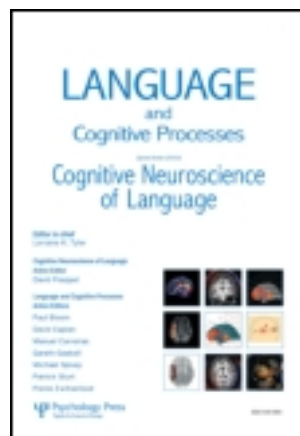




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Effects of dialect variation on the semantic predictability benefit

Cynthia G. Clopper^a

^a Department of Linguistics, Ohio State University, Columbus,
OH, USA

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Effects of dialect variation on the semantic predictability benefit

Cynthia G. Clopper

Department of Linguistics, Ohio State University, Columbus, OH,
USA

Words in semantically predictable sentences are more intelligible than words in less predictable or semantically anomalous sentences. However, the intelligibility benefit of semantically predictable words is reduced in noise and for non-native listeners, suggesting that semantic context contributes less to intelligibility under difficult listening conditions. The goal of the current study was to explore the effect of dialect variation on the semantic predictability benefit. Larger semantic predictability benefits were observed for more familiar dialects than less familiar dialects. In addition, more dialect differences in the size of the semantic predictability benefit were observed in conditions in which perceptual normalisation was more difficult. These results are consistent with a cue-weighting model in which dialect variation is comparable to energetic noise masking. Listeners attend less to semantic cues when perceptual normalisation for dialect variation is difficult and more to semantic cues when perceptual normalisation is easy.

Keywords: Speech perception; Dialect variation; Semantic context.

The effects of semantic context on speech intelligibility in noise have been well-established. The final word in a sentence is easier to identify if it is more semantically predictable from the preceding context than if it is less predictable (Duffy & Giolas, 1974; Kalikow, Stevens, & Elliott, 1977). For example, *crumbs* is easier to identify in *Break the dry bread into crumbs* than

Correspondence should be addressed to Cynthia G. Clopper, Department of Linguistics, Ohio State University, Oxley Hall 222, 1712 Neil Ave, Columbus, OH 43210, USA. E-mail: clopper.1@osu.edu

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in *She might discuss the crumbs*. Similarly, the final word in a sentence is easier to identify when the sentence is meaningful than when the sentence is semantically anomalous (Miller & Isard, 1963). For example, *crumbs* is easier to identify in *Break the dry bread into crumbs* than in *Consider the local floor about crumbs*. However, these effects of semantic context are reduced at more difficult signal-to-noise ratios (Kalikow et al., 1977; Miller & Isard, 1963).

Recent research has also shown that the effects of semantic context on speech intelligibility in noise are reduced for non-native listeners relative to native listeners (Bradlow & Alexander, 2008; Mayo, Florentine, & Buus, 1997). As Bradlow and Alexander (2008) discussed, these results are consistent with a cue-weighting model of speech processing similar to what Mattys, White, and Melhorn (2005) proposed to account for speech segmentation. Mattys et al. (2005) examined changes resulting from different signal-to-noise ratios in the relative weighting of lexical, segmental, and prosodic cues to word segmentation and attributed the effects that they observed to the relative quality of the information that was available in the signal. In easier listening conditions, listeners rely on lexical and semantic cues more than segmental cues for speech processing, whereas in more difficult conditions, the relative importance of the cues is reversed. More recently, Mattys, Brooks, and Cooke (2009) found that different kinds of processing loads have different effects on the relative weighting of lexical and segmental cues in speech segmentation. Reliance on lexical cues decreases as the quality of the signal decreases due to energetic masking. However, reliance on lexical cues increases as cognitive load increases due to informational masking.

The goal of the current study was to examine how dialect variation¹ affects the semantic predictability benefit. If dialect variability in the speech signal is similar to an energetic noise masker and affects the mapping between the signal and lexical categories, the semantic context effect should be smaller when perceptual normalisation is more difficult and listeners are more likely to rely on segmental cues than lexical or semantic cues. However, if perceptual normalisation is similar to informational masking and reflects a higher-level cognitive processing load, the semantic context effect should be larger when perceptual normalisation is more difficult and listeners are more likely to rely on lexical cues than segmental cues.

¹ In the American variationist sociolinguistic tradition, the term “dialect” is used to denote language varieties that differ segmentally (e.g., Labov, Ash, & Boberg, 2006), as well as those that differ morphologically, lexically, and syntactically. In keeping with this tradition, and to avoid potential confusion with non-native or foreign accents, the regional varieties in this study are referred to as dialects.

In the current study, the ease of perceptual normalisation was manipulated using three factors: dialect familiarity, stimulus presentation order, and lexical and segmental variability in the stimulus materials. First, dialect familiarity was selected as a factor because processing benefits have been observed for standard and familiar nonstandard dialects in speech intelligibility (Clopper & Bradlow, 2008; Labov & Ash, 1997; Mason, 1946), lexical decision (Floccia, Goslin, Girard, & Konopczynski, 2006; Impe, Geeraerts, & Speelman, 2008; Sumner & Samuel, 2009), and word and sentence comprehension (Adank & McQueen, 2007; Adank, Evans, Stuart-Smith, & Scott, 2009) tasks. In addition, Clopper and Bradlow (2008) observed more differences across dialects in the intelligibility of high predictability (HP) sentences at more difficult signal-to-noise ratios than at easier signal-to-noise ratios. These results suggest that perceptual normalisation is more difficult for less familiar dialects than more familiar dialects, particularly in more difficult listening conditions. Thus, if dialect variation is similar to energetic noise masking, the semantic context effect will be smaller for less familiar dialects than more familiar dialects. However, if perceptual normalisation for dialect variation imposes a cognitive load on the listener, the semantic context effect will be larger for less familiar dialects than more familiar dialects.

Labov and Ash (1997) provided preliminary evidence that the semantic context effect is smaller for unfamiliar dialects than familiar dialects. They found that local listeners were better able to use the semantic information in short phrases to identify words produced by talkers from Birmingham, Alabama, than nonlocal listeners. These results suggest that listeners rely more on semantic information when perceptual normalisation is easier and are consistent with an interpretation of dialect variation as more similar to energetic masking than informational masking.

Second, stimulus presentation order was selected as a factor because blocking trials by talker can make speech processing tasks easier, suggesting that listeners can normalise for talker-specific information across trials (Creelman, 1957; Mullennix, Pisoni, & Martin, 1989). Similarly, the effect of dialect familiarity is reduced when the stimulus materials are blocked by dialect relative to when they are presented in random order (Floccia et al., 2006), suggesting that blocking by dialect facilitates perceptual normalisation for unfamiliar, nonstandard varieties. Thus, if dialect variation is similar to energetic noise masking, the semantic context effect will be smaller when the stimulus materials are presented in a fully randomised order than when they are presented in single-dialect blocks. However, if perceptual normalisation for dialect variation imposes a cognitive load on the listener, the semantic context effect will be larger in the fully randomised condition than the blocked condition.

Third, lexical and segmental variability in the stimulus materials was selected as a factor because the mapping between talker- or dialect-specific variants and lexical representations is also affected by the local sentence context. Ladefoged and Broadbent (1957) demonstrated that listeners shift their vowel category boundaries based on the formant structure of the vowels in the preceding sentence context. Similarly, Plichta, Preston, and Rakerd (2007) found that listeners shift their vowel category boundaries to match dialect-specific variants in the sentence context. These results suggest that listeners can normalise for talker and dialect variability based on the information in a single sentence. In the stimulus materials selected for the current study, semantic context was confounded with lexical and segmental variability. Specifically, the low predictability (LP) sentences exhibited a fairly small range of syntactic structures and main verbs, whereas the anomalous sentences exhibited a wider range of phrase types and lexical items. As a result, the selected anomalous sentences were also more segmentally variable than the selected LP sentences, and this greater variability in the anomalous sentences may have provided listeners with a better opportunity to normalise for talker variation than the less variable LP sentences. Thus, if dialect variation is similar to energetic noise masking, the semantic context effect will be smaller for the less variable LP sentences than the more variable anomalous sentences. However, if perceptual normalisation for dialect variation imposes a cognitive load on the listener, the semantic context effect will be larger for the less variable LP sentences than the more variable anomalous sentences.

To examine the effects of dialect familiarity, blocking condition, and lexical and segmental variability on the size of the semantic context effect, HP, LP, and anomalous sentences produced by talkers from four regional dialects of American English (General American, Mid-Atlantic, North, and South) were presented to three groups of listeners (General American, Northern, and Mobile) in three different blocking conditions (unblocked, blocked by dialect, and a control condition). The characterisation of perceptual normalisation as either energetic or informational masking in the model of Mattys et al. (2009) makes competing predictions for the current study. In an energetic masking account, the semantic context effect will be smaller for the unfamiliar dialects than the familiar dialects, in the unblocked condition than the blocked condition, and for the LP sentences than the anomalous sentences. In an informational masking account, however, the semantic context effect will be larger for the unfamiliar dialects than the familiar dialects, in the unblocked condition than the blocked condition, and for the LP sentences than the anomalous sentences.

METHODS

Talkers

Twenty-four talkers were selected from the Nationwide Speech Project (NSP) corpus (Clopper & Pisoni, 2006). The talkers included three males and three females from each of four regional dialects of American English: Mid-Atlantic, North, South, and General American. The General American talkers included one male and one female talker each from the Midland, New England, and Western dialect groups in the NSP corpus. Combining these three dialects into a single General American dialect was motivated by previous research demonstrating that these three dialects are not strongly differentiated in production (Clopper, Pisoni, & de Jong, 2005) or perception (Clopper & Pisoni, 2007). The talkers were 18- to 25-year-old white, monolingual native speakers of American English. Each talker had lived exclusively in his or her dialect region until age 18, and both parents of each talker were also raised in the same region.

Stimulus materials

Forty-eight triples of matched HP, LP, and anomalous sentences were selected. The HP and LP sentences were taken from the Speech Perception in Noise (SPIN) test of Kalikow et al. (1977). These sentences were five to eight words long and contained two to five content words. For the HP sentences, the final word in the sentence was highly predictable from the preceding semantic context. For the LP sentences, the final word in the sentence was not predictable from the preceding semantic context. Each HP sentence was matched with an LP sentence with the same final target word. For example, the HP sentence *The judge is sitting on the bench* was matched with the LP sentence *I'm talking about the bench*.

The anomalous sentences were constructed by replacing each content word, except the final target word, in the HP sentences with another content word from the same syntactic class (Clopper & Pisoni, 2006). Thus, each of the anomalous sentences was also matched with an HP sentence with the same final target word. For example, the anomalous sentence *The arm is riding on the bench* was matched with the HP sentence *The judge is sitting on the bench*.

As noted in the Introduction section, the selected LP and anomalous sentences differed in their lexical and segmental content. A paired sample *t*-test confirmed that the anomalous sentences had significantly more content words preceding the target word ($M = 2.69$) than the LP sentences ($M = 2.06$, $t(47) = 4.23$, $p < .001$). The anomalous sentences also had significantly more

stressed vowel types preceding the target word ($M=2.52$) than the LP sentences ($M=1.96$, $t(47)=3.79$, $p<.001$).

Two different stimulus lists were constructed from the 48 sentence triples to counterbalance for item-specific effects. For the first list, two sentence triples were selected for each talker to maximise dialect-specific variation across talkers and dialects. For the second list, the sentences assigned to the Northern talkers were assigned to the Mid-Atlantic talkers and vice versa, because /æ/ exhibits variation in both dialects. Similarly, the sentences assigned to the Southern talkers in the first list were assigned to the General American talkers in the second list and vice versa, because /u, ow/ exhibit variation in both dialects. Approximately half of the listeners received each stimulus list. A complete list of the sentences selected for each talker dialect pair (Northern and Mid-Atlantic, Southern and General American) is shown in Appendix A.

The sentences were mixed with speech-shaped white noise at a signal-to-noise ratio of 0 dB. Each sentence was stored in an individual digital sound file with a 400 ms silent lead, followed by a 500 ms noise-only lead, followed by the sentence mixed with noise, and followed by a 500 ms noise-only tail. The sound files were sampled at 22050 Hz with 16-bit resolution for presentation to the listeners.

Listeners

One hundred and twenty-seven Ohio State University undergraduates (36 male, 91 female) participated as listeners in the experiment for partial credit in an introductory linguistics course. The listeners were 18- to 50-year-old ($M=21$, $SD=4$) monolingual native speakers of American English, with no history of speech or hearing disorders reported at the time of the experiment.

The residential histories of the listeners varied: 65 (21 male, 44 female) had lived exclusively in the General American dialect region until age 18; 33 (12 male, 21 female) had lived exclusively in the Northern dialect region until age 18; and the remaining 29 "Mobile" listeners (4 male, 25 female) had lived in more than one dialect region and/or abroad prior to age 18. The General American listeners were 18–34 years old ($M=21$, $SD=3$), the Northern listeners were 18–31 years old ($M=21$, $SD=3$), and the Mobile listeners were 18–50 years old ($M=22$, $SD=6$). The General American dialect was assumed to be familiar for all of the listeners because Ohio State University is located in the Midland dialect region. The Northern dialect was assumed to be familiar for the Northern listeners and moderately familiar for the Mobile listeners, 15 of whom had lived in the Northern dialect region. Nine of the Mobile listeners had lived in the Southern dialect region and four of the Mobile listeners had lived in the Mid-Atlantic dialect region. Thus, the

Southern and Mid-Atlantic dialects were assumed to be less familiar for all three listener groups.

Procedure

The listeners were randomly assigned to one of three blocking conditions. In the unblocked condition ($N=45$), all 144 sentences were presented in a different random order for each listener. In the blocked condition ($N=42$), the 36 sentences for each dialect were presented in a block together. The order of the four dialect blocks and the order of the trials within each block were randomised separately for each listener. The blocked and unblocked conditions differed in two respects. First, in the blocked condition, the stimulus materials were presented in four separate blocks of six talkers each, whereas in the unblocked condition, all of the stimulus materials were fully randomised. Second, in the blocked condition, all of the talkers from a given dialect were presented in a block together, whereas in the unblocked condition, the dialect of the talker varied randomly from trial to trial. To ensure that any differences that emerged between the unblocked and blocked conditions were due to blocking by dialect specifically, rather than blocking by talker more generally, a control condition ($N=40$) with four blocks of six pseudo-randomly selected talkers was also included. Each of the four blocks in the control condition was composed of the stimulus materials produced by three male and three female talkers from different dialect regions, with no dialect represented by more than two talkers. Thus, although one block in the blocked condition included all of the sentences produced by the six Northern talkers, one block in the control condition included the sentences produced by one General American, one Mid-Atlantic, and one Northern female talker, as well as one Northern and two Southern male talkers. Two sets of four blocks of six pseudo-randomly selected talkers were created, and approximately half of the listeners in the control condition were assigned to each set. The order of the four blocks and the order of the trials within each block were randomised separately for each listener.

The listeners were tested in a quiet room in groups of five or fewer. Each listener was seated at a personal computer equipped with a keyboard and headphones (Sennheiser HD 280 pro). On each trial, the listeners heard one sentence mixed with noise and were instructed to respond by typing the final word of the sentence. The experiment was self-paced and the next trial was initiated by pressing the Enter key on the keyboard. Prior to analysis, obvious typographical errors were corrected. In addition, homophones (e.g., *Matt* for *mat*) were scored as correct, but responses with incorrect or missing morphemes (e.g., *log* for *logs*) were scored as incorrect.

RESULTS

A summary of the mean target word accuracy for each talker dialect for each sentence type is shown in Figure 1. A repeated measures ANOVA on target word accuracy with talker dialect (General American, Mid-Atlantic, North, South) and sentence type (HP, LP, anomalous) as within-subject variables and listener dialect (General American, Northern, Mobile) and blocking condition (unblocked, blocked, control) as between-subject variables revealed significant main effects of talker dialect, $F(3, 354) = 102.44$, $p < .001$, sentence type, $F(2, 236) = 867.77$, $p < .001$, and blocking condition, $F(2, 118) = 3.85$, $p = .02$, as well as significant talker dialect $\times$ sentence type, $F(6, 708) = 8.35$, $p < .001$, sentence type $\times$ blocking condition, $F(4, 236) = 3.30$, $p = .01$, and talker dialect $\times$ sentence type $\times$ blocking condition, $F(12, 708) = 2.47$, $p = .004$, interactions. The main effect of listener dialect and the other interactions were not significant.

A series of Bonferroni-corrected posthoc t -tests was conducted to further explore the main effects. Paired-sample t -tests on talker dialect revealed that performance was significantly better for the General American talkers than for the Mid-Atlantic, $t(126) = 16.77$, $p < .001$, Northern, $t(126) = 12.33$, $p < .001$, and Southern, $t(126) = 11.38$, $p < .001$, talkers. None of the other pairwise talker dialect differences were significant. Paired-sample t -tests on sentence type revealed that performance was significantly better for the HP sentences than the LP, $t(126) = 36.27$, $p < .001$, and anomalous, $t(126) = 32.17$, $p < .001$, sentences. The difference between the LP and

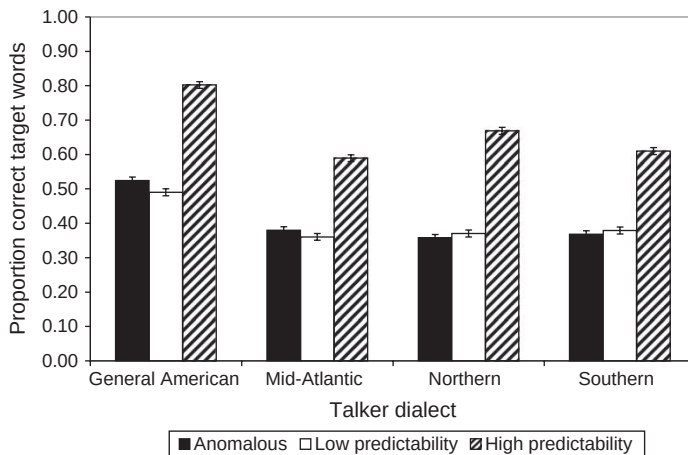


Figure 1. Mean target word accuracy for each talker dialect for each sentence type. Error bars are standard error.

anomalous sentences was not significant. Independent sample *t*-tests on blocking condition revealed no significant pairwise differences.

Thus, the General American dialect was most intelligible overall, and no effects of listener dialect were observed, consistent with the results reported by Clopper and Bradlow (2008) for HP sentences only. The HP target words were also more intelligible overall than the LP and anomalous target words, consistent with previous research on the effects of semantic context on speech intelligibility (Duffy & Giolas, 1974; Kalikow et al., 1977; Miller & Isard, 1963). The greater intelligibility of the HP targets than the LP and anomalous targets confirmed a significant semantic context effect for both types of sentences and suggests that the signal-to-noise ratio was not too difficult to completely eliminate the listeners' reliance on semantic cues.

To explore how dialect familiarity, blocking condition, and sentence type affected the size of the semantic context effect, difference scores were calculated to compare performance on the HP targets to the LP and anomalous targets. The mean difference scores for each talker dialect in each blocking condition are shown in Figures 2 and 3 for the HP–LP and HP–anomalous difference scores, respectively. As shown in Figures 2 and 3, the semantic context effect ranged from 20% for the anomalous sentences produced by the Mid-Atlantic talkers in the blocked condition to 38% for the LP sentences produced by the Northern talkers in the unblocked condition. Thus, for both types of sentences for all of the talker dialects in all of the blocking conditions, the listeners used semantic information to identify the final target word.

A repeated measures ANOVA on the difference scores with talker dialect and sentence type (HP–LP, HP–anomalous) as within-subject variables and blocking condition as a between-subject variable revealed significant main

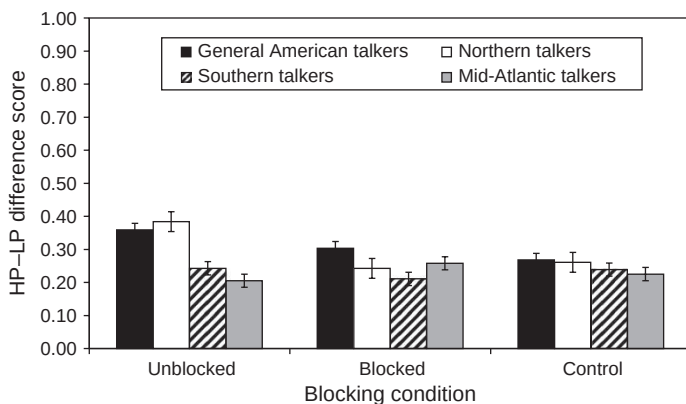


Figure 2. Mean HP–LP difference scores for each talker dialect in each blocking condition. Error bars are standard error.

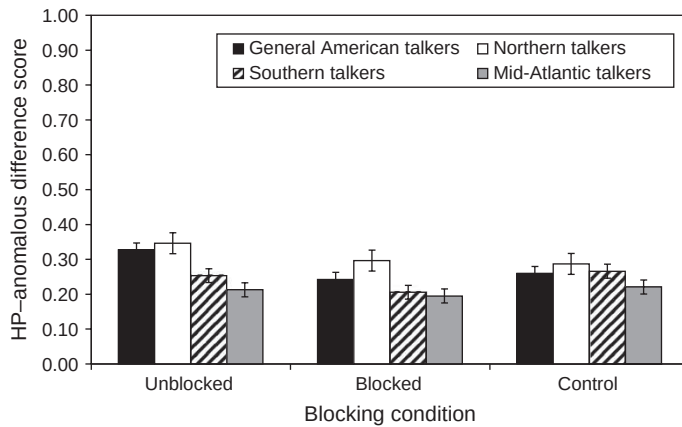


Figure 3. Mean HP-anomalous difference scores for each talker dialect in each blocking condition. Error bars are standard error.

effects of talker dialect, $F(3, 372) = 13.85$, $p < .001$, and blocking condition, $F(2, 124) = 4.59$, $p = .01$, as well as significant talker dialect $\times$ sentence type, $F(3, 372) = 3.02$, $p = .03$, talker dialect $\times$ blocking condition, $F(6, 372) = 2.58$, $p = .02$, and talker dialect $\times$ sentence type $\times$ blocking condition, $F(6, 372) = 2.36$, $p = .03$, interactions. The main effect of sentence type and the other interactions were not significant.

A series of Bonferroni-corrected t -tests was conducted to explore the main effects. Paired sample t -tests on talker dialect revealed significantly larger semantic predictability benefits for the General American and Northern dialects than the Mid-Atlantic and Southern dialects (all $p < .001$). No other pairwise talker dialect differences were significant. Independent sample t -tests on blocking condition revealed no significant pairwise differences. Thus, the semantic context effect was larger for the General American and Northern dialects than the Mid-Atlantic and Southern dialects, consistent with the finding that the semantic context effect is reduced for less familiar linguistic varieties (Bradlow & Alexander, 2008; Labov & Ash, 1997; Mayo et al., 1997).

The interaction between talker dialect, blocking condition, and sentence type obtained in the difference score analysis suggests that effects of blocking condition and sentence type on the semantic predictability benefit were mediated by dialect familiarity. For the HP-LP difference scores, Bonferroni-corrected paired sample t -tests on talker dialect in each blocking condition revealed a significantly larger semantic predictability benefit for the General American and Northern talkers than the Mid-Atlantic and Southern talkers in the unblocked condition (all $p < .001$). The semantic predictability benefit was also significantly larger for the General American talkers than the

Southern talkers in the blocked condition, $t(41) = 3.51$, $p = .001$. None of the other pairwise comparisons in the unblocked and blocked conditions and none of the pairwise comparisons in the control condition were significant. For the HP-anomalous difference scores, Bonferroni-corrected paired sample t -tests on talker dialect in each blocking condition revealed a significantly larger semantic predictability benefit for the General American and Northern talkers than the Mid-Atlantic talkers in the unblocked condition (both $p < .001$). No other pairwise comparisons in the unblocked condition and none of the pairwise comparisons in the blocked or control conditions were significant.

Thus, more differences between the dialects were significant in the unblocked condition (6) than in the blocked (1) or control (0) conditions. These results suggest that the effects of dialect familiarity on the semantic predictability benefit were attenuated when talker variability from trial to trial was reduced in the blocked and control conditions relative to the unblocked condition.² Similarly, more differences between the dialects were significant for the LP sentences (5) than for the anomalous sentences (2). These results suggest that the effects of dialect familiarity on the semantic predictability benefit were attenuated for the more lexically and segmentally variable anomalous sentences relative to the less variable LP sentences.

DISCUSSION

Taken together, the results of this experiment are consistent with an interpretation of talker and dialect variability as similar to energetic masking. When the talker dialect was less familiar, the mapping between the signal and the lexical representations was more difficult, and the listeners relied relatively less on semantic information. As a result, the semantic context effect was reduced for the less familiar Mid-Atlantic and Southern dialects relative to the more familiar Northern and General American dialects. Similarly, this effect of dialect familiarity on the semantic context effect was stronger when perceptual normalisation was more difficult, either because the talker was less predictable from trial to trial or because the lexical and segmental content preceding the target word was less informative about talker or dialect identity. As a result, the semantic context effect was more similar across the four dialects in the blocked and control conditions

²A close inspection of Figures 2 and 3 suggests that the semantic context effect may be reduced for the General American and Northern dialects in the blocked and control conditions relative to the unblocked condition. However, posthoc Bonferroni-corrected t -tests did not reveal any significant differences in the difference scores across blocking conditions within talker dialects.

than in the unblocked condition and for the anomalous sentences than for the LP sentences. Thus, talker and dialect variability is a source of noise in the speech signal that affects speech processing and the relative weighting of semantic cues in similar ways as the babble and speech-shaped white noise examined by Mattys et al. (2009). As energetic masking increases, listeners attend relatively less to semantic cues than at lower levels of energetic masking.

The correlate of this interpretation is that as energetic masking increases, listeners attend relatively more to segmental cues than at lower levels of energetic masking. The results of this experiment provide only indirect evidence for the claim that the listeners were attending more to segmental cues when perceptual normalisation was more difficult than when it was easier. When perceptual normalisation is more difficult, listeners are more likely to incorrectly map dialect-specific variants to lexical targets and therefore are more likely to misidentify the target words than when perceptual normalisation is easier. As shown in Figure 1, performance was significantly better for the highly familiar General American dialect than for the other dialects. This finding is consistent with the interpretation of target word errors as indicating failures to map the signal to appropriate lexical categories. More direct evidence for this claim is not available, however, because the target words in the current study were too variable across talkers and dialects to permit a detailed analysis of the error patterns. Therefore, further research with more controlled materials is necessary to determine the relative weighting of segmental and semantic cues in this task.

The size of the semantic context effect may also be related to how variable the productions were across the three sentence types within each dialect. The stimulus materials in the current study consisted of natural utterances produced in a reading task (Clopper & Pisoni, 2006). However, a word produced in an HP context tends to be phonetically reduced (Lieberman, 1963) and may exhibit more extreme dialect-specific variants (Clopper & Pierrehumbert, 2008) relative to the same word produced in an LP context. Two different stimulus lists were used in the current experiment to reduce the role of item-specific effects on the results, but the observed effects of perceptual normalisation on the size of the semantic predictability benefit could be further confirmed by cross-splicing the final target word from the HP sentences onto the anomalous and LP sentences.

The ease of perceptual normalisation was manipulated using three factors (dialect familiarity, blocking condition, and sentence type), and the effects of each of these factors on the semantic predictability benefit were somewhat different. Dialect familiarity elicited the numerically strongest effect of the three factors, but only when defined across all of the listener groups. An interaction between listener dialect and talker dialect was not observed,

suggesting that, for example, the Northern listeners did not perceive the Northern talkers as more intelligible than listeners with less familiarity with the Northern dialect. Dialect familiarity was assessed in terms of where the listeners had lived before age 18. However, other factors could also have contributed to the relative familiarity of the dialects, including age and amount of exposure to each region (Baker, Eddington, & Nay, 2009), travel experience, and exposure through the media (Stuart-Smith, 2007). In addition, Clopper and Bradlow (2008) argued that listeners' expectations about the kinds of speech they will hear in a university laboratory setting may affect their performance. Listener expectations have been shown to affect perception in vowel matching tasks in which participants are given explicit information about where the talker is supposed to be from (Hay, Nolan, & Drager, 2006; Niedzielski, 1999). In the current study, participants were not told before the experiment that they would be listening to speech produced by talkers from different dialects. Thus, one possible explanation for the lack of a listener-specific dialect familiarity effect is that all of the participants expected to hear a relatively standard variety of American English, such as General American English, and were therefore less able to map even highly familiar dialects onto the expected forms. Listener-specific effects of dialect familiarity would be expected to emerge if participants were told before the experiment that they would be hearing talkers from multiple different dialects of American English.

The effect of blocking condition was numerically weaker than the effect of dialect familiarity, and no significant differences were observed in overall intelligibility performance or semantic predictability benefit across the three conditions. The analysis of the semantic context difference scores revealed more differences between the dialects in the unblocked condition than in the blocked and control conditions. However, the effect of dialect familiarity on the size of the semantic predictability benefit was similar in the control condition, in which stimulus materials produced by talkers from different dialects were presented in blocks together, and in the blocked condition, in which all of the stimulus materials in each block were produced by talkers from the same dialect. Thus, perceptual normalisation for sets of talkers from different dialects was not different than perceptual normalisation for sets of talkers from the same dialect. Previous studies examining perceptual dialect normalisation have not explicitly compared the effects of blocking by dialect to the effects of blocking by talker (e.g., Evans & Iverson, 2004; Floccia et al., 2006; Maye, Aslin, & Tanenhaus, 2008). Additional research is therefore needed to determine if and when dialect similarity across trials facilitates perceptual normalisation for talker variability.

Finally, the effect of preceding lexical and segmental content was fairly modest. The corpus from which the stimulus materials were selected was not

large enough to allow an independent manipulation of segmental and semantic content. Thus, as noted above, further research with more controlled materials is necessary to determine the relative weighting of segmental and semantic cues in this task.

The observed differences between the strength of these three factors suggest that frequency and recency have different effects on the ease of perceptual normalisation. In an exemplar-based approach to perceptual normalisation, linguistic and indexical information are processed simultaneously (Pisoni, 1997), and exemplars of frequently encountered categories and of recently perceived categories have higher base activations than less frequent and less recent exemplars (Johnson, 1997). Categorisation is facilitated when the incoming signal is similar to exemplars with a relatively high base activation, and ease of perceptual normalisation is therefore a function of the base activation of the exemplars that are most similar to the incoming signal. In the context of the current study, listeners would have encountered the familiar dialects more frequently than the unfamiliar dialects, and the exemplars of the familiar dialects would therefore have a higher base activation than the exemplars of the unfamiliar dialects. The relatively strong effect of dialect familiarity in the current study, therefore, reflects a strong frequency effect on exemplar activation. Similarly, recently activated exemplars would be more similar to the incoming signal when the trials were blocked by talker and when the sentences contained talker- or dialect-specific segmental cues than when there was more variability from trial to trial and when the sentences did not contain cues to talker or dialect identity. Thus, the more modest effects of blocking and sentence type that were observed in the current study reflect recency effects on exemplar activation that are weaker than the observed frequency effect.

CONCLUSIONS

The results of the current study suggest that speech intelligibility performance in noise results from a complex interaction between semantic context and perceptual normalisation. One explanation for the semantic predictability benefit is that the context helps to constrain the lexical items under consideration by raising the activation level of predictable words (e.g., Aydelott & Bates, 2004; Gaskell & Marslen-Wilson, 2001). However, listeners can only use semantic information efficiently to the extent that the quality of the signal is adequate to support higher-level processing (Aydelott & Bates, 2004; Mattys et al., 2005, 2009). The current results suggest that the quality of the information in the signal is determined not only by the signal-to-noise ratio, but also by the variability in the signal itself and the extent to which listeners are able to perceptually normalise for that variability. In particular,

familiar dialects, low talker variability across trials, and high lexical and segmental variability within trials may facilitate perceptual normalisation even in difficult listening conditions, such that variants are not equally difficult to process in all contexts (Clopper, Pierrehumbert, & Tamati, 2010; Labov & Ash, 1997).

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APPENDIX A

TABLE A1
Northern and mid-Atlantic sentence triples

<i>High predictability</i>	<i>Low predictability</i>	<i>Anomalous</i>
The flashlight casts a bright beam.	She's discussing the beam.	The accident washes a short beam.
The cow gave birth to a calf.	She hopes Jane called about the calf.	The low woman was gladly in the calf.
The dealer shuffled the cards.	Mr. Black has discussed the cards.	The turn twisted the cards.
Ann works in the bank as a clerk.	Bob was considering the clerk.	Jane ate in the glass for a clerk.
The cabin was made of logs.	Harry had thought about the logs.	The ship was interested in logs.
Please wipe your feet on the mat.	Peter has considered the mat.	Please throw out your firemen in the mat.
The plow was pulled by an ox.	The man should discuss the ox.	The burglar was parked by an ox.
The cut on his knee formed a scab.	The boy would discuss the scab.	The chimpanzee on his checkers wore a scab.
She shortened the hem of her skirt.	Nancy didn't discuss the skirt.	She considered the floor of Jane's skirt.
Paul hit the water with a splash.	Bob has discussed the splash.	Tom took the elbow after a splash.
Kill the bugs with this spray.	Mary had considered the spray.	Think about the boys with this spray.
Banks keep their money in a vault.	Mr. Brown thinks about the vault.	Highways pour their hair about a vault.
The judge is sitting on the bench.	I'm talking about the bench.	The arm is riding on the bench.
Follow this road around the bend.	I'm glad you heard about the bend.	Discuss this sailboat on the bend.
Paul was arrested by the cops.	Ruth hopes Bill called about the cop.	Nancy was poured by the cops.
The poor man was deeply in debt.	We will consider the debt.	Mr. White hit the debt.
The shepherds guarded their flock.	Paul should have discussed the flock.	The problems guessed their flock.
The pond was full of croaking frogs.	The woman talked about the frogs.	The coat is talking about six frogs.
They drank a whole bottle of gin.	The girl talked about the gin.	They milked a frightened entry of gin.
The chicks followed the mother hen.	Bill didn't discuss the hen.	The stories covered the glass hen.
Tighten the belt by a notch.	The woman considered the notch.	Face the cop through a notch.
The sick child swallowed the pill.	Tom had spoken about the pill.	The folding hands drowned the pill.

Table A1 (Continued)

High predictability	Low predictability	Anomalous
The scarf was made of shiny silk.	Tom won't consider the silk.	The breakfast was decided by whole silk.
We camped out in our tent.	Bob considered the tent.	We rode off in our tent.

TABLE A2
Southern and general American sentence triples

High predictability	Low predictability	Anomalous
Cut the meat into small chunks.	I did not know about the chunks.	Toss the boy into shipwrecked chunks.
The detectives searched for a clue.	The man spoke about the clue.	The landlords stood for a clue.
Break the dry bread into crumbs.	She might discuss the crumbs.	Consider the local floor about crumbs.
The bird of peace is the dove.	Peter could consider the dove.	The player of maple is the dove.
The candle burned with a bright flame.	The girl should consider the flame.	The sink served with an easy flame.
The heavy rains caused a flood.	The class should consider the flood.	The round lion held a flood.
It was stuck together with glue.	Tom has not considered the glue.	It was beaten around with glue.
The guests were welcomed by the host.	Bill heard we asked about the host.	The seats were called about the host.
The cigarette smoke filled his lungs.	The old man talked about the lungs.	The old cloud broke his lungs.
The witness took a solemn oath.	He has a problem with the oath.	The thread broke a clenched oath.
Raise the flag up the pole.	Bob could consider the pole.	Water the worker between the pole.
Paul took a bath in the tub.	Miss Smith knows about the tub.	Eve raised a team in the tub.
The nurse gave him first aid.	Mr. Smith spoke about the aid.	The bread gave hockey loud aid.
The boat sailed across the bay.	Mr. Smith knew about the bay.	The problem hoped under the bay.
Ruth had a necklace of glass beads.	Tom has been discussing the beads.	Bill knew a can of maple beads.
The chicken pecked corn with its beak.	She's glad Bill called about the beak.	The cat is digging bread on its beak.

Table A2 (Continued)

<i>High predictability</i>	<i>Low predictability</i>	<i>Anomalous</i>
Bob was cut by the jackknife's blade.	Mary hasn't discussed the blade.	Miss Smith was worn by Adam's blade.
The wedding banquet was a feast.	We could consider the feast.	The first man heard a feast.
The bride wore a white gown.	The girl should not discuss the gown.	Betty buttered a sharp gown.
My son has a dog for a pet.	They heard I called about the pet.	My man wiped a shirt for a pet.
For dessert he had apple pie.	Ruth must have known about the pie.	For a bloodhound he had spoiled pie.
The shepherd watched his flock of sheep.	They've considered the sheep.	Miss Brown charged her wood of sheep.
We swam at the beach at high tide.	Mary can't consider the tide.	We cook at the car at sore tide.
A bicycle has two wheels.	Bill can't have considered the wheels.	David knows long wheels.