related condition [$z = 1.8$] but the semantic preview did not differ from the identical preview [$z < 1$] and the orthographic preview did not differ from the unrelated preview [$z = 1.5$]. This suggests that unrelated and orthographic nonword previews were more likely than identical and semantic previews to conflict with early processing of the target and trigger regressions back to words earlier in the sentence to resolve the conflict.

Finally, regressions into the target were equally likely in the unrelated and semantically related conditions [$z = -1.7$], but significantly more likely after a semantically related preview than after an identical preview [$z = 4.4$] and significantly more likely in the unrelated condition than the orthographically-related nonword condition [$t = -3.2$]. These average results replicate earlier findings (Rayner & Schotter, 2014; Schotter, 2013; Schotter et al., 2015) that the semantic preview benefit evident in early measures does not extend to total duration because it is counteracted by a higher rate of regressions back to the target after related previews.

Main Effects of Reading Proficiency

Fixation duration measures. Across fixation duration measures, higher reading ability was associated with shorter fixation times on the target [FFD: $t = -4.1$; SFD: $t = -4.6$; GD: $t = -$

4.6; GPD: $t = -4.0$; TD: $t = -3.8$]. Spelling ability did not predict average single fixation, first fixation, or total durations [all t s < 2.0] but higher spelling ability was associated with shorter gaze and go-past durations [GD: $t = -2.6$; GPD: $t = -2.4$].

Fixation probability measures. There was a marginal effect of reading ability [$z = -1.9$] and a significant effect of spelling ability [$z = -2.7$] on first-pass fixation rate because higher proficiency readers/spellers were more likely to skip the target than poorer readers/spellers. There were no main effects of reading or spelling ability on average regressions out of the target [both z s < 1] or average regressions into the target [both z s < 1].

Thus both high reading and high spelling ability were associated with faster, more efficient reading of the target word but did not affect the likelihood of regressions.

Interactions of Preview Effects and Reading Proficiency

Fixation duration measures. The benefit from a semantically related preview depended on reading ability. There were significant interactions between the unrelated vs. semantic contrast and reading ability on first-pass reading measures [FFD: $t = 2.1$; SFD: $t = 2.1$; GD: $t = 2.1$; GPD: $t < 1$; TFD: $t < 1$] and between the identical vs. semantic contrast and reading ability on gaze duration [FFD: $t = -1.7$; SFD: $t = -1.8$; GD: $t = -2.1$; GPD: $t < 1$; TFD: $t < 1$]. As displayed in the upper panel of Figure 2, higher reading ability was associated with a larger benefit from a semantically related preview over an unrelated preview but with *less* of the ‘identity boost’ indexed by stronger preview effects for identical than semantic previews. Thus, for highly skilled readers, a semantically related word preview was equivalent to an identical preview in first-pass reading.

Independent of the effects of reading ability, there were also significant interactions between the semantic vs. unrelated contrast and spelling ability on gaze and total duration [FFD:

$t = -1.4$; SFD: $t = -1.5$; GD: $t = -2.2$; GPD: $t < 1$; TFD: $t = -2.1$]. The spelling interaction on gaze duration is displayed in the lower panel of Figure 2. In contrast to the interaction with reading ability, higher spelling ability was associated with a *reduced* benefit from a semantically related preview. Good spellers showed equivalent interference from semantically related and unrelated (i.e., non-identical) word previews.

--- INSERT FIGURE 2 ABOUT HERE ---

Fixation probability measures. There were no significant interactions involving reading or spelling ability on first-pass fixation rate (all z s < 1.2). On regressions out of the target, there was a significant interaction between the semantic vs. unrelated contrast and spelling ability [$z = 2.3$] because better spellers were more likely to regress from the target after an unrelated preview than poorer spellers (see Figure 3).

--- INSERT FIGURE 3 ABOUT HERE ---

On regressions into the target, there was a significant interaction between the unrelated vs. orthographic contrast and reading ability [$z = 2.0$]. As displayed in Figure 4, this interaction occurred because increased reading ability was associated with a *reduced* effect of an unrelated preview on regression probability. There was also a significant interaction between the unrelated vs. orthographic contrast and spelling ability [$z = -2.5$]. This significant interaction reflected both a reduced likelihood of regressing to the target in the orthographic condition and an increased likelihood of regressing to the target in the unrelated condition, among better spellers.

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Overall, the results showed a benefit to first-pass reading from previews that were high in semantic feature overlap with the target. However, the semantic preview benefit observed in the average data masked independent and opposite effects of reading and spelling ability. High

reading ability was associated with a larger semantic preview benefit relative to an unrelated preview and equivalent facilitation from semantically related and identical previews. In contrast, higher spelling ability was associated with less benefit from the semantically related preview such that it provided no facilitation relative to an unrelated word. Reading and spelling ability also yielded opposite effects on late regressions back to the target with good readers less likely to regress to the target after an unrelated preview than poorer readers, while good spellers were more likely to regress after an unrelated preview than poorer spellers.

Additional Analyses

In order to capture independent dimensions of the individual differences measures and to confirm that the opposite effects of the correlated reading and spelling scores on semantic preview benefit were not simply an artifact of collinear predictors in the LMM analysis, two orthogonal predictors were computed by principal components analysis. PC1 accounted for approximately 75% of the variance and reflected a participant's overall level of written language proficiency (i.e., Reading + Spelling). PC2, which accounted for the remaining 25% of the variance in scores, is a discrepancy factor that captured the difference between reading and spelling ability (i.e., Spelling – Reading), partialling out overall proficiency. LMMs were specified for each fixation duration measure with the preview contrasts, the two principal components measures, and interactions between the preview contrasts and the proficiency measures as fixed effects and subject and item random intercepts and preview condition random slopes. The results of these analyses were consistent with the results derived from the underlying reading and spelling measures. Across fixation duration measures there was no effect of PC1 on any of the preview contrasts [all t s < 1.7]. Thus, the factor that represents the shared variance between reading and spelling ability yielded no effect on the magnitude of semantic preview

benefit. This likely reflects the opposite effects of reading and spelling ability (see Figure 2) that cancel each other out when combined.

However, there were significant interactions between the unrelated vs. semantic contrast and PC2 across first-pass measures [FFD: $b = -10.25$, $SE = 5.11$, $t = -2.01$; SFD: $b = -12.69$, $SE = 6.11$, $t = -2.08$; GD: $b = -15.58$, $SE = 6.53$, $t = -2.39$; GPD: $t < 1$; TFD: $t < 1$]. These interactions reflect the interaction with spelling ability: readers with high spelling ability relative to their level of reading ability had a reduced semantic preview benefit than those with relatively higher reading than spelling ability. Furthermore, on gaze duration, there was a significant interaction between the semantic vs. identical contrast and PC2 [FFD: $b = 5.82$, $SE = 5.71$, $t = 1.02$; SFD: $b = 7.08$, $SE = 5.96$, $t = 1.19$; GD: $b = 13.07$, $SE = 6.57$, $t = 1.99$; GPD: $t < 1$; TFD: $t < 1$]. This interaction, although confined to one measure, reflects the increased interference from a non-identical preview evident among high ability spellers. These results converge with the analyses based on the individual proficiency variables in showing that reading and spelling ability yield independent and opposite effects on semantic preview benefit in English.

GENERAL DISCUSSION

The aim of the present study was to provide insight into the factors determining semantic preview benefit in English by investigating the contribution of individual differences in reading proficiency. Based on our previous evidence that high reading and spelling ability is associated with deeper parafoveal processing (Veldre & Andrews, 2014, 2015a, 2015b), we predicted that these factors would also modulate semantic preview effects. Demonstrating semantic preview benefit in average samples of skilled readers of English also appears to depend on how semantic relatedness is defined, perhaps because preview and target words need to be closely related in meaning for semantic features of the preview to be integrated with target and/or sentence

processing (Schotter, 2013). Our semantic preview stimuli were therefore selected to have high feature overlap with the targets and to fit the sentence meaning, to maximize the likelihood of observing preview effects.

The average data showed a significant semantic preview benefit from the earliest measures of first-pass reading. These findings converge with those of Schotter (2013) in showing that, on average, skilled readers of English can extract semantic information from the parafovea under the right conditions. While, on average, the results provided strong evidence that readers of English process parafoveal words to the semantic level, the semantic preview benefit on first-pass reading measures significantly interacted with both reading and spelling ability. These interactions revealed that parafoveal semantic activation and integration processes depended on reading proficiency and highlight two important constraints on observing semantic preview benefit in English.

Firstly, semantic preview benefit requires that enough processing of the parafoveal word is completed in order to activate semantic information. The interaction with reading ability occurred because better readers showed a larger benefit from a semantically related preview relative to an unrelated preview than poorer readers. Better readers also showed less difference between a semantically related preview and an identical preview. Thus, consistent with our previous findings that highly skilled readers engage in faster, deeper processing of parafoveal information (Veldre & Andrews, 2014, 2015a, 2015b), higher proficiency readers showed a stronger semantic preview benefit than poorer readers, suggesting that better readers' parafoveal processing is more likely to reach the semantic level.

In contrast to the effects of reading ability, higher spelling ability was associated with a *reduced* semantic preview benefit on gaze and total duration and greater interference from non-

identical previews. Although it may be tempting to attribute the lack of semantic preview benefit among good spellers to a failure of these readers to extract semantic information from the parafovea, such an interpretation is inconsistent with other aspects of the data. Spelling ability significantly affected skipping rates because good spellers skipped more words than poor spellers. This implies that good spellers were *more* likely to fully identify words in the parafovea than poor spellers. Furthermore, spelling ability affected the likelihood of making a regression from the target because only good spellers were more likely to regress from the target to words earlier in the sentence after an unrelated than a semantically related preview. This implies that good spellers *were* sensitive to semantic information in the parafovea and that the spelling ability effects cannot be attributed to a lack of semantic activation among good spellers.⁸

The fact that readers with high spelling ability failed to show a semantic preview benefit therefore appears to indicate greater interference from the mismatch in orthographic information between the preview and target. This highlights a second constraint on semantic preview benefit in English: that the orthographic discrepancy between the preview and target can produce a cost that eliminates any benefit from the overlap in semantic features. The present findings suggest that precise orthographic knowledge enhances competition between the orthographic features of the preview and target which counteracts the benefits of shared semantic features. That is, for readers who are sensitive or oriented toward extracting precise orthographic features from words, the trade-off between orthographic inconsistency and semantic overlap eliminates any semantic preview benefit.

Schotter, Reichle, and Rayner (2014) provide a useful way of conceptualizing these differences. They point out that decisions to move the eyes from the target word in the boundary paradigm reflect a combination of three sources of information: information from preceding text,

information from the preview, and information from the target word itself. They argued that, since there is a lag of 50-60 ms before visual information from a newly fixated word impacts on cognitive processing, saccades may sometimes be initiated on the basis of the information extracted from the preview alone. That is, a display change from a semantically related preview to the target word may not even register with the reading system until the eyes have moved on, particularly when the semantic information from the parafovea is completely congruent with information from the preceding text and the target word that replaces it. This is argued to be consistent with the E-Z Reader model of eye movement control (Reichle, Pollatsek, Fisher, & Rayner, 1998), in which a decision to move the eyes is made upon the completion of an early stage of lexical processing (L_1), which signals to the reading system that full identification of a word is imminent. Thus, the completion of L_1 processing of a *preview* word triggers the initiation of a saccade program to move the eyes on from the *target* word before information directly extracted from the target word is available to the reading system, which can produce an apparent semantic preview benefit (Schotter et al., 2015).

The present results are consistent with the proposal that early oculomotor decisions are based on only cursory processing of a word. Critically, we found no evidence that semantic information affected the decision to skip the target word.⁹ While the results showed that better spellers skipped more words overall, indicating that they were more likely to successfully identify words in the parafovea, this did not interact with preview type. For all readers, the probability of skipping the target word depended solely on the lexical status of the preview stimulus: readers were less likely to skip an orthographically related nonword than an unrelated word but were equally likely to skip identical, semantically related and unrelated word previews. This is consistent with recent evidence that word skipping is determined by the ease of lexical

processing and is independent of semantic and/or syntactic fit (e.g., Abbott et al., 2015; Angele et al., 2014; Angele & Rayner, 2013; Choi & Gordon, 2013). In contrast to the skipping results, there were significant effects of preview relatedness on first-pass measures on the target that interacted with reading and spelling proficiency. The reading ability effects on semantic preview benefit suggest that better readers were more likely to complete L₁ processing of the preview word and program a forward saccade on the basis of the information extracted from the preview without (or prior to) integrating this information with the target word orthography. This is highlighted by the finding that, for good readers, a semantically related preview provided as much facilitation to first-pass reading as an identical preview.

The lack of semantic preview benefit among good spellers is also potentially compatible with Schotter et al.'s (2014, 2015) framework. As outlined above, good spellers were more likely to fully identify the parafoveal word and program a skip. This implies that, on average, better spellers completed L₁ processing of the preview word earlier than poor spellers. For trials on which good spellers fixated the target word, although the completion of L₁ processing of the preview did not occur quickly enough to program a skipping saccade, good spellers may still have completed L₂ processing of the preview before it was replaced by the target and have therefore 'settled on' a single lexical candidate. This would increase the likelihood that the orthographic features of the target word (which become available to the reading system 50-60 ms after fixation onset) would compete with those of the activated preview word and cause interference. This resulted in an equivalent cost to gaze duration for all non-identical previews, which wiped out the semantic preview benefit for good spellers. These subtle differences in good spellers' relative sensitivity to orthographic and semantic overlap appear to parallel effects reported for masked single word morphological priming (Andrews & Lo, 2013).

The above account suggests that observing semantic preview benefit in English critically depends on *when* the target orthographic information becomes available during the time-course of lexical processing (or postlexical integration) of the preview word. If the preview word has not been fully identified, no semantic preview benefit will be observed because orthographic information from the target replaces the preview very early in the time-course of processing. This pattern of results was evident among poor readers in the present study. However, if L₂ processing of the preview word completes *before* the orthographic information from the target becomes available, the presence of a semantic preview benefit will depend on the precision of the reader's lexical knowledge. For readers with imprecise lexical knowledge, reading will continue on the basis of activation of the preview word with little interference from the target orthographic information. However, for readers with precise lexical representations, the competition between the orthographic features of the preview and target words may result in interference that wipes out a semantic preview benefit. This account also implies that the interference should be observed relatively late in the eye movement record (i.e., on gaze duration) because enough time must elapse for the target orthographic information to become available to the reading system and cause interference that, presumably, cancels a planned saccade away from the target. This is precisely the pattern of results that was observed among good spellers in the present study.

As outlined in the Introduction, preview benefit effects have traditionally been interpreted as reflecting the integration of information from the parafovea with information from the target when it is fixated. This may indeed be true for *sublexical* preview effects. For example, an orthographic preview benefit might reflect the integration of orthographic features extracted from the preview with the target word. However, the precise source of semantic preview benefit

remains unclear. One possibility is that the preview word directly activates the target. This could occur by a similar mechanism to that underlying semantic priming or could reflect pre-activation from the sentence context (Schotter et al., 2015). Alternatively, it is possible that the facilitation from a semantically related preview is due to those words being a better fit in the sentence than unrelated words. That is, rather than reflecting facilitation of target identification from overlapping semantic features, per se, the preview benefits in the present study, may reflect facilitation from encoding a plausible/acceptable parafoveal word. This is because the semantically related preview not only differed from the unrelated preview in its semantic relationship to the target but it was often also a more acceptable continuation of the sentence. Notably, this was also a feature of the materials used in earlier studies that have observed an apparent semantic preview benefit in English (e.g., Rayner & Schotter, 2014; Schotter, 2013; Schotter et al., 2015). We are in the process of exploring whether semantic preview benefit can be observed when preview words are matched on plausibility (Veldre & Andrews, in preparation).

Conclusion

The present study provides evidence of two major sources of individual differences in semantic preview benefit in English. These effects were due to differences between readers in the extraction of semantic information from the parafovea as well as differences in the extent to which *orthographic* information from the preview is integrated with the perceptual information extracted when the target is fixated. Higher reading ability facilitates the rapid extraction of semantic information from the parafovea while higher spelling ability increases the likelihood of interference from the mismatch in orthography between the preview and target. These results suggest that previous failures to observe semantic preview effects in English do not indicate that

skilled readers fail to activate semantic attributes of parafoveal words, but rather that a mismatch between preview and target orthographic information can wipe out the benefit of semantic overlap. These findings add to our previous evidence (Veldre & Andrews, 2014, 2015a, 2015b) that individual differences among skilled readers can inform understanding of the role of parafoveal processing in skilled reading.

FOOTNOTES

¹ The evidence is also contradictory for Finnish (cf. Hyönä & Häikiö, 2005; White, Bertram, & Hyönä, 2008) and no semantic preview benefit was found for translation equivalents in mixed-language sentences read by Spanish-English bilinguals (Altarriba, Kambe, Pollatsek, & Rayner, 2001; but see Wang, Yeon, Zhou, Shu, & Yan, 2015 for evidence of mixed-language semantic preview benefit for Korean-Chinese bilinguals). However, there were features of the designs of each of these studies that may have worked against finding a semantic preview benefit.

² In slight contrast to Rayner et al. (1986), the visually similar nonwords used by Rayner et al. (2014) were one-letter-different neighbours of the target (e.g., *razar* as a preview for *razor*).

³ An additional two participants were tested but excluded from the analysis because they responded to less than half of the Nelson-Denny Reading Test comprehension questions in the allotted time.

⁴ Following the sentence reading task, participants were asked if they had noticed any display changes during the experiment and, if so, to estimate the number of display changes they were aware of. The majority of participants ($n = 54$) had no awareness of any display changes. Of those that did report some awareness only two participants noticed more than 5 display changes. Excluding these participants did not change the pattern of significant results so they were retained in the analyses.

⁵ There was a small difference in comprehension question accuracy between participants with low vs. high total scores on the Nelson-Denny Reading Test (93.1% vs. 95.1%), based on a mean split of the sample but this difference did not reach significance [$t(97) = 1.59, p = .12$].

⁶ Including subject and item random slopes resulted in some models failing to converge or reaching a singular convergence. In such cases a simpler random effects structure was specified. We report the model that converged with the most complex random effects structure (Barr, Levy, Scheepers, & Tily, 2013). Specifically the reported models for total duration, first-pass fixation rate, regressions-out, and regressions-in did not include item random slopes.

⁷ Consistent with this interpretation, LMM analyses including saccade launch distance as a continuous, mean-centered predictor revealed a significant interaction between launch distance and the orthographic vs. unrelated contrast [SFD: $b = -0.28, SE = 0.12, t = -2.40$; GD: $b = -0.35, SE = 0.15, t = -2.37$]. The form of this interaction was of a significant orthographic preview benefit when a saccade was launched far from the target [GD: $b = -13.48, SE = 5.79, t = -2.33$] but no significant difference between the orthographic and unrelated previews for saccades launched close to the target [GD: $b = 7.56, SE = 6.23, t = 1.21$]. Thus, when the preview was close to the point of fixation, letter information from the second half of the preview produced disruption on subsequent fixations on the target. However, when the preview was further into the parafovea, the orthographic overlap with the first-half of the target word facilitated its identification. Launch site did not interact with either of the semantic contrasts and its inclusion in the models did not change the pattern of significant effects. Therefore, launch site was not included in the final models.

⁸ The regression-out interaction may also contribute to explaining why the effect of spelling ability was restricted to the later measures of gaze and total duration. For good spellers unrelated previews may have increased the likelihood of immediate regressions from the target while semantically related previews may have increased the likelihood of immediately refixating the target word. Relative to poor spellers, this would have the effect of reducing gaze duration for unrelated previews and inflating gaze duration for semantically related previews. However, excluding trials in which readers made a regression from the target did not change the pattern of significant individual differences interactions on gaze duration. The reduced semantic preview benefit among good spellers is not, therefore, fully attributable to a trade-off between fixation duration and regressions among these readers.

⁹ There was also no evidence that parafoveal semantic information affected pre-target fixation duration, i.e., there was no evidence of any parafoveal-on-foveal effects [Pre-target GD: all $t_s < 1$].

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FIGURE CAPTIONS

Figure 1. Examples of the preview conditions used in the experiment: (a) identical, (b) semantically related word, (c) unrelated word, (d) orthographically related nonword. The invisible boundary is represented by the dashed line. In all conditions, the identical target word was displayed when the reader's eye crossed the boundary.

Figure 2. Gaze duration for each of the preview conditions on the target word over reading ability (upper panel) and spelling ability (lower panel). Error bands represent 90% confidence intervals.

Figure 3. Regressions out of the target word over levels of spelling ability for semantically related and unrelated preview conditions. Error bands represent 90% confidence intervals.

Figure 4. Regressions into the target word for orthographically related and unrelated preview conditions over reading ability (upper panel) and spelling ability (lower panel). Error bands represent 95% confidence intervals.

APPENDIX A

The sentence materials used in the experiment are listed below. The four preview conditions appear in parentheses in the following order: identical, semantically-related word, unrelated word, orthographically-related nonword.

Melanie thought that the man was really [psycho, insane, circus, psyrla] after learning of his crimes.

He needed to buy some sturdy [boots, shoes, check, boolz] because he was a keen bushwalker.

They would need at least [eight, three, house, eigbl] bottles of wine for the dinner party.

Patty needed to buy some [glue, tape, sink, glac] because she had to mend the ripped photo.

David began to prepare [supper, dinner, broken, supjon] after returning from the supermarket.

He recommended a lovely [perch, trout, crazy, perst] that was cooked with a lemon sauce.

She watched as the green [toad, frog, defy, toul] swam in the backyard pond.

The sharp tooth [ache, pain, wood, acto] caused her to miss work all week.

The moss had a deep [brown, green, major, brovm] colour and was very slippery to walk on.

She gave the dog a quick [wash, bath, ears, wacd] after returning from the beach.

He hoped the heavy [armour, helmet, donkey, armewn] would protect him in battle.

She hoped she would be a good [parent, mother, better, paroml] because this was her first child.

He put on the shiny [robe, cape, nick, rotc] after winning the championship bout.

The chef decided he would [grill, roast, couch, grith] some chicken for tonight's special.

The little girl had pretty [blonde, yellow, scheme, blorta] hair and resembled her grandmother.

The filthy, rusty [pans, pots, pets, pame] were noted in the inspector's report.

The steel structure would [shine, flash, crack, shirc] when the afternoon sun was overhead.

They thought that Joel was a real [geek, nerd, volt, geol] because he was always studying.

Toby kept his money in the large [barn, shed, woke, bacs] because he didn't trust banks.

It took at least [eleven, twelve, forest, eleuom] years for the economy to fully recover.

There was a brilliant [view, look, left, viau] from every window in the house.

Suzy really loved [candy, sugar, stick, canlp] because she was never allowed it as a kid.

They often played [poker, cards, rapid, potan] after work on Friday.

She remembered the exact [date, year, give, dafa] when man first walked on the moon.

She found her mother's [skirt, dress, horse, skin] hanging at the back of the wardrobe.
Matthew felt [shame, sorry, drink, shano] about Australia's treatment of refugees.
She approached the heavy [gate, door, sure, galo] before realising it was locked.
She remembered that Kathy [jogs, runs, wife, jopz] around the creek every afternoon.
They used large [saws, axes, rein, savz] when they cleared the land for farming.
The clerk shouted for us to quickly [move, come, work, mowa] towards the counter.
They jumped into the cramped [buggy, wagon, gully, bugpq] before driving to the next stop.
They recorded the number of white [vans, cars, laws, varz] during the vehicle audit.
He carefully put his large [sword, knife, drunk, swocl] down after the fight.
They noticed the young [fawn, deer, lump, faur] when the hunters left the forest.
The child had a large [face, head, less, faro] with big, expressive eyes.
She carefully filled four [mugs, cups, noon, mups] with coffee for her guests.
There was a light [mist, rain, rule, mizf] when they left the cinema.
They carefully toured the wrecked [ship, boat, diet, sheg] that had washed ashore.
Tom asked if I would [lend, loan, lamb, lert] some money to him for his car.
She picked up the small [turnip, potato, critic, turmry] from the counter and rinsed it in the sink.
They visited the lovely [chapel, church, effect, chagot] before booking their wedding.
Bacteria often inhabit [ocean, beach, birth, oceum] environments because they provide ideal conditions.
The creatures live in a deep [swamp, river, ready, swarg] that often floods when it rains.
There were exactly [zero, none, wish, zenc] remaining after the kids raided the lolly jar.
He could not even [limp, step, nose, lirr] over the finish line after falling during the race.
I did not think that the phone would [smash, break, older, smazt] when I dropped it.
We had some [fries, chips, stole, friac] while we watched the big game.
She would often [chat, talk, week, chul] with Evan about his many brothers and sisters.
Hannah would often [sniff, smell, cross, snilt] some of the flowers that grew outside her window.
Tina wanted a huge [lawn, yard, copy, lavr] because she loved lying on the grass in the sun.
She thought she would [retch, vomit, strap, retrl] when she smelled the sour milk.
He stored them in the dark [cellar, garage, injury, celhon] that had the tall wooden shelves.
Angel could only [laugh, smile, worse, laupt] when he heard the good news.
She wandered through the rather [grand, large, point, gramt] halls of the colonial estate.

They decided they should [dive, swim, ours, diro] under the fallen branch that lay across the river.

He stepped toward the high [ledge, cliff, slave, ledyo] before admiring the splendid view.

He could not believe how many [bugs, ants, trim, bupe] were living under the pot plant.

The kids would never [chew, bite, sums, chau] their food properly.

She eventually spotted a spare [stool, chair, usual, stoef] near the crowded bar.

The jacket was placed [below, under, since, belcu] some other items of clothing.

The teacher said that they should [print, write, mouth, priml] their names at the top of the page.

He bought a brown [vest, coat, roof, vezl] from the department store in town.

We watched the large [hawk, bird, fuel, havt] swoop down to get the food.

The little boy kept his precious [coin, cash, neck, corm] hidden under the bed.

She studied [waltz, dance, solid, walfs] because she had always loved the music.

The house had several [brick, stone, reach, briet] columns at the entrance.

It was quite a small [town, city, miss, toum] and was located on the beautiful coastline.

The violent thug's [rival, enemy, smoke, riveh] started a massive brawl.

They met the other [kids, boys, deep, kilc] after the class had finished.

A single raised [fist, hand, next, fizl] provided a simple image for the group's logo.

At the beach, the small [shack, house, women, sharf] stood alone amongst the dunes.

There was a terrible [noise, sound, stage, noica] when the waiter dropped the tray of drinks.