The present study investigates the kind of acoustic information that is stored lexically and how it is used by speakers and listeners alike. Many researchers have claimed that production and processing are strongly linked (e.g., Jurafsky et al., 2001; Aylett & Turk, 2004). That is, characteristics of the lexical representations should influence both speech production and processing. In previous work we have found a relationship between morphological characteristics of verbs and the production of vowel duration (Tucker et al., in preparation). The present study investigates the presence of a production/processing-link using data from auditory lexical decision and morphological decision experiments. We hypothesize that if the production-based morphology/vowel duration relationship is important for processing, manipulating that relationship will increase processing difficulty. However, if the relationship is not relevant for processing, manipulating the relationship will have little or no effect on processing difficulty.

The present study examines 36 irregular monosyllabic English verbs that differ between their past and present tense forms based on a single vowel (such as *sing/sang*, but not *weep/wept*). That is, the morphology of the word is contained wholly within the vowel. The contribution of morphology on vowel duration is quantified using a measure of morphological paradigmatic support: Naive Discriminative Learning cue association strengths (henceforth, NDL cue strengths; Baayen et al., 2011). A high NDL cue strength indicates a strong association between a vowel and the past tense, or substantial paradigmatic support for the past tense. A production study found that vowels associated with a high NDL cue strength are produced with longer durations, and vowels association with a low NDL cue strength are produced with shorter durations (Tucker et al., in preparation). The present study manipulates this production-based NDL cue strength/vowel duration relationship to test for its effects in processing. We manipulated the production-based relationship so that vowels associated with a low NDL cue strength are produced with longer durations, and vowels association with a high NDL cue strength were produced with shorter durations. If there is evidence for processing inhibition when the relationship is manipulated, the relationship between NDL cue strength and vowel duration is said to be facilitatory to speech processing.

A male speaker of Western Canadian English produced each irregular verb in the sentence “She clearly said ____ today” at 5 rates of speech (measured by beats per minute on a metronome). The vowel durations from the middle rate of speech served as the “normal” durations. Vowel duration was manipulated by splicing in vowels produced in the same word from either faster or slower speaking rates, resulting in shorter and longer vowel durations. Manipulated durations were assigned to each Target vowel based on its NDL cue strength association. In Figure 1, the farthest ends of the duration manipulation continuum (“shortest” and “longest”) represent a complete inversion of the production-based NDL cue strength/vowel duration relationship. Gradient manipulations between the “normal” and fully inverted manipulations were also assigned to each Target vowel, yielding a total of 5 manipulation types: shortest, short, normal, long, and longest. Filler and nonword stimuli were also recorded and manipulated in a similar way, though the type of manipulation was randomly assigned. There were as many Filler stimuli as there were Target stimuli (36 items each). Filler stimuli were counterbalanced by word type: other irregular verbs (counterbalanced for tense), regular verbs (counterbalanced for tense and the /t/, /d/, /әd/ past tense allomorph), and nouns (counterbalanced for plurality and regularity). Nonword stimuli were phonotactically legal pseudowords that had a phonological edit distance of 1-2 phones from the Target and Filler items. Two Nonword stimuli were created for each Target and Filler item. For the morphological decision task, the Filler nouns and their Nonword counterparts were removed. All the stimuli were presented in two tasks: lexical decision (word/nonword) and morphological decision (past/present tense). Reaction times were measured from the auditory offset of the stimulus. Participants were native speakers of Western Canadian English and participated in either the lexical ($n = 97$) or morphological ($n = 69$) decision tasks.
Overall, the results of a linear mixed-effects regression analysis (Figure 1 below) indicate that processing is modulated both by task (lexical and morphological decision) and NDL cue strength (high, mid, or low). Manipulating the production-based NDL cue strength/vowel duration relationship affected processing for 41% of the verbs. It appears that the relationship is important in morphological decision task for those verbs in the middle of the NDL cue strength continuum, and in the lexical decision task for those verbs at the low and high ends of the NDL cue strength continuum. That is, there is a link between the production-based NDL cue strength/vowel duration relationship and processing in those conditions only. There is not a link between production and processing in all tasks and with all NDL cue strengths, thus there is not a strong, ubiquitous link between production and processing.

The representation of acoustic detail must allow for a link between production and processing. One such approach is viewing acoustic detail as an available, but not obligatory tool to access lexical or morphological meaning. We propose that this tool captures the statistical association patterns between acoustic variation and linguistic predictors that a particular speaker/listener has gained throughout the language learning process. Though the patterns are available to facilitate both speech production and processing, the use of a particular pattern is conditioned on context (such as task and NDL cue strength). Thus, instead of being stored as a necessary component to access meaning, acoustic detail can be represented in an available network of learned statistical associations that link produced speech forms with stored lexical and morphological representations.

Figure 1. Significance results from the processing study. An asterisk (*) indicates a significant difference in a manipulated vowel duration from the “normal” vowel duration (shown in grey shading).

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